

Concept of Operations

IMPROVING PEDESTRIAN SAFETY AT SE BURNSIDE X SE POWELL
VALLEY RD AND HIGHWAY 99E X SE HOLLY AVE

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Version I

Approval Date: May 31st, 2018

College of Engineering
School of Civil and Construction Engineering

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1. Overview

The first section of this report will discuss the organization of this report, and introduce the project. The dynamics of the site and problem will be identified, including the project requirements, scope, consideration of stakeholders, and lifecycle analyses. The second section of this report will introduce the proposed solution to the problem, dividing the solution into short-term and long-term components. An outline of the potential parties that will be required to carry out the solution will also be provided. Section three provides the concept of operations for the proposed solutions, including functional, physical, enterprise architecture, while the fourth section will outline the development and implementation of the solutions. Encompassed in the development and implementation is a cost breakdown and timeline of the proposed projects. Finally, the anticipated impacts and risks of implementing the proposed solutions will be discussed. Impacