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TECHNICAL MEMORANDUM

Date:	June 28, 2017	Project #: 19890.4
To:	Jim Whynot and Jacque Betz, City of Gladstone Gail Curtis, Oregon Department of Transportation, Region 1	
From:	Matt Bell and Molly McCormick, Kittelson and Associates, Inc.	
Project:	Gladstone Transportation System Plan (TSP) Update	
Subject:	Final Tech Memo 8: TSP Solutions (Subtask 5.6)	

This memorandum identifies potential solutions to address the issues identified in *Tech Memo 5: Existing Gaps and Deficiencies* and *Tech Memo 6: Needs Analysis*. The solutions include:

- Transportation System Management and Operations (TSMO)
- Access Management
- Safety
- Pedestrian, Bicycle, and Transit
- Street System Connectivity
- Freight Mobility and Reliability
- Roadway Capacity

The solutions include potential policies, plans, programs, and projects for inclusion in the Gladstone Transportation System Plan (TSP) update. These solutions were reviewed by the project Technical Advisory Committee (TAC), Policy Advisory Committee (CAC), and general public to determine if they should move forward into the Draft TSP update and to identify the highest priorities for limited funding.

TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

Transportation Demand Management (TDM) and Transportation System Management (TSM) strategies are two complementary approaches to managing transportation and maximizing the existing system. Together, these strategies are referred to as Transportation System Management and Operations (TSMO). TDM addresses the *demand* on the system: the number of vehicles traveling on the roadways each day. TDM measures include any method intended to shift travel demand from single occupant vehicles to non-auto modes or carpooling, travel along less congested roadways, or at less congested times of the day. TSM addresses the *supply* of the system: using strategies to improve the system efficiency without increasing roadway widths or building new roads. TSM measures are focused on improving operations by enhancing capacity during peak times, typically with advanced technologies to improve traffic operations.

Metro's Regional TSMO Plan identifies four main areas of investment to improve system performance:

- Multi-modal traffic management – traffic signal coordination, transit signal priority, detection and countdown timers for bicycles and pedestrians.
- Traveler information – real-time traveler information for freeways and arterials and enhance traveler information tools.
- Traffic incident management – such as improved surveillance and expanded incident management teams and training.
- Transportation demand management (TDM) – ridesharing, collaborative marketing, individualized marketing, Transportation Management Associations (TMAs), and employer outreach.

The Plan also identifies specific strategies for 24 mobility corridors in the region. The following strategies are identified for Mobility Corridor 8: Oregon City to Gateway and Mobility Corridor 11: Milwaukie to Clackamas, which impact facilities in the City of Gladstone:

- Freeway Management for I-205
- Arterial Corridor Management with Transit Priority Treatment for OR 99E

Freeway Management refers to the expansion of freeway vehicle detection to provide comprehensive freeway traveler information including travel speed, travel times, volumes, forecasted information, incident conditions, and weather conditions. Arterial Corridor Management (ACM) refers to installing upgraded traffic signal controllers, establishing communications to the central traffic signal system, providing arterial detection (including bicycle detection where appropriate), routinely updating signal timings, upgrading traffic signage, and performing on-going maintenance and parts replacement. In addition, it may include providing real-time and forecast traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions and other events that may affect traffic conditions. The following section provides an overview of a broad range of TSMO measures that are being implemented and considered in the region and identifies and explains those that are most applicable to the City of Gladstone.

Solutions

Successful implementation of TSMO strategies relies on the participation of a variety of public and private entities. Strategies can be implemented by the city, a neighborhood, or particular employer. In addition, they can be categorized as policies, programs, or physical infrastructure investments. Table 1 provides a summary of potential measures that can be implemented within Gladstone and which entities are generally in the position to implement each one. As the city continues to grow and redevelop over the next 10 to 20 years, the applicability of these strategies can be further reviewed. Additional information on potential strategy implementation within Gladstone is discussed below.

Table 1: Transportation System Management and Transportation Demand Management strategies

TSMO Strategy	TDM or TSM?	Type of Investment	City	State	Transit Provider	Employers	Developers
Parking management	TSM/TDM	Policy	P		S	S	S
Limited/flexible parking requirements	TDM	Policy	P			S	S
Access management	TSM/TDM	Policy/ Infrastructure	P	P			
Connectivity standards	TSM/TDM	Policy/ Infrastructure	P	P			
Congestion pricing	TSM/TDM	Policy/ Infrastructure	P	P			
Flexible Work Shifts	TDM	Program/Policy	S			P	
Frequent transit service	TDM	Program	S		P		
Free or subsidized transit passes	TDM	Program	S			P	
Preferential carpool parking	TDM	Program	S			P	
Carpool match services	TDM	Program	S			S	
Parking cash out	TDM	Program			S	P	
Carsharing program support	TDM	Program	S			P	P
Bicycle facilities	TDM	Infrastructure	P	S	S	S	S
Pedestrian Facilities	TDM	Infrastructure	P	S	S	S	S
Regional ITS	TSM	Infrastructure	S	P			
Regional traffic management	TSM	Infrastructure	S	P			
Advanced signal systems	TSM	Infrastructure	S	P			
Real time traveler data	TSM	Infrastructure	S	P			
Arterial corridor management	TSM	Infrastructure	S	P			

TMA: Transportation Management Association – A TMA does not currently exist in Gladstone
P: Primary role
S: Secondary/Support role

The following section provides more detail on policy, programming and infrastructure strategies that may be effective for managing transportation demand and increasing system efficiency in the City of Gladstone, especially within the next 10 to 20 years.

Programming

Programming solutions can provide effective and low cost options for reducing transportation demand. Some of the most effective programming strategies can be implemented by employers and are aimed at encouraging non-single occupancy vehicle (SOV) commuting. These strategies are discussed below.

Carpool Match Services

Metro coordinates a rideshare/carpool program (see the DriveLessConnect.com website) that regional commuters can use to find other commuters with similar routes to work. The program allows commuters to connect and coordinate with others on locations, departure times, and driving responsibilities. Local employers can also play a role in encouraging carpooling by sharing information about the system, providing preferential carpool parking, and allowing employees to have flexibility in workday schedules.

Collaborative Marketing

Public agencies, local business owners and operators, developers, and transit service providers can collaborate on marketing to get the word out to residents about transportation options that provide an alternative to single-occupancy vehicles.

Policy

Policy solutions can be implemented by cities, counties, regions, or at the statewide level. Regional and state-level policies will affect transportation demand in Gladstone, but local policies can also have an impact. These policies are discussed below.

Limited and/or Flexible Parking Requirements

Cities set policies related to parking requirements for new developments. In order to allow developments that encourage multi-modal transportation, cities can set parking maximums and low minimums and/or allow for shared parking between uses. Cities can also provide developers the option to pay in-lieu fees instead of constructing additional parking. This option provides additional flexibility to developers that can increase the likelihood of development, especially on smaller lots where surface parking would cover a high portion of the total property.

Cities can also set policies that require provision of parking to the rear of buildings, allowing buildings in commercial areas to directly front the street. This urban form creates a more appealing environment for walking and window-shopping. In-lieu parking fees support this type of development for parcels that do not have rear- or side-access points.

Parking Management

Parking plays a large role in transportation demand management, and effective management of parking resources can encourage use of non-single occupancy vehicle modes. Cities can tailor policies to charge for public parking in certain areas or impose time limits on street parking in retail centers. Cities can also monitor public parking supply and utilization in order to inform future parking strategy.

Access Management

Access management describes a practice of managing the number, placement, and allowed movements at intersections and driveways that provide access to adjacent land uses. Access management policies can be an important tool to improve transportation system efficiency by limiting the number of opportunities for turning movements on to or off of certain streets.

In addition, well deployed access management strategies can help manage travel demand by improving travel conditions for pedestrian and bicycles. Eliminating the number of access points on roadways allows for continuous sidewalk and bicycle facilities and reduces the number of potential interruptions and conflict points between pedestrians, bicyclists, and motor vehicles.

Access management is typically adopted as a policy in development guidelines. It can be extremely difficult to implement an access management program once properties have been developed along a corridor. Cooperation among and involvement of relevant government agencies, business owners, land developers and the public is necessary to establish an access management plan that benefits all roadway users and businesses. Additional information on potential access management solutions is provided in a following section.

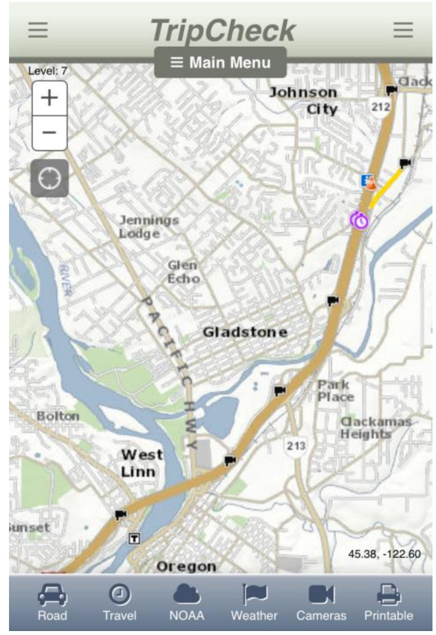
Signal Systems Improvements

Signal retiming and optimization offer a relatively low cost option to increase system efficiency. Retiming and optimization refers to updating timing plans to better match prevailing traffic conditions and coordinating signals. Timing optimization can be applied to existing systems or may include upgrading signal technology, such as signal communication infrastructure, signal controllers, or cabinets. Signal retiming can reduce travel times and be especially beneficial to improving travel time reliability. In high pedestrian or desired pedestrian areas, signal retiming can facilitate pedestrian movements through intersections by increasing minimum green times to give pedestrians time to cross during each cycle, eliminating the need to push pedestrian crossing buttons. Signals can also facilitate bicycle movements with the inclusion of bicycle detectors.

Signal upgrades often come at a higher cost and usually require further coordination between jurisdictions. However, upgrading signals provides the opportunity to incorporate advanced signal systems to further improve the efficiency of a transportation network. Strategies include coordinated signal operations across jurisdictions, centralized control of traffic signals, adaptive or active signal control, and transit or freight signal priority. These advanced signal systems can reduce delay, travel time and the number of stops for transit, freight, and other vehicles. In addition, these systems may help reduce vehicle emissions and improve travel time reliability. The following signal system solutions have been identified for consideration within Gladstone:

- **Transit signal priority** systems use sensors to detect approaching transit vehicles and alter signal timings to improve transit performance. This improves travel times for transit, reliability of transit travel time, and overall attractiveness of transit. The City of Portland has the only system of bus priority in the region, which is applied on most major arterial corridors, including OR 99E.
- **Truck signal priority** systems use sensors to detect approaching heavy vehicles and alter signal timings to improve truck freight travel. While truck signal priority may improve travel times for trucks, its primary purpose is to improve the overall performance of intersection operations by clearing any trucks that would otherwise be stopped at the intersection and subsequently have to spend a longer time getting back up to speed. Implementing truck signal priority requires additional advanced detector loops, usually placed in pairs back from the approach to the intersection.

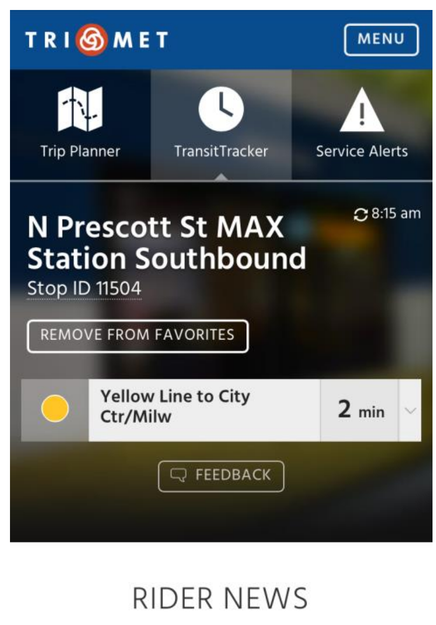
Real-Time Traveler Information



Traveler information consists of collecting and disseminating real-time transportation system information to the traveling public. This includes information on traffic and road conditions, general public transportation and parking information, interruptions due to roadway incidents, roadway maintenance and construction, and weather conditions. Traveler information is collected from roadway sensors, traffic cameras, vehicle probes, and more recently, media access control (MAC) devices such as cell phones or laptops. Data from these sources are sent to a central system and subsequently disseminated to the public so that drivers track conditions specific to their cars and can provide historical and real-time traffic conditions for travelers.

When roadway travelers are supplied with information on their trips, they may be able to avoid heavy congestion by altering a travel path, delaying the start of a trip, or changing which mode they can choose. This can reduce overall delay and fuel emissions. Traveler information projects can be prioritized over increasing capacity on roadway, often with high project visibility among the public.

Real-Time Transit Information



Transit agencies or third-party sources can disseminate both schedule and system performance information to travelers through a variety of applications, such as in-vehicle, wayside, or in-terminal dynamic message signs, as well as the Internet or wireless devices. Coordination with regional or multimodal traveler information efforts can increase the availability of this transit schedule and system performance information. TriMet has implemented this through its Transit Tracker system.

These systems enhance passenger convenience and may increase the attractiveness of transit to the public by encouraging travelers to consider transit as opposed to driving alone. They do require cooperation and integration between agencies for disseminating the information.

Improvements

- Lead or provide support of potential TSM and TDM strategies within the City
- Identify opportunities to for collaborative marketing with local business owners and operators, developers, and transit service providers

- Update the Gladstone Municipal Code to limit and/or allow for flexible parking requirements – Tech Memo 7: Regulator Solutions identifies potential changes to the GMC
- Develop access management standards for city streets that reflect the functional classification of the roadway – Additional information on potential access management measures is provided below
- Coordinate the traffic signals along SE 82nd Drive at the SE 82nd Drive/Oatfield Road and I-205 Northbound and Southbound Ramp Terminals – Further evaluation of the traffic operations associated with this potential improvements is provided in the motor vehicle section
- Implement truck signal priority at all signalized intersections along OR 99E and SE 82nd Drive

ACCESS MANAGEMENT

The Oregon Highway Plan (OHP) defines access management as a set of measures regulating access to streets, roads, and highways, from public roads and private driveways. Measures may include but are not limited to restrictions on the siting of interchanges, restrictions on the type and amount of access to roadways, and use of physical controls, such as signals and channelization including raised medians, to reduce impacts of approach road traffic on the main facility. The OHP requires that new connections to arterials and state highways be consistent with designated access management categories. The intent of this requirement is to provide guidance on the spacing of future extensions and connections along existing and future streets that are needed to provide reasonably direct routes for bicycle and pedestrian travel.

Solutions

The TSP should identify access management techniques and strategies that help to preserve transportation system investments and guard against deteriorations in safety and increased congestion. The City’s approach to access management should balance the need for land use activities and property parcels to be served with appropriate access while preserving safe and efficient movement of traffic. Access management solutions include:

- setting city-wide access spacing standards according to a roadway’s functional classification;
- obtaining special area designations along ODOT facilities that have alternative access spacing standards; and,
- defining a variance process for when the standard cannot be met;
- establishing an approach for access consolidation over time to move in the direction of the standards at each opportunity.

Access Spacing Standards

ODOT Standards

Oregon Administrative Rule 734, Division 51 establishes procedures, standards, and approval criteria used by ODOT to govern highway approach permitting and access management consistent with Oregon Revised Statutes (ORS), Oregon Administrative Rules (OAR), statewide planning goals, acknowledged comprehensive plans, and the OHP. The OHP serves as the policy basis for implementing Division 51 and guides the administration of access management rules, including mitigation and public investment, when required, to ensure highway safety and operations pursuant to this division.

Access management standards for approaches to state highways are based on the classification of the highway and highway designation, type of area, and posted speed. Within the Gladstone city limits, the OHP classifies OR 99E as a District Highway. Future developments along OR 99E (new development, redevelopment, zone changes, and/or comprehensive plan amendments) will be required to meet the OHP access management policies and standards. Table 2 summarizes ODOT's current access management standards for OR 99E per the OHP.

Table 2: OR 99E Access Spacing Standards

Highway Classification	Posted Speed (MPH)	Spacing Standards (Feet)[1]
District Highway	40	500

[1] These access management spacing standards do not apply to approaches in existence prior to April 1, 2000 except as provided in OAR 734-051-5120(9).

Special Transportation Area

Special Transportation Areas (STA) are highways or highway segments where alternate mobility and access management standards are considered. STAs look like traditional main streets with development generally located near the back of sidewalk on both sides of the highway. The primary objective of STAs is to provide access to and circulation amongst community activities, businesses and residences and to accommodate pedestrian, bicycle and transit movement on and across the highway. Direct local street connections and shared on-street parking are encouraged. Local auto, pedestrian, bicycle and transit movements to the area are generally as important as the through movement of traffic. Traffic speeds are slow, generally 25 miles per hour or lower.

STAs can be located on Statewide Highway and District Highways, such as OR 99E. While STAs may include some properties that are currently developed for auto dependent uses (e.g. drive through restaurants, gas stations, car washes), areas where the predominant land use pattern is auto-dependent uses are generally not appropriate for STA designation. STAs that include properties developed for auto-dependent uses should include planning and zoning that provide for redevelopment of the properties overtime to uses consistent with STA implementation.

City Standards

Access spacing standards for approaches to City streets are based on the roadway functional classification. Gladstone Municipal Code (GMC) Section 17.50.030 states that "full street connections, of at least local street classification, shall be provided at intervals of no more than five hundred thirty feet (530')" except where there are physical constraints. The city could include access spacing standards by functional classification. Table 1 identifies potential access spacing standards for the City.

Table 1: Access Spacing Standards

Functional Classification	Mixed-use or Residential			Commercial or Industrial		
	Max Block Size (Street to Street)[1]	Min Block Size (Street to Street)	Min Dwy Spacing (Street to Dwy & Dwy to Dwy)[2]	Max Block Size (Street to Street)[1]	Min Block Size (Street to Street)	Min Dwy Spacing (Street to Dwy & Dwy to Dwy)[2]
Major Arterial	530 feet	150 feet	150 feet	530 feet	150 feet	200 feet
Minor Arterial	530 feet	150 feet	150 feet	530 feet	150 feet	200 feet
Collector	530 feet	150 feet	100 feet	530 feet	150 feet	150 feet
Local Street	530 feet	150 feet	50 feet	530 feet	150 feet	50 feet

1. If the maximum block size is exceeded, mid-block pedestrian and bicycle accessways must be provided at spacing of no more than 330 feet, unless the connection is impractical due to existing development, topography, or environmental constraints.
2. Single family and two-family dwellings are exempt from the driveway to driveway spacing standards.

In addition to adopting access spacing standards, the City could adopt a policy that requires access be taken from lower classification streets whenever possible.

Access Spacing Variances

Access spacing variances may be provided to parcels whose highway/street frontage, topography, or location would otherwise preclude issuance of a conforming permit and would either have no reasonable access or cannot obtain reasonable alternate access to the public road system. In such a situation, a conditional access permit may be issued by ODOT or the City, as appropriate, for a connection to a property that cannot be accessed in a manner that is consistent with the spacing standards. The permit can carry a condition that the access may be closed at such time that reasonable access becomes available to a local public street. The approval condition might also require a given land owner to work in cooperation with adjacent land owners to provide either joint access points, front and rear cross-over easements, or a rear access upon future redevelopment.

The requirements for obtaining a deviation from ODOT's minimum spacing standards are documented in OAR 734-051-3050. For streets under the City's jurisdiction, the City may reduce the access spacing standards at the discretion of the City Engineer if the following conditions exist:

- Joint access driveways and cross access easements are provided in accordance with the standards;
- The site plan incorporates a unified access and circulation system in accordance with the standards;

- The property owner enters into a written agreement with the City that pre-existing connections on the site will be closed and eliminated after construction of each side of the joint use driveway; and/or,
- The proposed access plan for redevelopment properties moves in the direction of the spacing standards.

The City Engineer may modify or waive the access spacing standards for streets under the City's jurisdiction where the physical site characteristics or layout of abutting properties would make development of a unified or shared access and circulation system impractical, subject to the following considerations:

- Unless modified, application of the access standard will result in the degradation of operational and safety integrity of the transportation system.
- The granting of the variance shall meet the purpose and intent of these standards and shall not be considered until every feasible option for meeting access standards is explored.
- Applicants for variance from these standards must provide proof of unique or special conditions that make strict application of the standards impractical. Applicants shall include proof that:
    - Indirect or restricted access cannot be obtained;
    - No engineering or construction solutions can be applied to mitigate the condition; and,
    - No alternative access is available from a road with a lower functional classification than the primary roadway.

No variance shall be granted where such hardship is self-created. Consistency between access spacing requirements and exceptions in the TSP and GMC is an important regulatory solution to be addressed as part of this TSP update.

Access Consolidation through Management

From an operational perspective, access management measures limit the number of redundant access points along roadways. This enhances roadway capacity, improves safety, and benefits circulation. Enforcement of the access spacing standards should be complemented with provision of alternative access points. Purchasing right-of-way and closing driveways without a parallel road system and/or other local access could seriously affect the viability of the impacted properties. Thus, if an access management approach is taken, alternative access should be developed to avoid "land-locking" a given property.

As part of every land use action, the City should evaluate the potential need for conditioning a given development proposal with the following items in order to maintain and/or improve traffic operations and safety along the arterial and collector roadways.

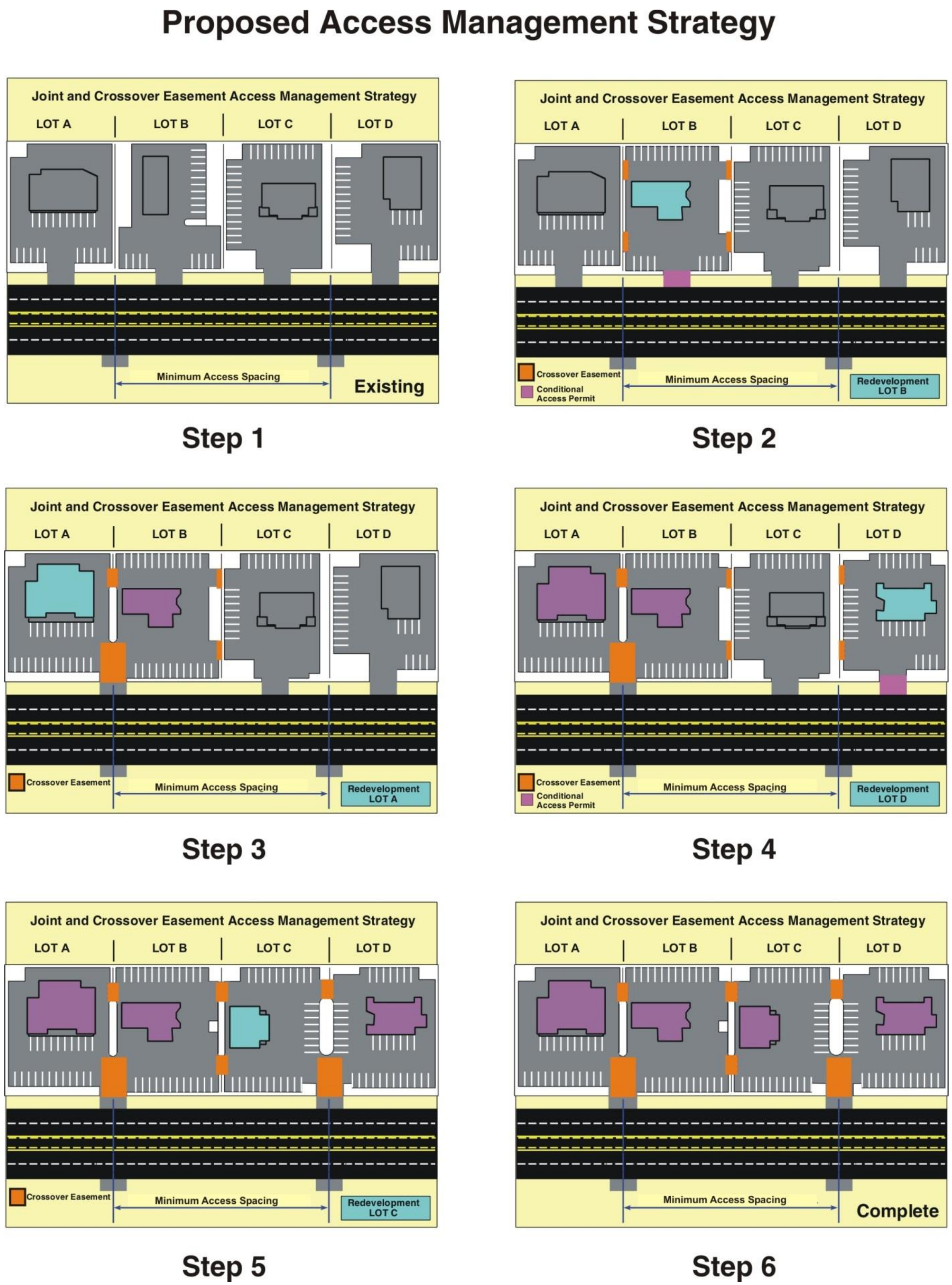
- Providing access only to the lower classification roadway when multiple roadways abut the property.
- Provision of crossover easements on all compatible parcels (considering topography, access, and land use) to facilitate future access between adjoining parcels.
- Issuance of conditional access permits to developments having proposed access points that do not meet the designated access spacing policy and/or have the ability to align with opposing driveways.
- Right-of-way dedications to facilitate the future planned roadway system in the vicinity of proposed developments.
- Half-street improvements (sidewalks, curb and gutter, bike lanes/paths, and/or travel lanes) along site frontages that do not have full build-out improvements in place at the time of development.

Exhibit 1 illustrates the application of cross-over easements and conditional access permits over time to achieve access management objectives. The individual steps are described in Table 3. As illustrated in the exhibit and supporting table, by using these guidelines, all driveways along the highways can eventually move in the overall direction of the access spacing standards as development and redevelopment occur along a given street.

Table 3: Example of Crossover Easement/Indenture/Consolidation

Step	Process
1	EXISTING – Currently Lots A, B, C, and D have site-access driveways that neither meet the access spacing criteria of 500 feet nor align with driveways or access points on the opposite side of the highway. Under these conditions motorists are into situations of potential conflict (conflicting left turns) with opposing traffic. Additionally, the number of side-street (or site-access driveway) intersections decreases the operation and safety of the highway
2	REDEVELOPMENT OF LOT B – At the time that Lot B redevelops, the City would review the proposed site plan and make recommendations to ensure that the site could promote future crossover or consolidated access. Next, the City would issue conditional permits for the development to provide crossover easements with Lots A and C, and ODOT/City would grant a conditional access permit to the lot. After evaluating the land use action, ODOT/City would determine that LOT B does not have either alternative access, nor can an access point be aligned with an opposing access point, nor can the available lot frontage provide an access point that meets the access spacing criteria set forth for segment of highway.
3	REDEVELOPMENT OF LOT A – At the time Lot A redevelops, the City/ODOT would undertake the same review process as with the redevelopment of LOT B (see Step 2); however, under this scenario ODOT and the City would use the previously obtained cross-over easement at Lot B consolidate the access points of Lots A and B. ODOT/City would then relocate the conditional access of Lot B to align with the opposing access point and provide and efficient access to both Lots A and B. The consolidation of site-access driveways for Lots A and B will not only reduce the number of driveways accessing the highway, but will also eliminate the conflicting left-turn movements the highway by the alignment with the opposing access point.
4	REDEVELOPMENT OF LOT D – The redevelopment of Lot D will be handled in same manner as the redevelopment of Lot B (see Step 2)
5	REDEVELOPMENT OF LOT C – The redevelopment of Lot C will be reviewed once again to ensure that the site will accommodate crossover and/or consolidated access. Using the crossover agreements with Lots B and D, Lot C would share a consolidated access point with Lot D and will also have alternative frontage access the shared site-access driveway of Lots A and B. By using the crossover agreement and conditional access permit process, the City and ODOT will be able to eliminate another access point and provide the alignment with the opposing access points.
6	COMPLETE – After Lots A, B, C, and D redevelop over time, the number of access points will be reduced and aligned, and the remaining access points will meet the access spacing standard.

Exhibit 1: Cross Over Easement



Improvements

- Develop city-wide access spacing standards according to a roadway's functional classification
- Define a variance process for when the standard cannot be met (See above)
- Establishing an approach for access consolidation over time to move in the direction of the standards at each opportunity (See above)

SAFETY

Traffic safety plays an important role in determining the most appropriate solutions for a given gap or deficiency, particularly in areas where real or perceived safety risks may prevent people from using more active travel modes, such as walking, biking, and taking transit. The real or perceived safety risks may reflect the crash history of an area or the physical and/or operational characteristics of the roadways (narrow travel lanes, winding curves, steep grades, high traffic volumes, high travel speeds, lots of heavy vehicles, etc.). Several methodologies have been developed to analyze and identify solutions for addressing traffic safety within an area. Many of which are documented in the Highway Safety Manual (HSM) as well as several other resources developed by ODOT for addressing safety along roadway segments, at intersections, and for pedestrian and bicyclists.

Solutions

This section summarizes the solutions considered for implementation within the City of Gladstone to address real or perceived safety issues along roadway segments, at intersections, and/or for pedestrians and bicyclists. Note: many of the solutions overlap, which illustrates how some solutions address multiple safety issues.

Roadway Segments

There are a variety of potential safety solutions that can be applied within Gladstone to address systemic crashes that occur along roadway segments, such as sideswipe and run off the road crashes as well as general speeding and other driver behaviors.

- Enhanced signs and pavement markings for curves (with and without flashing beacons)
- Rumble strips (e.g. centerline, shoulder line, and edge line)
- Tree/vegetation removal
- Traffic calming
- Enhanced enforcement
- Road diet

Intersections

There are a variety of potential safety solutions that can be applied within Gladstone to address systemic crashes that occur at intersections, such as angle crashes, turning movement crashes, rear-end crashes, and crashes that involve other travel modes. The solutions include:

- Enhanced signs and pavement markings (e.g. stop signs, warning signs, and/or beacons)
- Signal improvements (e.g. signal timing, signal phasing)
- Left-turn phasing (e.g. permitted, protected, permitted-protected)
- Enhanced enforcement
- Pedestrian and bicycle improvements (see below)
- Intersection lighting
- Traffic calming

Pedestrian and Bicycle

There are a variety of potential safety solutions that can be applied within Gladstone to address pedestrian and bicycle safety. The following provides a summary of the solutions by traffic control.

Signalized intersections

Pedestrian Safety Solutions

- Street lighting
- Right-turn channelization
- Countdown pedestrian heads
- Leading pedestrian interval
- Left-turn phasing
- Vehicle turning movement restrictions

Bicycle Safety Solutions

- Street lighting
- Bicycle signal
- Bicycle detection
- Pavement markings
- Right-turn channelization
- Leading bicycle interval
- Left-turn phasing
- Vehicle turning movement restrictions

Unsignalized intersections

Pedestrian Safety Solutions

- Street lighting
- Enhanced crossing treatments
- Reduced curb radii
- Pedestrian refuge island or median
- Speed reduction treatments
- Vehicle turning movement restrictions

Bicycle Safety Solutions

- Street lighting
- Enhanced crossing treatments
- Reduced curb radii
- Skip Striping
- Supplemental signs and markings
- Bicycle boulevards
- Longitudinal bike stencil
- Speed reduction treatments
- Vehicle turning movement restrictions
- Strip bike lanes

Roadway segment – No traffic control

Pedestrian Safety Solutions

- Street lighting
- Access management
- Sidewalks Street lighting
- Enhanced mid-block crossing treatments
- Road Diet
- Pedestrian refuge island or median

Bicycle Safety Solutions

- Access management
- Bicycle route signage
- Longitudinal bike stencil
- Cycle tracks
- Dynamic warning signs
- Enhanced mid-block crossing treatments
- Street lighting
- Restrict on-street parking
- Road Diet
- Refuge Island or median

Improvements

A majority of the safety improvements are addressed within subsequent sections of this memorandum for the pedestrian, bicycle, and motor vehicle systems, with the exception of the safety improvements at a few key intersections as described below.

I-205 Southbound Ramp Terminal/SE 82nd Drive

The crash rate at the I-205 Southbound Ramp Terminal/SE 82nd Drive intersection currently exceeds the critical crash rate by both intersection type and by volume. The crash data shows a trend for rear-end crashes at the intersection. Of the 30 rear-end crashes observed in the five years of data, 23 occurred on the north leg of the intersection as vehicles were exiting I-205, 22 of the crashes were caused by a driver following too closely. The following improvements are being considered at the intersection:

- **Install enhanced signs with flashing beacons and pavement markings that "SLOW" traffic on the southbound approach**
- Reduce the posted speed limit at the southbound approach to 35 mph

OR 99E/Arlington Street

The OR 99E/Arlington Street intersection is identified on the current ODOT Statewide Priority Index System (SPIS) as within the top five percent of crash sites in Oregon. While ODOT has not completed an investigation of the intersection, potential safety solutions have been discussed with the Traffic Safety Committee. Per those discussions, the following improvement is being considered at the intersection:

- Reconfigure the westbound approach to include a separate left-turn lane with protected phasing and shared through/right-turn lane and reconfigure the eastbound approach to restrict the left-turn movement. Maintain the eastbound approach as permitted.

Solution	V/C	Delay (seconds)	LOS
Reconfigure Intersection	0.90	36.4	D

Additional capacity based improvements are described below under Motor Vehicle System

SE 82nd Drive/Arlington Street

The SE 82nd Drive/Arlington Street intersection is an all-way stop controlled intersection with multiple lanes at the northbound and southbound approaches. Several safety concerns have been expressed related to pedestrians crossing SE 82nd Drive to/from the Safeway. Therefore, the following improvement is being considered at the intersection.

- Reconfigure the southbound approach to a shared through/left-turn lane and maintain the separate right-turn lane; install a raised median island in the southbound left-turn lane and install a stop sign in the median; install a crosswalk across the north leg and curb extensions, where feasible, to shorten crossing distances across Arlington Street and SE 82nd Drive

City-wide

A number of safety issues have been identified throughout the planning process along key corridors throughout the city, including OR 99E, Oatfield Road, SE 82nd Drive, and others. While several projects have been identified along each of these corridors that will address some of the safety concerns, other concerns may not be addressed. Therefore the following improvements are being considered to address safety issues throughout the city:

- Evaluate traffic safety along OR 99E, Oatfield Road, SE 82nd Drive, and other key corridors to identify appropriate countermeasures.

PEDESTRIAN SYSTEM

Pedestrian facilities are the elements of the transportation system that enable people to walk safely and efficiently between neighborhoods, retail centers, employment areas, and transit stops. These include facilities for pedestrian movement along key roadways (e.g., sidewalks, multi-use paths, and trails) and for safe roadway crossings (e.g., crosswalks, crossing beacons, pedestrian refuge islands). Each facility plays an important role in developing a comprehensive pedestrian network.

Solutions

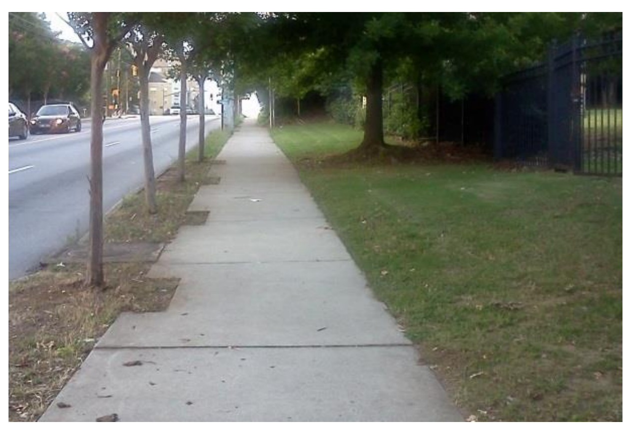
This section summarizes the solutions considered for implementation within the City of Gladstone to address existing gaps and deficiencies in the pedestrian system and future needs.

Sidewalks

Sidewalks are the fundamental building blocks of the pedestrian system. They enable people to walk comfortably, conveniently, and safely from place to place. They also provide an important means of mobility for people with disabilities, families with strollers, and others who may not be able to travel on an unimproved roadside surface. Sidewalks are usually 6 to 8-feet wide and constructed from concrete. They are also frequently separated from the roadway by a curb, landscaping, and/or on-street parking. Sidewalks are widely used in urban and suburban settings. Ideally, sidewalks could be provided along both sides of the roadway; however, some areas with physical or right-of-way constraints may require that sidewalk be located on only one side. Sidewalk solutions include:

- Fill in the gaps
- Install sidewalks on one-side of the roadway
- Install sidewalks on both sides of the roadway
- Re-construct existing sidewalks with appropriate width and buffer
- Improve existing sidewalks with appropriate lighting

Sidewalk Improvements



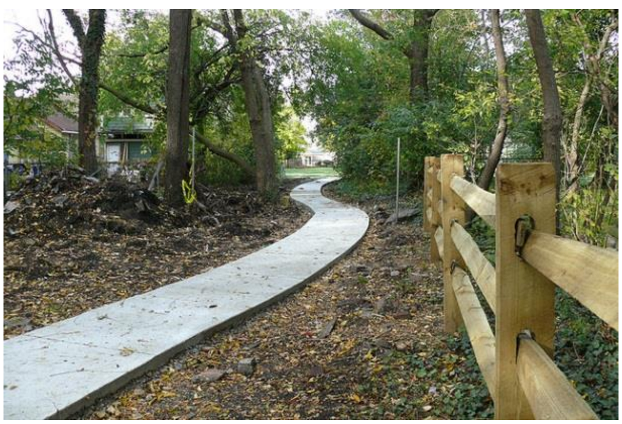
Sidewalk Improvements

Accessways

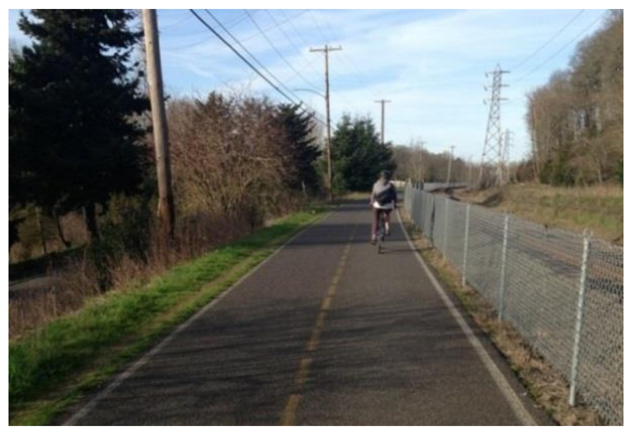
Non-vehicular connections between cul-de-sacs and adjacent roadways can significantly reduce travel distances for pedestrians, thereby encouraging more people to walk. Appropriate improvements should provide for more direct, convenient, and safe bicycle or pedestrian travel within and between residential areas and neighborhood activity centers. Gladstone has several existing accessways that create connections between neighborhoods and pedestrian and bicycle routes. Potential new connections could use existing City right-of-way between cul-de-sacs or unconnected roadways to provide a paved or unpaved path or trail for non-motorized use.

Shared-use Paths and Trails

Shared-use paths are paved, bi-directional, trails that can serve both pedestrians and bicyclists. Shared-use paths and trails can be constructed adjacent to roadways where the topography, right-of-way, or other issues don't allow for the construction of sidewalks and bike facilities. A minimum width of 10 feet is recommended for low-pedestrian/bicycle-traffic contexts; 12 to 20 feet should be considered in areas with moderate to high levels of bicycle and pedestrian traffic. Shared-use paths can be used to create longer-distance links within and between communities and provide regional connections. They play an integral role in recreation, commuting, and accessibility due to their appeal to users of all ages and skill levels.



Accessways



Shared-use Paths and Trails

Enhanced Pedestrian Crossings

Pedestrian crossing facilities enable pedestrians to safely cross streets, railroad tracks, and other transportation facilities. Planning for appropriate pedestrian crossings requires the community to balance vehicular mobility needs with providing crossing locations that the desired routes of walkers. Enhanced pedestrian crossing treatments include:

- Median refuge islands
- High visibility pavement markings and signs
- Rapid rectangular flashing beacons (RRFB)
- Pedestrian Hybrid Beacons (HAWK)
- Curb extensions
- Pedestrian signals
  - Pedestrian countdown heads
  - Leading Pedestrian interval

Many of the treatments listed above can be applied together at one crossing location to further alert drivers of the presence of pedestrians in the roadway. See Attachment "A" for a detailed description of enhanced pedestrian crossing treatments.

Enhanced Pedestrian Crossing with RRFBs

Enhanced Pedestrian Crossing with Pedestrian Signal

Improvements

The following improvements have been organized by streets segment, intersection, and off-street improvements. Where there are multiple improvements, the improvements shown in **bold text** were identified as the preferred improvement based on an evaluation of environmental, engineering, land use "fatal flaws" and anticipated funding capacity as well as discussions with the project team, advisory committees, and the general public.

Street Segment Improvements

The following street segment improvements have been organized by functional classification.

Arterials

Arterials serve an important function for pedestrian access and circulation within Gladstone, particularly those that are served by local transit service. The following provides a summary of the pedestrian improvements along arterial streets.

SE 82nd Drive

SE 82nd Drive has continuous sidewalks along both sides of the roadway from the north city limits to the southern terminus at Cross Park, with the exception of a gap along the south side of the roadway from Edgewater Road to the I-205 southbound ramp terminal. While the majority of the roadway has sidewalks, the PLTS analysis indicates that the sidewalks may not be suitable for all pedestrians. This is primarily due to poor sidewalk condition, narrow sidewalk width, lack of a buffer, and limited street lighting. Therefore, the following improvements are being considered along the roadway:

- Fill in the gap on the south side of the roadway with new sidewalks from Edgewater Road to the I-205 southbound ramp terminal

- Remove existing sidewalks and install new sidewalks of appropriate width along both sides of the roadway
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway
- Regardless of the sidewalk improvements, evaluate light levels and install street lighting from 1st Street to the southern terminus of the roadway as necessary

OR 99E (McLoughlin Boulevard)

OR 99E currently has continuous sidewalks along both sides of the roadway from the north city limits to the south city limits, with the exception of an approximately 400-foot section along the west side of the roadway, south of Glen Echo Avenue. Several of the sidewalk segments also have landscape strips. However, the PLTS analysis indicates that some segments the sidewalks may not be suitable for all pedestrians. This is primarily due to lack of a landscape strips in some areas, limited street lighting, and relatively high traffic volumes and travel speeds along OR 99E. Therefore, the following improvements are being considered along the roadway.

- **Fill in the gap on the west side of the roadway with new sidewalks, south of Glen Echo Avenue**
- **Plant street trees along both sides of OR 99E within the existing landscape strips. Note: ODOT Permits are required for street trees**
- **Reduce the posted speed limit to 35 mph**
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway
- Regardless of the sidewalk improvements, evaluate light levels and install street lighting along the full length of the roadway as necessary

Arlington Street

Arlington Street currently has continuous sidewalks along both sides of the roadway from OR 99E to Oatfield Road. Several segments also have landscape strips. However, the PLTS analysis indicates that the sidewalks may not be suitable for all pedestrians. This is primarily due to poor sidewalk condition, narrow sidewalk width, lack of a buffer, and limited street lighting. Therefore, the following improvements are being considered along the roadway:

- Remove the existing sidewalks and install new sidewalks of appropriate width on both sides of the roadway
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway
- Regardless of the sidewalk improvements, evaluate light levels and install street lighting along the full length of the roadway as necessary

Oatfield Road

Oatfield Road currently has continuous sidewalks along both sides of the roadway from Webster Road to SE 82nd Drive; however, there are several gaps in the sidewalks on the south side of the roadway from Webster Road to the north city limits and one gap along the north side of the roadway from Pak Way to the north city limits, this is due, in part, to the steep grades on both sides of the roadway. The PLTS analysis indicates that where sidewalks are present along Oatfield Road, they may not be suitable for all pedestrians. This is primarily due to narrow sidewalk width, lack of a buffer, and poor sidewalk condition. In all other areas the PLTS analysis reflects the lack of sidewalks. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gaps on one or two sides of the roadway, as grades allow, from Webster Road to the north city limits.**
- Remove the existing sidewalks and install new sidewalks of appropriate width along one or two sides of the roadway as grades allow
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along one or two sides of the roadway as grades allow

Portland Avenue

Portland Avenue currently has continuous sidewalks along both sides of the roadway from Clackamas Boulevard to Nelson Lane; however, there are several gaps in the sidewalks on both sides of the roadway from Nelson Lane to the north city limits. The PLTS analysis indicates that the majority of the sidewalks along Portland Avenue may not be suitable for all pedestrians. This is primarily due to poor sidewalk condition and narrow sidewalk width. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gap on both sides of the roadway from Nelson Lane to the north city limits**
- Remove the existing sidewalks and install new sidewalks of appropriate width along both sides of the roadway
- Remove existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway

Webster Road

Webster Road currently has continuous sidewalks along both sides of the roadway from Oatfield Road to the north city limits, with the exception of a gap along the east side of the roadway from Charolais Drive to the north city limits. However, the PLTS analysis indicates that the pedestrian facilities along Webster Road may not be suitable for all pedestrians. This is primarily due to poor sidewalk condition, narrow sidewalk width, and lack of a buffer. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gap on the east side of the roadway from Charolais Drive to the north city limits**

- Remove the existing sidewalks and install new sidewalks of appropriate width along both sides of the roadway
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway

Arlington Street, Facing East

Oatfield Road, Facing North

Collectors

Collectors also serve an important function for pedestrian access and circulation within Gladstone and may provide direct access to essential destinations, such as schools, parks, churches, and commercial areas. The following provides a summary of the pedestrian improvements along collector streets.

Abernathy Lane

Abernathy Lane currently has continuous sidewalks along the north side of the roadway and a shared-use path adjacent to the south side of the roadway from Glen Echo Avenue to Portland Avenue. The PLTS analysis indicates that the pedestrian facilities along Abernathy Lane are suitable for a majority of pedestrians. To further improve the facilities and encourage pedestrian use, the following improvements are being considered along the roadway:

- **Provide pedestrian-scale lighting along the shared-use path in addition to the street lighting already provided along the roadway**

Cason Road

Cason Road currently has continuous sidewalks along both sides of the roadway from Webster Road to the eastern City limits, with the exception of a gap along the south side of the roadway from Ohlson Road to the eastern city limits. However, the PLTS analysis indicates that the sidewalks may not be suitable for all pedestrians. This is primarily due to lack of a buffer. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gap on the south side of the roadway from Ohlson Road to the east city limits**
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway

Dartmouth Street

Dartmouth Street currently has continuous sidewalks along both sides of the roadway from OR 99E to Oatfield Road, with the exception of gaps along the north side of the roadway from Chicago Avenue to Harvard Street and from Yale Avenue to Oatfield Road. The PLTS analysis indicates that the sidewalks may not be suitable for all pedestrians. This is primarily due to poor sidewalk condition, narrow sidewalk width, and limited street lighting. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gaps along on the north side of the roadway from Chicago Avenue to Harvard Street and from Yale Avenue to Oatfield Road**
- Remove the existing sidewalks and install new sidewalks of appropriate width along both sides of the roadway
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway
- Regardless of the sidewalk improvements, evaluate light levels and install street lighting along the full length of the roadway as necessary

Gloucester Street

Gloucester Street currently has continuous sidewalks along both sides of the roadway from OR 99E to Oatfield Road; however, the PLTS analysis indicates that the sidewalks may not be suitable for all pedestrians. This is primarily due to poor sidewalk condition, narrow sidewalk width, and limited street lighting. Therefore, the following improvements are being considered along the roadway:

- Remove the existing sidewalks and install new sidewalks of appropriate width along both sides of the roadway
- Remove the existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway
- Regardless of the sidewalk improvements, install street lighting along the full length of the roadway as necessary

Glen Echo Avenue

There are several gaps in the sidewalks along Glen Echo Avenue from OR 99E to Oatfield Road. The PLTS analysis indicates that the roadway may not be suitable for all pedestrians. This is primarily due to sidewalk gaps, poor pavement condition, lack of a buffer, and limited street lighting. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gaps along on one or two sides of the roadway from OR 99E to Oatfield Road as appropriate – due to significant right-of-way constraints, sidewalks may only be developed on one side of the roadway.**
- Remove the existing sidewalks and install new sidewalks along one or two sides of the roadway as appropriate

- Remove the existing sidewalks and install alnd scape strips and new sidewalks of appropriate width along both sides of the roadway
- Regardless of the sidewalk improvements, evaluate light levels and install street lighting along the full length of the roadway as necessary

Los Verdes Drive/Valley View Road

Los Verdes Drive currently has continuous sidewalks along both sides of the roadway from Webster Road to Valley View Road; there are several gaps in the sidewalk along both sides of Valley View Road from Jennings Avenue to Los Verdes Drive. The PLTS analysis indicates that the sidewalks may not be suitable for all pedestrians. This primarily due to sidewalk gaps, poor sidewalk condition, narrow sidewalk width, and limited street lighting. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gap along both sides of the roadway from Valley View Road to Jennings Avenue**
- Remove the existing sidewalks and install new sidewalks of appropriate width along both sides of the roadway
- Remove the existing sidewalks and install new landscape strips and sidewalks of appropriate width along both sides of the roadway
- Regardless of the sidewalk improvements, evaluate light levels and install street lighting from Crownview Drive to Webster Road as necessary

River Road

River Road currently has continuous sidewalks along both sides of the roadway from Arlington Street to the northern city limits; however, the PLTS analysis indicates that the sidewalks may not be suitable for all pedestrians. This is primarily due to lack of a buffer. Therefore, the following improvements are being considered along the roadway:

- Remove existing sidewalks and install new sidewalks of appropriate width along both sides of the roadway
- Remove existing sidewalks and install landscape strips and new sidewalks of appropriate width along both sides of the roadway

Abernathy Lane, Facing North

Glen Echo Avenue, Facing East

Local Streets

Local streets provide direct access to essential destinations throughout Gladstone, such as schools, parks, churches, and commercial areas. Pedestrian facilities should be provided along at least one side of each street to ensure adequate access for pedestrians.

Beatrice Avenue

Beatrice Avenue provides an important north-south connection between Clackamas Boulevard and Abernathy Lane (assuming provision of the Beatrice Avenue accessway described below) that parallels OR 99E and Portland Avenue. There are currently no sidewalks from Hereford Street to Clackamas Boulevard. Therefore, the following improvements are being considered along the roadway:

- Install new sidewalks of appropriate width on one side of the roadway
- **Install new sidewalks of appropriate width along both sides of the roadway**

Beverly Lane

Beverly Lane provides an important east-west connection between Oatfield Road and Harvard Avenue and access to Gladstone High School. There are currently sidewalks along both sides of the roadway from Harvard Avenue to the roadway terminus, with the exception of a gap on the south side of the roadway from Harvard Avenue to Beverly Drive. Therefore, the following improvements are being considered along the roadway:

- **Fill in the gap on the south side of the roadway from Harvard Avenue to Beverly Drive**

Chicago Avenue

Chicago Avenue provides an important north-south connection between Arlington Street and Hereford Street and access to John Wetten Elementary School. There are partial sidewalk provided on both sides of the roadway between Hereford Avenue and Exeter Street. Therefore, the following improvements are being considered along the roadway:

- Fill in the gaps on the east side of the roadway between Hereford Street and Exeter Street and adjacent to John Wetten Elementary School
- **Fill in the gaps along both sides of the roadway between Hereford Street and Exeter Street**

Clackamas Boulevard

Clackamas Boulevard provides an important east-west connection that parallels Arlington Street. It also provides access to Cross Park and Chief Charles Ames Memorial Park. There are sidewalks provided on the south side of the roadway between the two parks; however, there are no sidewalks located west of Chief Charles Ames Memorial Park. The roadway through this area is also relatively narrow and houses are built close to the edge of the roadway, which may make adding sidewalks difficult. Therefore, the following improvements are being considered along the roadway:

- **Install a mixed-use shoulders along one or two sides of the roadway**
- Install sidewalks on the south side of the roadway from Charles Ames Memorial Park to Arlington Street

Clayton Way

Clayton Way provides an important east-west connection between Ridgegate Drive and Webster Road for pedestrians and access within the vicinity of Walter L Kaxberger Middle School. There are partial sidewalks provided on both sides of the roadway between Stonewood Drive and Webster Road. Therefore, the following improvements are being considered along the roadway:

- Fill in the gaps on one side of the roadway from the roadway terminus to Webster Road
- **Fill in the gaps on both sides of the roadway from the roadway terminus to Webster Road**

Cornell Avenue

Cornell Avenue provides an important north south connection between Clackamas Boulevard and Collins Crest Street that parallels Oatfield Road. There are currently no sidewalks along both sides the roadway. Therefore, the following improvements are being considered along the roadway:

- Install new sidewalks of appropriate width along one side of the roadway
- **Install new sidewalks of appropriate width along both sides of the roadway**

Fairfield Street

Fairfield Street provides an important east-west connection between Oatfield Road and Harvard Avenue and access to John Wetten Elementary School. There are currently continuous sidewalks on both sides of the roadway except one gap located on the south side of the road between Portland Avenue and Chicago Avenue. Therefore, the following improvement is being considered along the roadway:

- **Fill in the gap on the south side of the roadway between Portland Avenue and Chicago Avenue**

Harvard Avenue

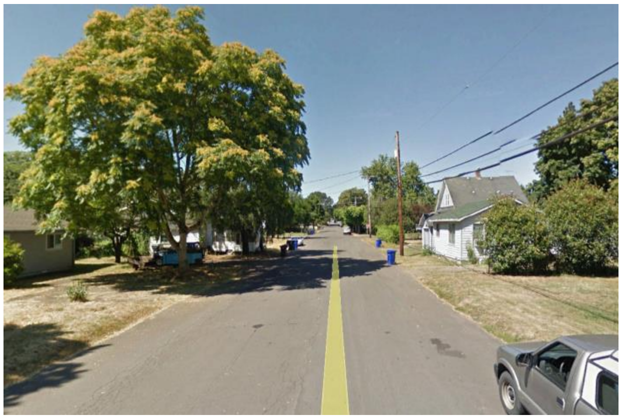
Harvard Avenue provides an important north-south connection between Hereford Street and Nelson Lane and access to Gladstone High School. There are partial sidewalks provided on both sides of the roadway between Herford Street and Beverly Lane. Therefore, the following improvements are being considered along the roadway:

- Fill in the gaps along the west side of the roadway between Herford Street and Beverly Lane and adjacent to Gladstone High School
- **Fill in the gaps along both sides of the roadway between Herford Street and Beverly Lane and adjacent to Gladstone High School**

Oakridge Drive

Oakridge Drive provides an important east-west connection between Oatfield Road and Valley View Road. There are partial sidewalks provided on both sides of the roadway. Therefore, the following improvements are being considered along the roadway:

- Fill in the gaps along the south side of the roadway
- **Fill in the gaps along both sides of the roadway**



Beatrice Avenue, Facing North

Clackamas Boulevard, Facing East

Intersections Improvements

Beatrice Avenue/Abernathy Lane

There are no enhanced pedestrian crossings within the vicinity of the Beatrice Avenue/Abernathy Lane intersection. Therefore, the following improvement is being considered:

- Install an enhanced pedestrian crossing to facilitate movement across Abernathy Lane. The types of enhanced crossing treatments are to be determined.

SE 82nd Drive/I-205 Southbound Ramp Terminal

The SE 82nd Drive/I-205 Southbound Ramp Terminal intersection does not have an enhanced crossing from the southwest corner of the intersection to the right-turn splitter island.

- Install a signalized pedestrian crossing in the southwest corner of the intersection to the right-turn splitter island. The crosswalk should include ADA compliant pedestrian ramps, continental striping, and countdown pedestrian heads.

Cason Road/Ohlson Road

There are no enhanced pedestrian crossings within the vicinity of the Cason Road/Ohlson Road intersection. Therefore, the following improvement is being considered:

- Install an enhanced pedestrian crossing to facilitate movement across Cason Road. The types of enhanced crossing treatments are to be determined.

Jennings Avenue/Valley View Road

There are no enhanced pedestrian crossings within the vicinity of the Jennings Avenue/Valley View Road intersection. Therefore, the following improvement is being considered:

- Install an enhanced pedestrian crossing to facilitate movement across Jennings Road. The types of enhanced crossing treatments are to be determined.

Oatfield Road/Glen Echo Avenue

There are no enhanced pedestrian crossings within the vicinity of the Oatfield Road/Glen Echo Avenue intersection. Therefore, the following improvement is being considered:

- Install an enhanced pedestrian crossing to facilitate movement across Oatfield Road. The types of enhanced crossing treatments are to be determined; however, given the traffic volumes and travel speeds along Oatfield Road it is assumed that the crossing will include:
    - Median refuge islands
    - High visibility pavement markings and signs
    - Rectangular Rapid Flash Beacons (RRFBs)

SE 82nd Drive/I-205 Southbound Ramp Terminal

Oatfield Road/Glen Echo Avenue

Oatfield Road/Gloucester Street

There are no enhanced pedestrian crossings within the vicinity of the Oatfield Road/Gloucester Street intersection. Therefore, the following improvement is being considered:

- Install an enhanced pedestrian crossing to facilitate movement across Oatfield Road. The types of enhanced crossing treatments are to be determined; however, given the traffic volumes and travel speeds along Oatfield Road it is assumed that the crossing will include:
    - High visibility pavement markings and signs
    - Rectangular Rapid Flash Beacons (RRFBs)

Portland Avenue/Arlington Street

There are no marked crosswalks within the vicinity of the Portland Avenue/Arlington Street intersection. Therefore the following improvement is being considered:

- Install marked crosswalks at the east, west, and south legs of the intersection.

Portland Avenue/Exeter Street

There are marked crosswalks across the north leg of the Portland Avenue/Exeter Street intersection; however, the east, west, and south legs are unmarked. Therefore the following improvement is being considered:

- Install marked crosswalks at the east, west, and south legs of the intersection.

Portland Avenue/Glen Echo Avenue

There are no enhanced pedestrian crossings within the vicinity of the Portland Avenue/Glen Echo Avenue (north) intersection. Therefore, the following improvement is being considered:

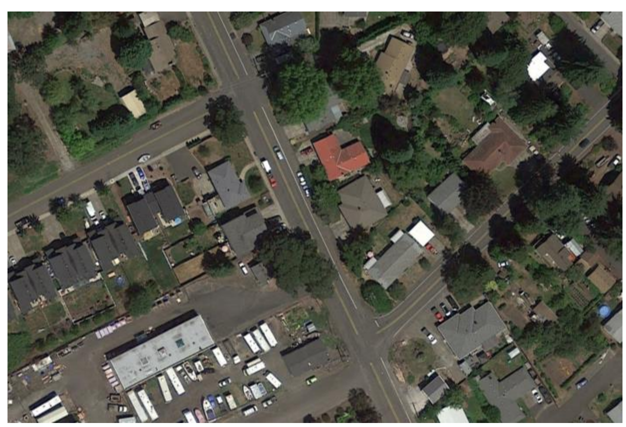
- Install an enhanced pedestrian crossing to facilitate movement across Portland Avenue. The types of enhanced crossing treatments are to be determined.

Portland Avenue/Glen Echo Avenue (south location)

There are no enhanced pedestrian crossings within the vicinity of the Portland Avenue/Glen Echo Avenue (south) intersection. Therefore, the following improvement is being considered:

- Install an enhanced pedestrian crossing to facilitate movement across Portland Avenue. The types of enhanced crossing treatments are to be determined.

Portland Avenue/Arlington Street



Portland Avenue/Glen Echo Avenue (north and south)

Webster Road/Cason Road

There are no enhanced pedestrian crossings within the vicinity of the Webster Road/Cason Road intersection. Therefore, the following improvement is being considered:

- Install an enhanced pedestrian crossing to facilitate movements across Webster Road and Cason Road. The types of enhanced crossing treatments are to be determined; however, given the traffic volumes and travel speeds along Oatfield Road it is assumed that the crossing will include:
    - High visibility pavement markings and signs
    - Rectangular Rapid Flash Beacons (RRFBs)

Portland Avenue

Portland Avenue provides on-street parking along both sides of the roadway. It also provides marked crosswalks at most major intersections between Arlington Street and Nelson Lane. Therefore, the following improvement is being considered:

- Install curb extensions along Portland Avenue at every major intersection between Arlington Street and Nelson Lane (up to 15 locations)

Arlington Street

Arlington Street provides on-street parking along both sides of the roadway. It also has marked crosswalks a most intersections between Arlington Street and Nelson Lane. Therefore, the following improvement is being considered:

- Install curb extensions along Arlington Street at every major intersection between OR 99E and SE 82nd Drive (up to 10 locations)

Other Intersection Improvements

- Reconfigure the marked crosswalks at the Crownview Drive/Los Verdes Drive intersection and the Valley View Road/Valley View Drive intersections – Install pedestrian ramps as necessary.

Off-street Improvements

The following off-street improvements consist of the pedestrian accessways between cul-de-sacs and dead-end streets, new shared-use paths and trails, and a new pedestrian/bicycle bridge.

Duniway Avenue Accessway

Right of way between Duniway Avenue (east) and Duniway Avenue (west) has been preserved; however, a new roadway connection may not be feasible. Therefore, the following improvement is being considered:

- Install a new accessway that connects Duniway Avenue (east) and Duniway Avenue (west). Due to grade constraints, an accessway at this location would need to be raised.

Beatrice Avenue Accessway

Right of way along Beatrice Avenue has been preserved between Ipswitch Street and Jersey Street; however, a new roadway connection may not be feasible. Therefore, the following improvement is being considered:

- Install a new accessway that connects Beatrice Avenue from Ipswich Street to W Jersey Street. There are considerable constraints due to a nearby creek.

Jenson Road Shared-use Path

Jenson Road is currently being used as a shared-use path. The right-of-way is under consideration for making the use of the roadway as a shared-use path permanent and including signing and pedestrian-scale lighting to encourage pedestrian and cyclist usage between River Road and Dahl Park Road.

Beatrice Avenue Accessway, Facing North

Jenson Road Shared-use Path, Facing West

Shared-use Path under OR 99E

OR 99E can be an obstacle for pedestrian wishing to access the Clackamas and Willamette Rivers and their adjacent beaches on the west portion of Gladstone. Therefore, a shared-use path that would travel under the OR 99E bridge is being considered. Such a path would connect Clackamas Boulevard to Dahl Park Road. There are considerable constraints to the path due to rising water levels in the Clackamas River.

Olson Wetlands Shared-use Path

A potential shared-use path connection is being considered from Abernethy Court to Risley Avenue to provide further pedestrian and bicycle connectivity from the Trolley Trail to southwest Gladstone.

Trolley Trail Bridge

The City has explored the possibility of constructing a pedestrian bridge crossing the Clackamas River south of Gladstone to create a connection between Gladstone and Oregon City. The previous rail bridge in the same location was demolished in 2014 after being unused for many years and becoming structurally unstable.

BICYCLE SYSTEM

Bicycle facilities are the elements of the transportation system that enable people to travel safely and efficiently by bike. These include facilities along key roadways (e.g., shared lane pavement markings, on-street bike lanes, and separated bike facilities) and facilities at key crossing locations (e.g., enhanced bike crossings). These also include end of trip facilities (e.g. secure bike parking, changing rooms, and showers at worksites); however, these facilities are addressed through the development code. Each facility plays a role in developing a comprehensive bicycle system.

Solutions

This section summarizes the solutions considered for implementation within the City of Gladstone to address existing gaps and deficiencies in the bicycle system and future needs.

Alternative Routes

Designate an alternative route along a parallel street that provides a more comfortable environment for cyclists with the same level of connectivity. The alternative route could be identified by wayfinding signs, which could also be used to identify essential destinations that can be reached by the route. The alternative route may provide shared-lane pavement markings and signs, on-street bike lanes, or other bicycle facilities.

Shared Lane Pavement Markings and Signs

Shared-lane pavement markings (often called “sharrows”) are not a bicycle facility, but a tool designed to help accommodate bicyclists on roadways where bike lanes are desirable but infeasible to construct. Sharrows indicate a shared roadway space for cyclists and motorists and are typically centered in the roadway or approximately four feet from the edge of the travelway. Sharrows are suitable on roadways with relatively low travel speeds (<35 mph) and low ADT (<3,000 ADT); however, they may also be used to transition between discontinuous bicycle facilities. Sharrows could be applied along a variety of streets within Gladstone where room for on-street bike lanes is limited.

On-Street bike lanes

On-street bike lanes are striped lanes on the roadway dedicated for the exclusive use of cyclists. Bike lanes are typically placed at the outer edge of pavement (but to the inside of right-turn lanes and/or on-street parking). Bicycle lanes can improve safety and security of cyclists and (if comprehensive) can provide direct connections between origins and destinations. On-street bike lanes could be applied along a variety of streets within Gladstone where space allows.

Separated Bike Facilities

Separated bike facilities include buffered bike lanes and separated bike lanes, or cycle tracks. Buffered bike lanes are on-street bike lanes that include an additional striped buffer of typically 2-3 feet between the bicycle lane and the vehicle travel lane and/or between the bicycle lane and the vehicle parking lane. They are typically located along streets that require a higher level of separation to improve the comfort of bicycling. Separated bike lanes, also known as cycle tracks, are bicycle facilities that are separated from motor vehicle traffic by a buffer and a physical barrier, such as planters, flexible posts, parked cars, or a mountable curb. One-way separated bike lanes are typically found on each side of the street, like a standard bike lane, while a two-way separated bike lanes are typically found on one side of the street.

On-street Bike Lanes

Buffered Bike Lanes

Enhanced Crossings

Enhanced bicycle crossing facilities enable cyclists to safely cross streets, railroad tracks, and other transportation facilities. Planning for appropriate bicycle crossings requires the community to balance vehicular mobility needs with providing crossing locations that the desired routes of cyclists. Enhanced bicycle crossings include:

- Bike Boxes – designated space at an intersection that allows cyclists to wait in front of motor vehicles while waiting to turn or continue through the intersection.
- Two-Stage Left-turn Boxes – designated space at a signalized intersection outside of the travel lane that provides cyclists with a place to wait while making a two-stage left-turn.
- Pavement marking through intersections – pavement markings that extend and bike lane through an intersection.
- Bike Only Signals – A traffic signal that is dedicated for cyclists
- Bicycle Detection – Vehicle detection for bicycles

Additional information on the Enhanced bicycle crossing treatments is provided in Attachment A.

Wayfinding Signs

Wayfinding signs are signs located along roadways or at intersections that direct bicyclists towards destinations in the area and/or to define a bicycle route. They typically include distances and average walk/cycle times. Wayfinding signs are generally used on primary bicycle routes and multiuse paths.

Improvements

The following improvements have been organized by streets segment, intersection, and off-street improvements. Where there are multiple improvements, the improvement shown in **bold text** was identified as the preferred improvement based on an evaluation of environmental, engineering, land use "fatal flaws" and anticipated funding capacity as well as discussions with the project team, advisory committees, and the general public.

Street Segment Improvements

The following street segment improvements have been organized by functional classification.

Arterials

Arterials serve an important function for bicycle access and circulation within Gladstone, particularly those that are served by local transit service. The following provides a summary of the bicycle improvements along arterial streets.

SE 82nd Drive

SE 82nd Drive currently has on-street bike lanes along both sides of the roadway; however, the BLTS analysis indicates that the segment from Oatfield Road to the north-east City limits is NOT suitable for most cyclists. This is primarily due to the relatively high travel speeds and narrow bike lanes along the roadway. Therefore, the following improvements are being considered along the roadway:

- Reduce the posted speed limit to 30 mph
- Reduce the travel lane width and install wider bike lanes on both sides of the roadway
- **Reduce the travel lane width and install buffered bike lanes on both sides of the roadway**
- Install separated bike facilities on one or two sides of the roadway

OR 99E (McLoughlin Boulevard)

OR 99E is a state facility. It currently has on-street bike lanes along both sides of the roadway; buffered bike lanes are provided where space is available; however, the BLTS analysis indicates that the roadway is currently NOT suitable for most cyclists. This is primarily due to the relatively high travel speeds and narrow bike lanes (in the non-buffered areas) along the roadway. Therefore, the following improvements are being considered along the roadway:

- **Reduce the posted speed limit to 35 mph**
- Reduce the travel lane width and install wider bike lanes on both sides of the roadway
- **Reduce the travel lane width and install buffered bike lanes on both sides of the roadway**
- Install separated bike facilities on one or two sides of the roadway

Arlington Street

Arlington Street currently does not have bicycle facilities; however, the BLTS analysis indicates that the roadway is currently suitable for most cyclists. This is primarily due to the relatively low speeds along the roadway. Therefore, the following improvements are being considered along the roadway:

- **Establish and alternative route along Clackamas River Drive with wayfinding signs and pavement markings**
- Install shared lane pavement marking and signs
- **Remove parking from both sides of the roadway from OR 99E to Clackamas Boulevard and install on-street bike lanes**
- **Remove parking from both sides of the roadway from Clackamas Boulevard to SE 82nd Drive and install on-street bike lanes**
- **Widen the roadway from Clackamas Boulevard to SE 82nd Drive and install on-street bike lanes and parking on both sides**

Oatfield Road

Oatfield Road currently has on-street bike lanes on both sides of the roadway; however, the BLTS analysis indicates that the roadway is currently NOT suitable for most cyclists. This is primarily due to the relatively high travel speeds and narrow bike lanes along the roadway. Therefore, the following improvements are being considered along the roadway:

- **Reduce the posted speed limit to 30 mph**
- **Reduce the travel lane width and install wider bike lanes on both sides of the roadway**
- Reduce the travel lane width and install buffered bike lanes on both sides of the roadway
- Install separated bike facilities on one or two sides of the roadway

Portland Avenue

Portland Avenue currently does not have bicycle facilities; however, the BLTS analysis indicates that the roadway is currently suitable for most cyclists. This is primarily due to the relatively low speeds along the roadway. Portland Avenue has a center two-way left-turn lane from Clackamas Boulevard to Nelson Lane, which is largely unnecessary given the relatively low traffic volumes along the roadway. North of Nelson Lane, Portland Avenue is relatively narrow. Therefore, the following improvements are being considered along the roadway:

- Portland Avenue from Clackamas Boulevard to Nelson Lane:
    - Install shared lane pavement marking and signs
    - **Remove the center two-way left-turn lane and install on-street bike lanes on both sides of the roadway**

    - Improvements along Portland Avenue will be determined through the downtown revitalization plan
  - Remove the center two-way left-turn lane and install separated bike facilities on both sides of the roadway
- Portland Avenue from Nelson Lane to Jennings Road
  - Install shared lane pavement marking and signs
  - Establish and alternative route to Jennings Avenue along Abernathy Lane – Emphasize the route with wayfinding signage
  - Remove parking from one side of the roadway and install on-street bike lanes
  - **Widen the roadway and install on-street bike lanes and parking on both sides**

Webster Road

Webster Road currently has on-street bike lanes on both sides of the roadway; however, the BLTS analysis indicates that the roadway is currently NOT suitable for most cyclists. This is primarily due to the relatively high travel speeds and narrow bike lanes along the roadway. Therefore, the following improvements are being considered along the roadway:

- **Reduce the posted speed limit to 30 mph**
- **Reduce the travel lane width and install wider bike lanes on both sides of the roadway**
- Reduce the travel lane width and install buffered bike lanes on both sides of the roadway
- Install separated bike facilities on one or two sides of the roadway

Portland Avenue, Facing South

Oatfield Road, Facing South

Collectors

Collectors also serve an important function for bicycle access and circulation within Gladstone and may provide direct access to essential destinations, such as schools, parks, churches, and commercial areas. The following provides a summary of the bicycle improvements along collector streets.

Abernathy Lane

Abernathy Lane currently has a relatively wide shoulder/on-street parking lane on the north side of the roadway and a shared-use path adjacent to the south side of the roadway from Glen Echo Avenue to Portland Avenue. The BLTS analysis indicates that the roadway is currently suitable for most cyclists. This is primarily due to the relatively low travel speeds along the roadway and the presence of a shoulder/on-street parking lane. Therefore, the following improvements are being considered along the roadway:

- **Install bike lanes on the north side of the roadway adjacent to the parking lane**
- Remove the parking and install bike lanes on both sides of the roadway

Cason Road

Cason Road currently has on-street bike lanes on both sides of the roadway and the BLTS analysis indicates that the roadway is currently suitable for most cyclists. However, there are no bike symbols within the on-street bike lanes and the bike lanes drop prior to Webster Road. Therefore, the following improvements are being considered along the roadway:

- **Install bike symbols within the on-street bike lanes**
- **Restripe the east leg of the Webster Road/Cason Road intersection to emphasize the bike connection**

Cason Road, Facing West

Abernathy Lane, Facing East

Dartmouth Street

Dartmouth Street does not have bicycle facilities; however, the BLTS analysis indicates that the roadway is currently suitable for most cyclists. This is primarily due to the relatively low travel speeds along the roadway. Therefore, the following improvements are being considered along the roadway:

- **Install shared lane pavement marking and signs from OR 99E to Portland Avenue and (given the width of the roadway) on-street bike lanes from Portland Avenue to Oatfield Road**
- Remove parking from both sides of the roadway and install on-street bike lanes from OR 99E to Portland Avenue

- Widen the roadway from OR 99E to Portland Avenue and install on-street bike lanes and parking on both sides

Gloucester Street

Gloucester Street currently does not have bicycle facilities; however, the BLTS analysis indicates that the roadway is currently suitable for most cyclists. This is primarily due to the relatively low travel speeds along the roadway. Therefore, the following improvements are being considered along the roadway:

- Install shared lane pavement marking and signs
- **Remove parking from both sides of the roadway and install on-street bike lanes**
- **Widen the roadway and install on-street bike lanes and parking on both sides**

Glen Echo Avenue

Glen Echo Avenue does not have bicycle facilities. The BLTS analysis indicates that the segment from OR 99E to Portland Avenue is NOT suitable for most cyclists. This is primarily due to the lack of bike facilities. Therefore, the following improvements are being considered along the roadway:

- **Reduce the posted speed limit to 25 mph**
- Install shared lane pavement marking and signs
- **Widen the roadway and install on-street bike lanes and parking on both sides**

The BLTS analysis also indicates that the segment from Portland Avenue to Oatfield Road is suitable for most cyclists. This is primarily due to the relatively low travel speeds. Therefore, the following improvements are being considered along the roadway:

- Install shared lane pavement marking and signs
- **Widen the roadway and install on-street bike lanes and parking on both sides**

Los Verdes Drive

Los Verdes Drive does not have bicycle facilities; however, the BLTS analysis indicates that the roadway is currently suitable for most cyclists. This is primarily due to the relatively low travel speeds along the roadway. Therefore, the following improvements are being considered along the roadway:

- **Install shared lane pavement marking and signs**
- Remove parking from both sides of the roadway and install on-street bike lanes
- Widen the roadway and install on-street bike lanes and parking on both sides

River Road

River Road currently has on-street bike lanes on both sides of the roadway and the BLTS analysis indicates that the roadway is currently suitable for most cyclists. However, the bike lanes on the west side of the roadway drop at the south-eastbound approach to OR 99E. Therefore, the following improvements are being considered along the roadway:

- **Install a "Bike Lane Ends" sign at the south-eastbound approach to OR 99E**
- **Install shared lane pavement marking at the south-eastbound approach to OR 99E**
- **Install a shared bike-lane/right-turn lane at the south-eastbound approach to OR 99E**

Local Streets

Local streets also play an important role in providing bicycle connectivity within the city. The following local streets have been identified as playing a critical role in providing connectivity to essential destinations. The types of treatments considered along these roadways include shared pavement markings and signs, wayfinding signs to essential destinations, and mixed-use shoulders.

- Clackamas Boulevard, Arlington Street to SE 82nd Drive
- Beatrice Avenue, from Abernathy Lane to Clackamas Boulevard
- Hereford Street, from Beatrice Avenue to Oatfield Road
- Nelson Lane/Harvard Avenue, from Portland Avenue to Hereford Street
- Beverly Lane/Collins Crest, from Harvard Avenue to Oatfield Road
- Ridgegate Drive/Penny Court/Clayton Way, from Oatfield Road to Webster Road
- Duniway Avenue, from Abernathy Lane Abernathy Lane to Portland Avenue
- Fairfield Street, from Cornell Avenue to Oatfield Road
- Cornell Avenue, from Clackamas Boulevard to Collins Crest
- Chicago Avenue, from Hereford Street to Arlington Street

Intersection Improvements

OR 99E/Arlington Street

The OR 99E/Arlington Street intersection currently has on-street bike lanes at the northbound and southbound approaches to the intersection; the on-street bike lanes along River Road drop at the eastbound approach to the intersection and there are no on-street bike lanes along Arlington Street at the westbound approach. Therefore, the following improvements have been identified for the intersection:

- Install two-stage left-turn bike boxes at the northbound and southbound approaches to the intersection

- Install bike boxes at the eastbound and westbound approaches to the intersection
- **Install skip striping along OR 99E through the intersection with green paint in the conflict areas – implement this treatment at all major intersections along OR 99E and in all conflict areas**

SE 82nd Drive/Oatfield Road

The SE 82nd Drive/Oatfield Road intersection currently has on-street bike lanes at the northbound, southbound, and eastbound approaches to the intersection. However, there are no enhanced crossing treatments to facilitate movement through the intersection. Therefore, the following improvements have been identified for the intersection:

- Install two-stage left-turn bike boxes at the northbound, southbound, and eastbound approaches to the intersection
- Install bike boxes at the eastbound and westbound approaches to the intersection
- **Install skip striping along SE 82nd Drive through the intersection with green paint in the conflict areas – implement this treatment at all major intersections along SE 82nd Drive and in all conflict areas**


OR 99E at Arlington Street


SE 82nd Drive at Oatfield Road

Oatfield Road/Webster Road

The Oatfield Road/Webster Road intersection currently has on-street bike lanes at the northbound, southbound, and westbound approaches to the intersection. However, there are no enhanced crossing treatments to facilitate movement through the intersection. Also, the northbound and westbound bike lanes are on the outside of the right-turn lanes. Therefore, the following improvements have been identified for the intersection:

- **Install skip striping along Oatfield Road through the intersection with green paint in the conflict areas – implement this treatment at all major intersections along Oatfield Road and in all conflict areas**

- **Reconfigure the northbound and westbound approaches to the intersection so that the bike lane is between the through (or left-turn) lane and the right-turn lane.**

Portland Avenue/Trolley Trail

The Trolley Trail travels along the south side of Abernathy Lane between the north city limits and Portland Avenue. The trail continues along Portland Avenue between Abernathy Lane and Columbia Boulevard at the future head of the Trolley Trail Bridge. Currently there is no way to transition from the Trolley Trail to Portland Avenue on the east side of the roadway by foot or by bike. Therefore, the following improvements have been identified for the Portland Avenue/Trolley Trail intersection:

- Install an enhanced pedestrian/bicycle crossing at the Portland Avenue/Trolley Trail intersection. The types of enhanced crossing treatments are to be determined.

Other Intersection Improvements

- Reconfigure the marked crosswalks at the Crownview Drive/Los Verdes Drive intersection and the Valley View Road/Valley View Drive intersections – Install pedestrian ramps as necessary.

TRANSIT

Public transit can provide important connections to destinations for people that do not drive or bike and can provide an additional option for all transportation system users for certain trips. Public transit links to walking, bicycling, or driving trips: users can walk to and from transit stops and their homes, shopping or work places, people can drive to park-and-ride locations to access a bus, or people can bring their bikes on transit vehicles and bicycle from a transit stop to their final destination.

Providing transit service in smaller cities is generally led by a local or regional transit agency, and is dependent on having the land use and densities that can support service. The city can plan for transit-supportive land use patterns and support future transit viability by designing and building streets that will comfortably accommodate transit stops and include the right-of-way that could allow for transit stops to be located as close as possible to important destinations. At a minimum, a transit stop should be well-signed and have a comfortable space to wait. Benches and shelter from the weather can improve user comfort, and including bike parking near bus stops allows people the option to leave their bike at one trip-end instead of bringing it on the bus.

Solutions

This section summarizes the solutions considered for implementation within the City of Gladstone to address existing gaps and deficiencies in the transit system and future needs.

New or Re-routed Fixed-Route Service

Fixed-route service enhancement can include:

- Increase the service frequency by reducing headways or time between arrivals

- Increase hours of service by providing service earlier in the morning and/or later in the evening
- Increase service coverage by re-routing existing service or implementing new service

Stop Enhancements

Transit stops are designated locations where residents can access local transit service. Transit stops are normally located at major intersections. The types of amenities provided at each transit stop (i.e. pole, bench, shelter, ridership information, trash receptacles) tend to reflect the level of usage, as discussed in the TriMet Bus Stops Guidelines from July 2010.

- Pole and bus stop sign – All bus stops require a pole and bus stop sign to identify the bus stop location. TriMet prefers that bus signs are provided on their own dedicated TriMet pole instead of being placed on existing poles, columns, and other locations as done historically.
- Bus stop shelters – Shelters are preferred for stops with 50 or more boardings per weekday but may be considered at stops served by infrequent service that have a minimum of 35 boardings per day on routes with peak headways greater than 17 minutes.
- Seating – Seating can be considered at any stop as long as accessibility is provided, safety and accessibility are not compromised by seating placement, and ad bench placement is allowed. Types of seating include:
    - Premium bench (minimum of 25 boardings per day)
    - Ad bench and Simme seat (minimum of 12 boardings per day)
- Trash cans – Trash cans are only provided at sheltered bus stops.
- Lighting – TriMet has set a goal to provide 1.5 to 2 foot-candles of light around a bus stop area.

Park-and-Ride Facilities

Park-and-ride facilities provide parking for people who wish to transfer from their personal vehicle to public transportation or carpools/vanpools. Park-and-rides are frequently located near major intersections, at commercial centers, or on express and commuter bus routes. It is Oregon state policy to encourage the development and use of park-and-ride facilities at appropriate urban and rural locations adjacent to or within the highway right-of-way. Park-and-ride facilities can provide an efficient method to provide transit service to low density areas, connecting people to jobs, and providing an alternate mode to complete long-distance commutes.

Park-and-ride facilities may be either shared-use, such as at a school or shopping center, or exclusive-use. Shared-use facilities are generally designated and maintained through agreements reached between the local public transit agency or rideshare program operator and the property owner. Shared lots can save the expense of building a new parking lot, increase the utilization of existing spaces, and avoid utilization of developable land for surface parking. In the case of shopping centers, the presence of a shared-use park-and-ride has frequently been shown to be mutually beneficial, as park-and-riders tend to patronize the businesses in the center.

Other Solutions

The Regional High Capacity Transit (HCT) Plan identifies several HCT corridors within the Gladstone area. While most of the corridors are conceptual at this time, there are several things the City can do to prepare for HCT. Per discussions with TriMet, the primary solutions for Gladstone include:

- Modify the development code to allow for higher densities within the City
- Coordinate with Clackamas County on priorities for HCT for the 2018 RTP update

TriMet Stop (Before)

TriMet Stop (After)

Improvements

New or Re-routed Fixed-Route Service

The following streets are being considered for new or re-routed fixed-route service to address the need for additional service coverage within the surrounding area:

- Portland Avenue from Abernathy Lane to Jennings Avenue – Portland Avenue currently does not connect to Jennings Avenue
- Jennings Avenue from OR 99E to Oatfield Road
- Cason Road from Webster Road to Strawberry Lane
- SE 82nd Drive from Oatfield Road to the north city limits

Stop Enhancements

The following bus stops are being considered for shelter installation due to adequate ridership volumes:

- Bus stop ID: 10323, OR 99E/Glen Echo Avenue,
- Bus stop ID: 10324, OR 99E/Gloucester Street,
- Bus stop ID: 10325, OR 99E/River Road, and
- Bus stop ID: 10327, OR 99E/Gloucester Street.

Park-and-Ride Facilities

The following locations have been identified as potential location for park-and-ride facilities:

- Gladstone Christian Church (could serve Lines 32, 34 and 79)
- Tri-City Baptist Temple (could serve Line 79)
- Oregon Conference of Seventh-day Adventists (could serve Lines 79 and 32)
- St Stephen Lutheran Church (could service Lines 33, 34, and 99)
- The Church of Jesus Christ of Latter-day Saints (could serve Lines 79 and 32)

The City should work with these churches to determine the potential for park-and-rides in their lots.

TriMet Service Enhancement Plans for the Southeast Region

The Service Enhancement Plans for the Southeast region include potential changes in the fixed-route services to Gladstone, including:

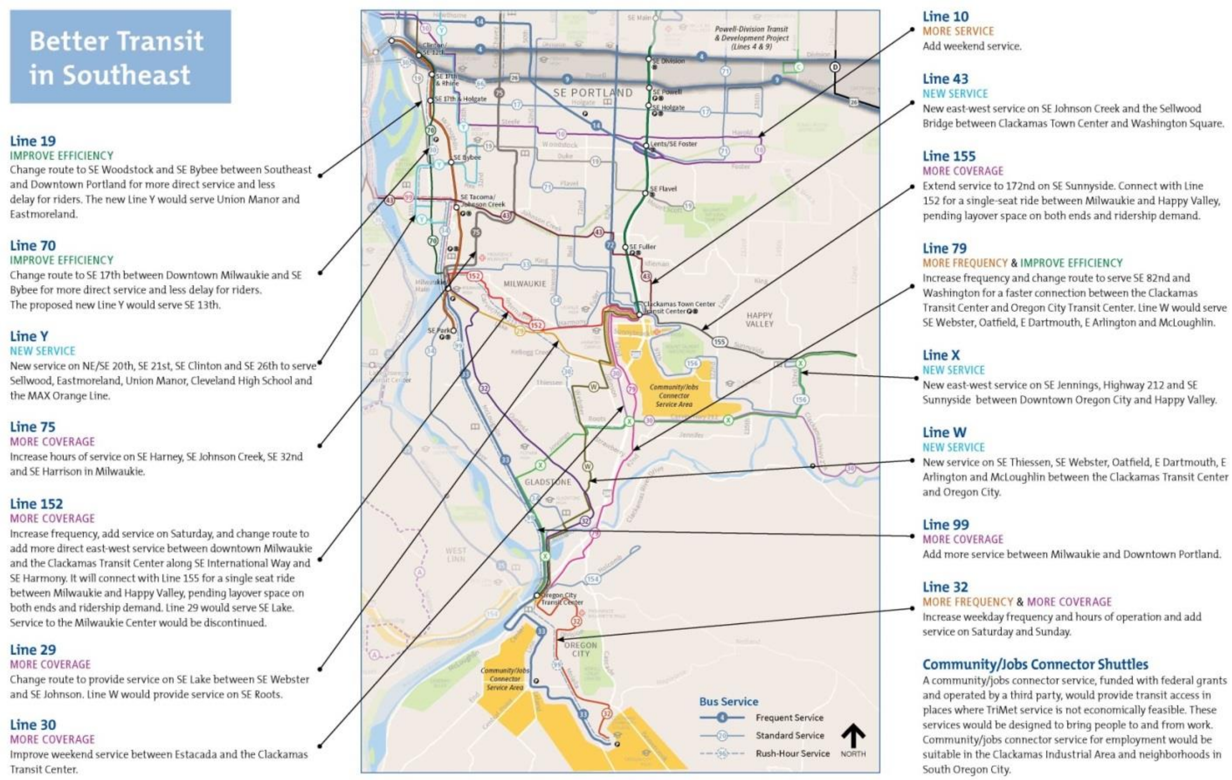
- Line 79, More Frequency and Improved Efficiency - Increase frequency and change route to serve SE 82nd Drive and Washington Street for a faster connection between the Clackamas Transit Center and Oregon City Transit Center. Line W (see below) would serve Webster Road, Oatfield Road, Dartmouth Street, Arlington Street, and OR 99E.
- Line X, New Service – New east-west along OR 99E, Jennings Avenue, Highway 212, and Sunnyside Road service between downtown Oregon City and Happy Valley.
- Line W, New Service – New service on Thiessen Road, Webster Road, Oatfield Road, Dartmouth Street, Arlington Street, and OR 99E between the Clackamas Transit Center and Oregon City.
- Line 99, More Coverage – Add more service coverage between Milwaukie and Downtown Portland.
- Line 32, More Frequency and More Coverage – Increase weekday frequency and hours of operation and add service on Saturday and Sunday.

TriMet's Service Enhancement Plans for the Southeast Region are illustrated in Exhibit 1.

Other Transit Improvements

- Relocate the transit stop at the northwest corner of the OR 99E Arlington Street intersection to the southwest corner of the intersections with a dedicated bus pull out
- Install a no-parking/bus zone sign along the west side of Webster Road adjacent to Walter L Krawberger Middle School.
- Install a no-parking/bus zone sign along the west side of Webster Road adjacent to the Webster Ridge Apartments.

Exhibit 1: TriMet's Service Enhancement Plans for the Southeast Region



MOTOR VEHICLE SYSTEM

Streets serve a majority of all trips within Gladstone across all travel modes. In addition to motorists, pedestrians, bicyclists, and public transit riders use streets to access areas locally and regionally.

Solutions

This section summarizes the solutions considered for implementation within the City of Gladstone to address existing gaps and deficiencies in the motor vehicle system and future needs.

Street System Connectivity Solutions

Although the southern portion of Gladstone is largely built on a grid system, much of the residential neighborhood development in the northern portion has resulted in a network of cul-de-sacs and stubs streets due to topography. These streets can be desirable to residents because they can limit traffic speeds and volumes on local streets, but cul-de-sacs and stub streets result in longer trip distances, increased reliance on arterials for local trips, and limited options for people to walk and bike to the places they want to go.

The future street system needs to balance the benefits of providing a well-connected grid system with the topographical challenges in the city. Incremental improvements to the street system can be planned carefully to provide route choices for motorists, cyclists, and pedestrians while accounting for potential neighborhood impacts. In addition, the quality of the transportation system can be improved by making connectivity improvements to the pedestrian and bicycle system separate from street connectivity, as discussed through solutions presented in the previous sections.

The following are potential connectivity solutions that can be applied in the City of Gladstone.

- Re-designate a roadway with a higher *or lower* functional classification to improve the order and function of the roadway
- Construct a new roadway or extend an existing roadway to improve connectivity within an area of the city

Freight Mobility and Reliability Solutions

No specific solutions have been identified to address freight mobility and reliability within the City, with the exception of the TSMO solutions identified above for truck signal priority and the capacity based solutions identified below at several key intersections along OR 99E and SE 82nd Drive.

Capacity Based Solutions

Turn Lanes

Separate left- and right-turn lanes, as well as two-way left-turn lanes (TWLTL) can provide separation between slowed or stopped vehicles waiting to turn and through vehicles. The design of turn lanes is largely determined based on a traffic study that identifies the storage length needed to accommodate vehicle queues. Turn lanes are commonly used at intersections where the turning volumes warrant the need for separation.

Traffic Signals

Traffic signals allow opposing streams of traffic to proceed in an alternating pattern. National and state guidance indicates when it is appropriate to install traffic signals at intersections. When used, traffic signals can effectively manage high traffic volumes and provide dedicated times in which pedestrians and cyclists can cross roadways. Because they continuously draw from a power source and must be periodically re-timed, signals typically have higher maintenance costs than other types of intersection control. Signals can improve safety at intersections where signal warrants are met, however, they may result in an increase in rear-end crashes compared to other solutions. Signals have a significant range in costs depending on the number of approaches, how many through and turn lanes each approach has, and, if it is located in an urban or rural area. The cost of a new traffic signal ranges from approximately $250,000 in rural areas to $350,000 in urban areas.

Signal Timing/Phasing Modifications

Signal retiming and optimization offers a relatively low cost option to increase system efficiency. Retiming and optimization refers to updating timing plans to better match prevailing traffic conditions and coordinating signals. Timing optimization can be applied to existing systems or may include upgrading signal technology, such as signal communication infrastructure, signal controllers, or cabinets. Signal retiming can reduce travel times and be especially beneficial to improving travel time reliability. In high pedestrian or desired pedestrian areas, signal retiming can facilitate pedestrian movements through intersections by increasing minimum green times to give pedestrians time to cross during each cycle. Signals can also facilitate bicycle movements with the inclusion of bicycle detectors.

Signal upgrades often come at a higher cost than signal timing and phasing modifications and usually require further coordination between jurisdictions. However, upgrading signals provides the opportunity to incorporate advanced signal systems to further improve the efficiency of a transportation network. Strategies include coordinated signal operations across jurisdictions, centralized control of traffic signals, adaptive or active signal control, and transit or freight signal priority as described above. These advanced signal systems can reduce delay, travel time and the number of stops for transit, freight, and other vehicles. In addition, these systems may help reduce vehicle emissions and improve travel time reliability.

Roundabouts

Roundabouts are circular intersections where entering vehicles yield to vehicles already in the circle. They are designed to slow vehicle speeds to 20 to 30 mph or less before they enter the intersection, which promotes a more comfortable environment for pedestrians, bicyclists, and other non-motorized users. Roundabouts have fewer conflict-points and have been shown to reduce the severity of crashes, as compared to signalized intersections. Roundabouts can be more costly to design and install when compared to other intersection control types, but they have a lower operating and maintenance cost than traffic signals. Topography must be carefully evaluated in considering a roundabout, given that slope characteristics at an intersection may render a roundabout infeasible. The cost of a new roundabouts ranges from approximately $1 million to $2 million depending upon the number of lanes and the slope conditions.

Traffic Signal


Roundabout

Improvements

The following improvements have been organized into connectivity improvements, freight mobility and reliability improvements, and capacity based improvements. Where there are multiple improvements, the improvements shown in **bold text** were identified as the preferred improvement based on an evaluation of environmental, engineering, land use “fatal flaws” and anticipated funding capacity as well as discussions with the project team, advisory committees, and the general public.

Connectivity Improvements

The following identifies potential connectivity improvements, including potential changes to the city’s functional classification plan and new street connections. Given that there are limited opportunities for new arterial or collector streets within the City, the new street connections are limited to an extension of an existing street and two new local street connections.

- Re-designate Portland Avenue as a collector street
- Re-designate Dartmouth Street as local street
- Extend Portland Avenue north to Jennings Avenue
- Extend Tyron Court southeast to connect with Nelson Lane as part of future development (on private property)
- Connect two segments of E Kenmore Street to create one segment from Harvard Avenue to Cornell Avenue as part of future development (on private property)

Freight Mobility and Reliability Improvements

No specific improvements have been identified to address freight mobility and reliability within the City, with the exception of the TSMO improvements identified above for truck signal priority and the capacity based improvements identified below at several key intersections along OR 99E and 82d Drive.

Capacity Based Improvements

OR 99E/Arlington Street

The OR 99E/Arlington Street intersection is forecast to exceed ODOT’s mobility target under year 2040 conditions. Although each approach has a movement that is overcapacity, the eastbound right-turn and northbound left-turn movements are forecast to experience average delays greater than 350 seconds per vehicle. Therefore, the following improvements are being considered at the intersection:

- Install a second separate right-turn lane on the eastbound approach and a second separate left-turn-lane on the northbound approach and update the northbound and southbound left-turn movements to protected phasing and the eastbound right-turn movement to protected and overlap phasing.
- **Restrict eastbound movements at the intersection, making the block of River Road west of OR 99E a one-way street, and install a second separate through lane on the southbound**

approach. The northbound left-turn, southbound right-turn, and westbound through movements will still be allowed. In addition to capacity changes, signal timing and phasing will be optimized as necessary. It is important to note that this solution would have an impact on upstream signals due to drivers re-routing to parallel routes.

- Restrict all movements to and from River Road by creating a stub street that does not connect to OR 99E. In addition to capacity changes, signal timing and phasing will be optimized as necessary. It is important to note that this solution would have an impact on upstream signals due to drivers re-routing to parallel routes.

Solution	V/C	Delay (seconds)	LOS
Turn lanes and signal phasing updates	1.10	63.2	E
Restricted eastbound movements	0.98	33.3	C
Restrict all movements to and from River Road	1.09	40.6	D

OR 99E/Glen Echo Avenue

The OR 99E/Glen Echo Avenue intersection is forecast to not meet ODOT's operating standard of a v/c less than 0.99 under future 2040 conditions. Although the northbound and southbound movements are forecast to operate at acceptable levels, the eastbound and westbound movements are expected to experience excessive average delays. Therefore, the following improvements are being considered at the intersection:

- **Install a separate right-turn lane on the westbound approach. Signal timing updates are not necessary based on the forecasted volumes but this improvement would provide an opportunity to complete signal retiming at this intersection.**
- In addition to the added westbound right-turn lane, reconfigure the eastbound approach to have a separate left-turn lane and a shared through-right turn lane.

As part of the investigation of the OR 99E solution, OR 99E/Glen Echo was further analyzed with additional northbound right-turn volumes and additional eastbound right-turn volumes based on half of the driver rerouting along OR 99E through the Glen Echo intersection and half the drivers rerouting through the Gloucester intersection.

Solution	V/C	Delay (seconds)	LOS
Westbound turn lane	0.95	36.9	D
Reconfigure eastbound approach	0.88	23.1	C

I-205 Southbound Ramp Terminal/SE 82nd Drive

The I-205 Southbound Ramp Terminal/SE 82nd Drive intersection is forecast to not meet ODOT's operating standard of a v/c less than 0.85 under future 2040 conditions. The critical westbound left-turn movement is forecast to experience average delays greater than 150 seconds per vehicle. Therefore, the following improvements are being considered at the intersection:

- Increase the cycle length from 75 to 150 seconds and optimize the signal timing. The expectation is that both I-205 ramp terminals will have increased cycle lengths and continue to operate in coordination.
- **Install a second separate left-turn lane on the westbound approach. Signal timing updates are not necessary based on the forecasted volumes but this improvement would provide an opportunity to complete signal retiming at this intersection. This solution will require widening of the bridge of I-205 in between the ramp terminals and the southbound on-ramp**.
- Reconfigure the intersection to restrict westbound left-turn movements by constructing a channelized right-turn cloverleaf-style on-ramp for the westbound right-turn movement. The westbound vehicles entering the freeway will transition from the current left-turn movement to a free-flow right-turn movement
- Acquire right-of-way and install a multi-lane roundabout, including a shared left-through lane and separate right-turn lane on both the north and west legs and a separate left-turn lane and shared through-right lane on the east leg. The separate right-turn lanes for eastbound and southbound traffic will provided with an additional receiving lane to allow for a free-flow movement.

Solution	V/C	Delay (seconds)	LOS
Signal retiming	0.88	36.9	D
Westbound turn lane	0.72	28.8	C
On-ramp reconfiguration	0.58	6.9	A
Roundabout	-	35.0	D

I-205 Northbound Ramp Terminal/SE 82nd Drive

The I-205 Northbound Ramp Terminal/SE 82nd Drive intersection is forecast to not meet ODOT's operating standard of a v/c less than 0.85 under future 2040 conditions. The critical westbound through movement is forecast to experience average delays greater than 50 seconds per vehicle. Therefore, the following improvements are being considered at the intersection:

- Increase the cycle length from 75 to 150 seconds, update the westbound left-turn movement to permitted phasing, and optimize the signal timing. The expectation is that both I-205 ramp terminals will have increased cycle lengths and continue to operate in coordination.
- **Install a second separate through lane on the westbound approach, convert the westbound left-turn phasing to permitted, and update the signal timing. This solution will require widening of the bridge of I-205 in between the ramp terminals.**
- Acquire right-of-way and install a multi-lane roundabout, including a shared left-through lane and a shared through-right lane on the east leg, a shared left-through lane and a separate right-turn lane on the south leg, and a shared lane on the west leg. Operations can be improved by providing an additional receiving lane to allow the northbound right-turn to function as a free-flow movement but this option would create further right-of-way implications.

Solution	V/C	Delay (seconds)	LOS
Signal retiming	0.89	39.8	D
Westbound through lane	0.69	21.4	C
Roundabout	-	31.4	D

Attachment B contains the traffic conditions worksheets for the motor vehicle Improvements.

Oatfield Road/Dartmouth Street

While the Oatfield Road/Dartmouth Street intersection was not evaluated as part of the TSP update, anecdotal evidence suggests that the left-turn movements to/from Oatfield Road can be a challenge during peak time periods. In addition, some motorists use Dartmouth Street to bypass Arlington Street, which contributes to relatively high travel speeds along the roadway. Therefore, the following improvements are being considered at the intersection:

- Install a median along Oatfield Road to restrict left-turn movements to/from Dartmouth Street. Note: many local residents as well as the local transit agency (TriMet) currently use Dartmouth Street to access Oatfield Road; therefore, this restriction should be explored further with their input.

Other Motor Vehicle Improvements

- Install No Parking signs along the north side of Gloucester Street from OR 99E to 50-feet to the east OR paint the curb yellow similar to the west side of OR 99E

Attachment A Pedestrian and Bicycle Crossing Treatments

PEDESTRIAN CROSSING TREATMENTS

Pedestrian crossing facilities enable pedestrians to safely cross streets, railroad tracks, and other transportation facilities. Planning for appropriate pedestrian crossings requires the community to balance vehicular mobility needs with providing crossing locations that the desired routes of walkers.

Unmarked Crosswalks

Under Oregon law, pedestrians have the right-of-way at all unsignalized intersections. On narrow, low-speed streets unmarked crosswalks are generally sufficient for pedestrians to cross the street safely, as the low-speed environment makes drivers more responsive to the presence of pedestrians. However, drivers are less likely to yield to pedestrians at unmarked crosswalks on high-speed and/or high-volume roadways, even when the pedestrian has stepped onto the roadway. In these situations, enhanced pedestrian crossing facilities are needed to remind drivers that they must yield when pedestrians are present.

Marked Crosswalks

Marked crosswalks are painted roadway markings that indicate the location of a crosswalk to motorists. Marked crosswalks can be accompanied by signs, curb extensions and/or median refuge islands, and may occur at intersections or at mid-block locations. Research has shown that marked crosswalks in certain situations do not improve pedestrian safety and can even make it worse. Recent research indicates that on multi-lane roadways (more than two lanes), marked crosswalks should not be installed without accompanying treatments, such as Rectangular Rapid Flash Beacons (RRFBs) or Pedestrian Hybrid beacons.

Rectangular Rapid Flashing Beacon (RRFB)

RRFBs are user-actuated amber lights that have an irregular flash pattern similar to emergency flashers on police vehicles. These supplemental warning lights are used at unsignalized intersections or mid-block crosswalks to improve safety for pedestrians using a crosswalk. RRFBs could be used at any unsignalized intersection or mid-block crossing where warrants require a higher level of crosswalk protection.

Pedestrian Hybrid Beacon

A Pedestrian Hybrid Beacon (sometimes called a HAWK signal) is a user-actuated signal that is unlit when not in use. It begins with a yellow light alerting drivers to slow, and then displays a solid red light requiring drivers to remain stopped while pedestrians cross the street. The beacon then shifts to flashing red lights to signal that motorists may proceed, after stopping, and after pedestrians have completed their crossing. A Pedestrian Hybrid Beacon can be used at mid-block crossings or, in some cases, at unsignalized intersections (the MUTCD suggests that the beacons be located at least 100-feet from an intersection). Pedestrian Hybrid Beacons could be used at any unsignalized intersection or mid-block crossing where warrants require a higher level of crosswalk protection.

Pedestrian Signal

Pedestrian Signals provide pedestrians with a signal-controlled crossing at a mid-block location or, in some cases at a previously stop-controlled intersection where pedestrian volumes warrant full signalization (the MUTCD no longer allows half signals at intersections). The signal remains green for the mainline traffic movements until actuated by a pushbutton to call a red signal for traffic. They are typically located at midblock crossings with high pedestrian or bicycle demand and/or high traffic volumes, such as where multi-use paths intersect with roadways.

Pedestrian Countdown Heads

Pedestrian Countdown heads inform pedestrians of the time remaining to cross the street with a countdown timer at the signalized crossing. The countdown should include enough time for a pedestrian to cross the full length of the street, or in rare cases, reach a refuge island. The 2009 Manual on Uniform Traffic Control Devices (MUTCD) requires all new pedestrian signals, and any retrofitted signals to include pedestrian countdown signals.

Leading Pedestrian Interval (LPI)

Leading pedestrian intervals allow pedestrians to start crossing the street at a signalized intersections five to seven seconds before conflicting vehicles are given a green light and allowed to enter the intersection. They are most commonly used at signalized intersections where left- or right-turning vehicles interfere with pedestrian crossing movements. LPI could be applied at all existing or potential future traffic signals to improve crossing conditions for pedestrians.

Geometric Considerations

There are a number of geometric enhancements that can be considered at pedestrian crossings that may be implemented in conjunction with previously discuss treatments.

Curb Extensions

Curb extensions create additional space for pedestrians at crosswalks and allow pedestrians and vehicles to better see each other. Curb extensions are typically installed at intersections and midblock crossings located along roadways with on-street parking to help reduce crossing distances and the amount of exposure pedestrians have to vehicle traffic. Curb extensions can narrow the vehicle path, slow down traffic, and prohibit fast turns. Curb extensions could be applied along any street where on-street parking is allowed or where there is sufficient shoulder width so the curb extension does not conflict with on-street bike lanes.

Raised Median Island

Raised median islands provide a protected area in the middle of the roadway where pedestrians can stop while crossing the street. Raised median islands allow pedestrians to complete two-stage crossings if needed. Raised median islands can narrow the vehicle path and slow down traffic along the roadway. Raised median islands could be applied along any street where they would not interfere with turning movements at driveways and intersecting roadways.

Other Considerations

Street Furniture and Lighting

Street furniture includes pedestrian seating, information / wayfinding structures, and trash cans. Street furniture and lighting can be used to enhance the pedestrian experience and encourage pedestrian activity on a street.

Bicycle Crossing Treatments

Pavement Markings Through Intersections

Pavement markings can be extended through the intersection for bicyclists. Green paint can be used in "conflict zones" where vehicles and bicycles may cross paths in intersections, at driveways, or at right-turn pockets. These pavement marking are typically used at signalized intersections to emphasize a connection in a larger bicycle network. They could be used along at all signalized intersections and in other select "conflict zones".

Bike Box

Bicycle boxes are designated spaces at signalized intersections, placed between a set-back stop bar and the pedestrian crosswalk, that allow bicyclists to queue in front of motor vehicles at red lights. Bike boxes are typically used at signalized intersections to facilitate turn movements as well as other movements for cyclists.

Two-Stage Left-Turn Bike Box

Two-stage left-turn bike boxes allow bicyclists to safely and comfortably make left-turns at multilane intersections from a right-side bicycle lane or cycle track. Bicyclists arriving on a green light travel into the intersection and pull out into the two-stage turn queue box away from through-moving bicycles and in front of cross street traffic, where they can wait to proceed through on the side-street green signal. Two-stage left-turn bike boxes can be applied at signalized intersections to improve bicycle crossing conditions.

Bike only signal

Bicycle-only signals can be used at intersections to provide a separate signal phase that is dedicated to bicyclists. At this stage, the MUTCD does not allow bicycle signal to operation concurrent with permissive vehicle phases.

Bicycle Detection

Many traffic signals along are actuated, meaning that green indication is given to a movement when a vehicle is detected. However, actuating a signal as a cyclist can be difficult. Bicycle detection allows cyclists to actuate the traffic signal from the bicycle lane with a detector that is calibrated to recognize a bicycle. Pavement markings could be added to show cyclists where to stand to actuate a signal. Bicycle detection is typically applied at signalized intersections that accommodate bicycles and can be used at all of the signalized intersection to improve bicycle crossing conditions.

Other Considerations

Bicycle Parking

Bicycle parking facilities provide safe and secure places for people to park their bicycles. The most common bicycle parking facility is the "staple", which provides space for up to two bicycles and is typically located along the side of the road in a commercial area or near the main entrance to a building. Bicycle parking could be applied along streets located adjacent to commercial properties.

Wayfinding Signs

Wayfinding signs are signs located along roadways or at intersections that direct bicyclists towards destinations in the area and/or to define a bicycle route. They typically include distances and average walk/cycle times. Wayfinding signs are generally used on primary bicycle routes and multiuse paths.

Attachment B Motor Vehicle Improvements Worksheets

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	65	680	175	62	61	448	1677	237	53	2176	12
Future Volume (vph)	6	65	680	175	62	61	448	1677	237	53	2176	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.8	4.8	4.0	4.8	
Lane Util. Factor		1.00	0.88		1.00	1.00	0.97	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	0.98	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		0.99	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1892	2760		1739	1565	3467	3505	1511	1770	3502	
Flt Permitted		0.97	1.00		0.73	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1850	2760		1320	1565	3467	3505	1511	1770	3502	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	6	68	716	184	65	64	472	1765	249	56	2291	13
RTOR Reduction (vph)	0	0	34	0	0	51	0	0	84	0	0	0
Lane Group Flow (vph)	0	74	682	0	249	13	472	1765	165	56	2304	0
Confl. Peds. (#/hr)	7		13	13		7	4		3	3		4
Confl. Bikes (#/hr)						1			2			
Heavy Vehicles (%)	0%	0%	3%	6%	0%	1%	1%	3%	4%	2%	3%	0%
Turn Type	Perm	NA	pt+ov	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases		4	4 5		8		5	2		1	6	
Permitted Phases	4			8		8			2			
Actuated Green, G (s)		24.7	43.5		24.7	24.7	14.8	75.0	75.0	7.5	67.7	
Effective Green, g (s)		24.7	43.5		24.7	24.7	14.8	75.0	75.0	7.5	67.7	
Actuated g/C Ratio		0.21	0.36		0.21	0.21	0.12	0.62	0.62	0.06	0.56	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.8	4.8	4.0	4.8	
Vehicle Extension (s)		2.5			2.5	2.5	2.3	4.7	4.7	2.3	4.7	
Lane Grp Cap (vph)		380	1000		271	322	427	2190	944	110	1975	
v/s Ratio Prot			0.25				c0.14	0.50		0.03	c0.66	
v/s Ratio Perm		0.04			c0.19	0.01			0.11			
v/c Ratio		0.19	0.68		0.92	0.04	1.11	0.81	0.18	0.51	1.17	
Uniform Delay, d1		39.4	32.4		46.7	38.2	52.6	17.0	9.5	54.5	26.1	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.10	0.75	
Incremental Delay, d2		0.2	1.8		33.5	0.0	75.3	3.3	0.4	0.9	77.6	
Delay (s)		39.6	34.2		80.2	38.2	127.9	20.3	9.9	60.8	97.3	
Level of Service		D	C		F	D	F	C	A	E	F	
Approach Delay (s)		34.7			71.6			39.7			96.4	
Approach LOS		C			E			D			F	

Intersection Summary			
HCM 2000 Control Delay	63.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	113.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	175	62	61	448	1677	237	53	2856	12
Future Volume (vph)	0	0	0	175	62	61	448	1677	237	53	2856	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.8	4.8	4.0	4.8	
Lane Util. Factor					1.00	1.00	0.97	0.95	1.00	1.00	0.91	
Frpb, ped/bikes					1.00	0.98	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes					1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt					1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected					0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)					1755	1564	3467	3505	1511	1770	5033	
Flt Permitted					0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)					1755	1564	3467	3505	1511	1770	5033	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	184	65	64	472	1765	249	56	3006	13
RTOR Reduction (vph)	0	0	0	0	0	53	0	0	77	0	0	0
Lane Group Flow (vph)	0	0	0	0	249	11	472	1765	172	56	3019	0
Confl. Peds. (#/hr)	7		13	13		7	4		3	3		4
Confl. Bikes (#/hr)						1			2			
Heavy Vehicles (%)	0%	0%	3%	6%	0%	1%	1%	3%	4%	2%	3%	0%
Turn Type				Split	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases				8	8		5	2		1	6	
Permitted Phases						8			2			
Actuated Green, G (s)					21.1	21.1	14.8	78.6	78.6	7.5	71.3	
Effective Green, g (s)					21.1	21.1	14.8	78.6	78.6	7.5	71.3	
Actuated g/C Ratio					0.18	0.18	0.12	0.65	0.65	0.06	0.59	
Clearance Time (s)					4.0	4.0	4.0	4.8	4.8	4.0	4.8	
Vehicle Extension (s)					2.5	2.5	2.3	4.7	4.7	2.3	4.7	
Lane Grp Cap (vph)					308	275	427	2295	989	110	2990	
v/s Ratio Prot					c0.14		c0.14	0.50		0.03	c0.60	
v/s Ratio Perm						0.01			0.11			
v/c Ratio					0.81	0.04	1.11	0.77	0.17	0.51	1.01	
Uniform Delay, d1					47.5	41.1	52.6	14.4	8.1	54.5	24.4	
Progression Factor					1.00	1.00	1.00	1.00	1.00	1.05	0.81	
Incremental Delay, d2					14.0	0.0	75.3	2.5	0.4	0.2	7.6	
Delay (s)					61.5	41.1	127.9	16.9	8.4	57.6	27.2	
Level of Service					E	D	F	B	A	E	C	
Approach Delay (s)		0.0			57.3			37.2			27.7	
Approach LOS		A			E			D			C	

Intersection Summary			
HCM 2000 Control Delay	33.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	99.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	175	61	2125	237	53	2856
Future Volume (vph)	175	61	2125	237	53	2856
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.8	4.8	4.0	4.8
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1703	1599	3505	1511	1770	3505
Flt Permitted	0.95	1.00	1.00	1.00	0.04	1.00
Satd. Flow (perm)	1703	1599	3505	1511	81	3505
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	184	64	2237	249	56	3006
RTOR Reduction (vph)	0	56	0	67	0	0
Lane Group Flow (vph)	184	8	2237	182	56	3006
Confl. Peds. (#/hr)	13	7		3	3	
Confl. Bikes (#/hr)		1		2		
Heavy Vehicles (%)	6%	1%	3%	4%	2%	3%
Turn Type	Prot	Prot	NA	Perm	pm+pt	NA
Protected Phases	3	3	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	15.0	15.0	87.7	87.7	95.7	95.7
Effective Green, g (s)	15.0	15.0	87.7	87.7	95.7	95.7
Actuated g/C Ratio	0.12	0.12	0.73	0.73	0.80	0.80
Clearance Time (s)	4.5	4.5	4.8	4.8	4.0	4.8
Vehicle Extension (s)	3.0	3.0	4.7	4.7	2.3	4.7
Lane Grp Cap (vph)	212	199	2561	1104	120	2795
v/s Ratio Prot	c0.11	0.01	0.64		0.02	c0.86
v/s Ratio Perm				0.12	0.35	
v/c Ratio	0.87	0.04	0.87	0.16	0.47	1.08
Uniform Delay, d1	51.5	46.2	12.0	4.9	22.4	12.1
Progression Factor	1.00	1.00	1.00	1.00	1.08	2.01
Incremental Delay, d2	29.1	0.1	4.5	0.3	0.2	34.8
Delay (s)	80.6	46.3	16.5	5.3	24.2	59.2
Level of Service	F	D	B	A	C	E
Approach Delay (s)	71.7		15.4			58.6
Approach LOS	E		B			E

Intersection Summary			
HCM 2000 Control Delay	40.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.3
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	206	81	76	47	52	199	47	1577	56	114	1867	185
Future Volume (vph)	206	81	76	47	52	199	47	1577	56	114	1867	185
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.8	4.8	4.0	4.8	4.8
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.98		1.00	0.98	1.00	1.00	0.95	1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1810	1528		1809	1573	1736	3505	1525	1805	3505	1548
Flt Permitted		0.65	1.00		0.28	1.00	0.05	1.00	1.00	0.07	1.00	1.00
Satd. Flow (perm)		1215	1528		510	1573	94	3505	1525	140	3505	1548
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	219	86	81	50	55	212	50	1678	60	121	1986	197
RTOR Reduction (vph)	0	0	44	0	0	172	0	0	16	0	0	33
Lane Group Flow (vph)	0	305	37	0	105	40	50	1678	44	121	1986	164
Confl. Peds. (#/hr)	3		4	4		3	4		8	8		4
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	4%	4%	3%	2%	1%	4%	3%	1%	0%	3%	1%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)		21.0	21.0		21.0	21.0	82.3	77.5	77.5	90.1	81.4	81.4
Effective Green, g (s)		21.0	21.0		21.0	21.0	82.3	77.5	77.5	90.1	81.4	81.4
Actuated g/C Ratio		0.18	0.18		0.18	0.18	0.69	0.65	0.65	0.75	0.68	0.68
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.8	4.8	4.0	4.8	4.8
Vehicle Extension (s)		2.5	2.5		2.5	2.5	2.3	4.7	4.7	2.3	4.7	4.7
Lane Grp Cap (vph)		212	267		89	275	130	2263	984	225	2377	1050
v/s Ratio Prot							0.02	0.48		c0.04	c0.57	
v/s Ratio Perm		c0.25	0.02		0.21	0.03	0.25		0.03	0.36		0.11
v/c Ratio		1.44	0.14		1.18	0.15	0.38	0.74	0.04	0.54	0.84	0.16
Uniform Delay, d1		49.5	41.9		49.5	41.9	16.9	14.4	7.8	15.9	14.3	6.9
Progression Factor		1.00	1.00		1.00	1.00	1.73	0.68	1.49	1.00	1.00	1.00
Incremental Delay, d2		222.1	0.2		151.7	0.2	0.8	1.6	0.1	1.6	3.7	0.3
Delay (s)		271.6	42.0		201.2	42.1	29.9	11.4	11.6	17.6	18.0	7.3
Level of Service		F	D		F	D	C	B	B	B	B	A
Approach Delay (s)		223.5			94.8			12.0			17.1	
Approach LOS		F			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	36.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	89.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	206	81	76	47	52	199	47	1577	56	114	1867	185
Future Volume (vph)	206	81	76	47	52	199	47	1577	56	114	1867	185
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0	4.0	4.8	4.8	4.0	4.8	4.8
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99			1.00	0.98	1.00	1.00	0.95	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.93			1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00			0.98	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1800	1681			1809	1573	1736	3505	1525	1805	3505	1548
Flt Permitted	0.62	1.00			0.66	1.00	0.05	1.00	1.00	0.07	1.00	1.00
Satd. Flow (perm)	1174	1681			1218	1573	94	3505	1525	140	3505	1548
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	219	86	81	50	55	212	50	1678	60	121	1986	197
RTOR Reduction (vph)	0	28	0	0	0	172	0	0	16	0	0	33
Lane Group Flow (vph)	219	139	0	0	105	40	50	1678	44	121	1986	164
Confl. Peds. (#/hr)	3		4	4		3	4		8	8		4
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	4%	4%	3%	2%	1%	4%	3%	1%	0%	3%	1%
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	21.0	21.0			21.0	21.0	82.3	77.5	77.5	90.1	81.4	81.4
Effective Green, g (s)	21.0	21.0			21.0	21.0	82.3	77.5	77.5	90.1	81.4	81.4
Actuated g/C Ratio	0.18	0.18			0.18	0.18	0.69	0.65	0.65	0.75	0.68	0.68
Clearance Time (s)	4.0	4.0			4.0	4.0	4.0	4.8	4.8	4.0	4.8	4.8
Vehicle Extension (s)	2.5	2.5			2.5	2.5	2.3	4.7	4.7	2.3	4.7	4.7
Lane Grp Cap (vph)	205	294			213	275	130	2263	984	225	2377	1050
v/s Ratio Prot		0.08					0.02	0.48		c0.04	c0.57	
v/s Ratio Perm	c0.19				0.09	0.03	0.25		0.03	0.36		0.11
v/c Ratio	1.07	0.47			0.49	0.15	0.38	0.74	0.04	0.54	0.84	0.16
Uniform Delay, d1	49.5	44.5			44.7	41.9	16.9	14.4	7.8	15.9	14.3	6.9
Progression Factor	1.00	1.00			1.00	1.00	1.73	0.68	1.49	1.00	1.00	1.00
Incremental Delay, d2	82.1	0.9			1.3	0.2	0.8	1.6	0.1	1.6	3.7	0.3
Delay (s)	131.6	45.4			46.0	42.1	29.9	11.4	11.6	17.6	18.0	7.3
Level of Service	F	D			D	D	C	B	B	B	B	A
Approach Delay (s)		94.3			43.4			12.0			17.1	
Approach LOS		F			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	23.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	90.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	547	655	768	649	0	0	0	0	16	4	321
Future Volume (vph)	0	547	655	768	649	0	0	0	0	16	4	321
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5						5.5	5.5
Lane Util. Factor		1.00	1.00	1.00	1.00						1.00	1.00
Frpb, ped/bikes		1.00	1.00	1.00	1.00						1.00	1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00						1.00	1.00
Frt		1.00	0.85	1.00	1.00						1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00						0.96	1.00
Satd. Flow (prot)		1827	1568	1687	1863						1730	1599
Flt Permitted		1.00	1.00	0.20	1.00						0.96	1.00
Satd. Flow (perm)		1827	1568	348	1863						1730	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	0	564	675	792	669	0	0	0	0	16	4	331
RTOR Reduction (vph)	0	0	220	0	0	0	0	0	0	0	0	302
Lane Group Flow (vph)	0	564	455	792	669	0	0	0	0	0	20	29
Confl. Peds. (#/hr)							2					2
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	4%	3%	7%	2%	0%	0%	0%	0%	7%	0%	1%
Turn Type		NA	Perm	pm+pt	NA					Split	NA	Prot
Protected Phases		2		1	6					4	4	4
Permitted Phases			2	6								
Actuated Green, G (s)		60.0	60.0	127.0	127.0						13.0	13.0
Effective Green, g (s)		60.0	60.0	127.0	127.0						13.0	13.0
Actuated g/C Ratio		0.40	0.40	0.85	0.85						0.09	0.09
Clearance Time (s)		4.5	4.5	4.5	4.5						5.5	5.5
Vehicle Extension (s)		4.2	4.2	2.3	0.2						6.0	6.0
Lane Grp Cap (vph)		730	627	852	1577						149	138
v/s Ratio Prot		0.31		c0.39	0.36						0.01	c0.02
v/s Ratio Perm			0.29	c0.40								
v/c Ratio		0.77	0.73	0.93	0.42						0.13	0.21
Uniform Delay, d1		39.1	38.1	27.8	2.8						63.3	63.7
Progression Factor		1.00	1.00	1.07	1.03						1.00	1.00
Incremental Delay, d2		7.8	7.2	8.7	0.4						1.2	2.1
Delay (s)		46.9	45.3	38.5	3.2						64.5	65.8
Level of Service		D	D	D	A						E	E
Approach Delay (s)		46.0			22.3			0.0			65.7	
Approach LOS		D			C			A			E	

Intersection Summary			
HCM 2000 Control Delay	36.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	14.5
Intersection Capacity Utilization	101.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	547	655	768	649	0	0	0	0	16	4	321
Future Volume (vph)	0	547	655	768	649	0	0	0	0	16	4	321
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5						5.5	5.5
Lane Util. Factor		1.00	1.00	0.97	1.00						1.00	1.00
Frpb, ped/bikes		1.00	1.00	1.00	1.00						1.00	1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00						1.00	1.00
Frt		1.00	0.85	1.00	1.00						1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00						0.96	1.00
Satd. Flow (prot)		1827	1568	3273	1863						1730	1599
Flt Permitted		1.00	1.00	0.95	1.00						0.96	1.00
Satd. Flow (perm)		1827	1568	3273	1863						1730	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	0	564	675	792	669	0	0	0	0	16	4	331
RTOR Reduction (vph)	0	0	187	0	0	0	0	0	0	0	0	293
Lane Group Flow (vph)	0	564	488	792	669	0	0	0	0	0	20	38
Confl. Peds. (#/hr)							2					2
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	4%	3%	7%	2%	0%	0%	0%	0%	7%	0%	1%
Turn Type		NA	Perm	Prot	NA					Split	NA	Prot
Protected Phases		2		1	6					4	4	4
Permitted Phases			2									
Actuated Green, G (s)		25.5	25.5	26.5	56.5						8.5	8.5
Effective Green, g (s)		25.5	25.5	26.5	56.5						8.5	8.5
Actuated g/C Ratio		0.34	0.34	0.35	0.75						0.11	0.11
Clearance Time (s)		4.5	4.5	4.5	4.5						5.5	5.5
Vehicle Extension (s)		4.2	4.2	2.3	0.2						6.0	6.0
Lane Grp Cap (vph)		621	533	1156	1403						196	181
v/s Ratio Prot		0.31		c0.24	0.36						0.01	c0.02
v/s Ratio Perm			c0.31									
v/c Ratio		0.91	0.92	0.69	0.48						0.10	0.21
Uniform Delay, d1		23.6	23.7	20.7	3.6						29.8	30.2
Progression Factor		1.00	1.00	1.07	0.75						1.00	1.00
Incremental Delay, d2		19.5	22.9	1.2	0.9						0.6	1.6
Delay (s)		43.1	46.6	23.4	3.6						30.5	31.8
Level of Service		D	D	C	A						C	C
Approach Delay (s)		45.0			14.3			0.0			31.7	
Approach LOS		D			B			A			C	

Intersection Summary			
HCM 2000 Control Delay	28.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.5
Intersection Capacity Utilization	80.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	547	655	0	649	768	0	0	0	16	4	321
Future Volume (vph)	0	547	655	0	649	768	0	0	0	16	4	321
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.5	4.0					5.5	5.5
Lane Util. Factor		1.00	1.00		1.00	1.00					1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	0.98					1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00	1.00					1.00	1.00
Frt		1.00	0.85		1.00	0.85					1.00	0.85
Flt Protected		1.00	1.00		1.00	1.00					0.96	1.00
Satd. Flow (prot)		1827	1568		1863	1582					1730	1599
Flt Permitted		1.00	1.00		1.00	1.00					0.96	1.00
Satd. Flow (perm)		1827	1568		1863	1582					1730	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	0	564	675	0	669	792	0	0	0	16	4	331
RTOR Reduction (vph)	0	0	167	0	0	0	0	0	0	0	0	293
Lane Group Flow (vph)	0	564	509	0	669	792	0	0	0	0	20	38
Confl. Peds. (#/hr)							2					2
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	4%	3%	7%	2%	0%	0%	0%	0%	7%	0%	1%
Turn Type		NA	Perm		NA	Free				Split	NA	Prot
Protected Phases		2			6					4	4	4
Permitted Phases			2			Free						
Actuated Green, G (s)		56.5	56.5		56.5	75.0					8.5	8.5
Effective Green, g (s)		56.5	56.5		56.5	75.0					8.5	8.5
Actuated g/C Ratio		0.75	0.75		0.75	1.00					0.11	0.11
Clearance Time (s)		4.5	4.5		4.5						5.5	5.5
Vehicle Extension (s)		4.2	4.2		0.2						6.0	6.0
Lane Grp Cap (vph)		1376	1181		1403	1582					196	181
v/s Ratio Prot		0.31			0.36						0.01	0.02
v/s Ratio Perm			0.32			c0.50						
v/c Ratio		0.41	0.43		0.48	0.50					0.10	0.21
Uniform Delay, d1		3.3	3.4		3.6	0.0					29.8	30.2
Progression Factor		1.00	1.00		1.70	1.00					1.00	1.00
Incremental Delay, d2		0.9	1.1		0.4	0.4					0.6	1.6
Delay (s)		4.2	4.5		6.4	0.4					30.5	31.8
Level of Service		A	A		A	A					C	C
Approach Delay (s)		4.4			3.2			0.0			31.7	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM 2000 Control Delay	6.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Intersection 7: I-205 Southbound Ramp Terminal/SE 82nd Drive	Approach															
Parameter	EB (West Leg): 82nd Dr				WB (East Leg): 82nd Dr				NB (South Leg): I-205 SB Ramps				SB (North Leg): I-205 SB Ramps			
INPUTS																
Lane Configuration																
Entry Lane(s) Configuration	LT, R				L, TR				LTR				LT, R			
(Note: This assumes 4 legs.)	Case:	2			Case:	3			Case:	1			Case:	2		
RT bypass configuration			Add Lane				None				None				Add Lane	
(Note: This is in addition to the entry lane(s))			Case:	3			Case:	1			Case:	1			Case:	3
Number of conflicting circ lanes	1	1			1	1				1			2	2		
Number of conflicting exit lanes for bypass lane (if used)																
Vehicular Volumes	U (v1U)	L (v1)	T (v2)	R (v3)	U (v4U)	L (v4)	T (v5)	R (v6)	U (v7U)	L (v7)	T (v8)	R (v9)	U (v10U)	L (v10)	T (v11)	R (v12)
Flow (veh/h)		0	547	655		768	649	0		0	0	0		16	4	321
% HV		0	4	3		7	2	0		0	0	0		7	0	1
PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Pedestrian Volumes (crossing leg)																
n_p	0				0				0				2			
Constants																
Time period, T (h)	0.25															
PCE for HV	2															
Default Values																
Lane volume assignment																
Case 4: LT, TR (bias to right lane)																
% Volume in left lane, right lane	0.47	0.53			0.47	0.53			0.47	0.53			0.47	0.53		
Case 5: L, LTR (bias to left lane)																
% volume in left lane, right lane	0.53	0.47			0.53	0.47			0.53	0.47			0.53	0.47		
Case 6: LTR, R (bias to right lane)																
% volume in left lane, right lane	0.47	0.53			0.47	0.53			0.47	0.53			0.47	0.53		
Capacity models																
Case 1: 1 confl lane																
Calibration parameters																
A (intercept)	1130	1130			1130	1130			1130	1130			1130	1130		
B (coefficient)	0.001	0.001			0.001	0.001			0.001	0.001			0.001	0.001		
Case 2: 2 confl lanes																
Calibration parameters																
A (intercept)	1130	1130			1130	1130			1130	1130			1130	1130		
B (coefficient)	0.00075	0.0007			0.00075	0.0007			0.00075	0.0007			0.00075	0.0007		
RT bypass, 1 confl lane (assumed same as Case 1 above)																
Calibration parameters																
A (intercept)	1130				1130				1130				1130			
B (coefficient)	0.001				0.001				0.001				0.001			
RT bypass, 2 confl lanes (assumed right lane, Case 2 above)																
Calibration parameters																
A (intercept)	1130				1130				1130				1130			
B (coefficient)	0.0007				0.0007				0.0007				0.0007			
SUMMARY																
Entry lane volume (veh/h)	567	0	675		809	651	N/A		N/A	0	N/A		21	0	331	
Entry lane capacity (veh/h)	458	458	N/A		1079	1079	N/A		N/A	618	N/A		355	382	N/A	
x (v/c ratio)	1.24	0.00	N/A		0.75	0.60	N/A		N/A	0.00	N/A		0.06	0.00	N/A	
Lane control delay (s/veh)	151.7	7.9	0.0		16.3	11.3	N/A		N/A	5.8	N/A		11.1	9.4	0.0	
Lane LOS	F	A	N/A		C	B	N/A		N/A	A	N/A		B	A	N/A	
Approach control delay (s/veh)	69.3				14.1				0.0				0.7			
Approach LOS	F				B				N/A				A			
Intersection control delay (s/veh)	35.0															
Intersection LOS	D															
95th percentile queue (veh)	22.9	0.0	N/A		7.4	4.2	N/A		N/A	0.0	N/A		0.2	0.0	N/A	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	347	247	15	1038	404	682
Future Volume (vph)	347	247	15	1038	404	682
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1810	1568	1805	1845	1752	1482
Flt Permitted	1.00	1.00	0.50	1.00	0.95	1.00
Satd. Flow (perm)	1810	1568	951	1845	1752	1482
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	365	260	16	1093	425	718
RTOR Reduction (vph)	0	48	0	0	0	391
Lane Group Flow (vph)	365	212	16	1093	425	327
Heavy Vehicles (%)	5%	3%	0%	3%	3%	9%
Turn Type	NA	Perm	Perm	NA	Prot	Prot
Protected Phases	2			6	8	8
Permitted Phases		2	6			
Actuated Green, G (s)	100.8	100.8	100.8	100.8	39.2	39.2
Effective Green, g (s)	100.8	100.8	100.8	100.8	39.2	39.2
Actuated g/C Ratio	0.67	0.67	0.67	0.67	0.26	0.26
Clearance Time (s)	4.5	4.5	4.5	4.5	5.5	5.5
Vehicle Extension (s)	0.2	0.2	4.2	4.2	2.3	2.3
Lane Grp Cap (vph)	1216	1053	639	1239	457	387
v/s Ratio Prot	0.20			c0.59	c0.24	0.22
v/s Ratio Perm		0.14	0.02			
v/c Ratio	0.30	0.20	0.03	0.88	0.93	0.84
Uniform Delay, d1	10.1	9.3	8.2	19.8	54.1	52.5
Progression Factor	0.07	0.01	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.3	0.1	9.3	25.2	15.0
Delay (s)	1.1	0.4	8.3	29.1	79.2	67.5
Level of Service	A	A	A	C	E	E
Approach Delay (s)	0.8			28.8	71.9	
Approach LOS	A			C	E	

Intersection Summary			
HCM 2000 Control Delay	39.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	347	247	15	1038	404	682
Future Volume (vph)	347	247	15	1038	404	682
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.0	4.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1810	1568	1805	3505	1752	1482
Flt Permitted	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	1810	1568	1805	3505	1752	1482
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	365	260	16	1093	425	718
RTOR Reduction (vph)	0	76	0	0	0	349
Lane Group Flow (vph)	365	184	16	1093	425	369
Heavy Vehicles (%)	5%	3%	0%	3%	3%	9%
Turn Type	NA	Perm	Prot	NA	Prot	Prot
Protected Phases	2		1	6	8	8
Permitted Phases		2				
Actuated Green, G (s)	37.3	37.3	1.4	42.7	22.3	22.3
Effective Green, g (s)	37.3	37.3	1.4	42.7	22.3	22.3
Actuated g/C Ratio	0.50	0.50	0.02	0.57	0.30	0.30
Clearance Time (s)	4.5	4.5	4.0	4.5	5.5	5.5
Vehicle Extension (s)	0.2	0.2	2.3	4.2	2.3	2.3
Lane Grp Cap (vph)	900	779	33	1995	520	440
v/s Ratio Prot	0.20		0.01	c0.31	0.24	c0.25
v/s Ratio Perm		0.12				
v/c Ratio	0.41	0.24	0.48	0.55	0.82	0.84
Uniform Delay, d1	11.9	10.7	36.4	10.1	24.5	24.7
Progression Factor	0.93	1.13	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.4	6.4	1.1	9.3	12.7
Delay (s)	11.8	12.5	42.8	11.2	33.8	37.4
Level of Service	B	B	D	B	C	D
Approach Delay (s)	12.1			11.7	36.0	
Approach LOS	B			B	D	

Intersection Summary			
HCM 2000 Control Delay	21.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Intersection 8: I-205 Northbound Ramp Terminal/SE 82nd Drive	Approach															
Parameter	EB (West Leg): 82nd Dr				WB (East Leg): 82nd Dr				NB (South Leg): I-205 NB Ramps				SB (North Leg): I-205 NB Ramps			
INPUTS																
Lane Configuration																
Entry Lane(s) Configuration	LTR				LT, TR				LT, R				LTR			
(Note: This assumes 4 legs.)	Case:	1			Case:	4			Case:	2			Case:	1		
RT bypass configuration			None				None				None				None	
(Note: This is in addition to the entry lane(s))			Case:	1			Case:	1			Case:	1			Case:	1
Number of conflicting circ lanes		1			1	1			1	1				2		
Number of conflicting exit lanes for bypass lane (if used)																
Vehicular Volumes	U (v1U)	L (v1)	T (v2)	R (v3)	U (v4U)	L (v4)	T (v5)	R (v6)	U (v7U)	L (v7)	T (v8)	R (v9)	U (v10U)	L (v10)	T (v11)	R (v12)
Flow (veh/h)		0	347	247		15	1038	1		404	0	682		0	0	0
% HV		0	5	3		0	3	0		3	0	9		0	0	0
PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Pedestrian Volumes (crossing leg)																
n_p	0				1				0				0			
Constants																
Time period, T (h)	0.25															
PCE for HV	2															
Default Values																
Lane volume assignment																
Case 4: LT, TR (bias to right lane)																
% Volume in left lane, right lane	0.47	0.53			0.47	0.53			0.47	0.53			0.47	0.53		
Case 5: L, LTR (bias to left lane)																
% volume in left lane, right lane	0.53	0.47			0.53	0.47			0.53	0.47			0.53	0.47		
Case 6: LTR, R (bias to right lane)																
% volume in left lane, right lane	0.47	0.53			0.47	0.53			0.47	0.53			0.47	0.53		
Capacity models																
Case 1: 1 confl lane																
Calibration parameters																
A (intercept)	1130	1130			1130	1130			1130	1130			1130	1130		
B (coefficient)	0.001	0.001			0.001	0.001			0.001	0.001			0.001	0.001		
Case 2: 2 confl lanes																
Calibration parameters																
A (intercept)	1130	1130			1130	1130			1130	1130			1130	1130		
B (coefficient)	0.00075	0.0007			0.00075	0.0007			0.00075	0.0007			0.00075	0.0007		
RT bypass, 1 confl lane (assumed same as Case 1 above)																
Calibration parameters																
A (intercept)	1130				1130				1130				1130			
B (coefficient)	0.001				0.001				0.001				0.001			
RT bypass, 2 confl lanes (assumed right lane, Case 2 above)																
Calibration parameters																
A (intercept)	1130				1130				1130				1130			
B (coefficient)	0.0007				0.0007				0.0007				0.0007			
SUMMARY																
Entry lane volume (veh/h)	N/A	627	N/A		526	594	N/A		430	768	N/A		N/A	0	N/A	
Entry lane capacity (veh/h)	N/A	1059	N/A		705	705	N/A		745	745	N/A		N/A	370	N/A	
x (v/c ratio)	N/A	0.59	N/A		0.75	0.84	N/A		0.58	1.03	N/A		N/A	0.00	N/A	
Lane control delay (s/veh)	N/A	11.2	N/A		22.3	30.4	N/A		14.1	64.8	N/A		N/A	9.7	N/A	
Lane LOS	N/A	B	N/A		C	D	N/A		B	F	N/A		N/A	A	N/A	
Approach control delay (s/veh)	11.2				26.6				46.6				0.0			
Approach LOS	B				D				E				N/A			
Intersection control delay (s/veh)	31.4															
Intersection LOS	D															
95th percentile queue (veh)	N/A	4.0	N/A		6.8	9.5	N/A		3.7	18.5	N/A		N/A	0.0	N/A	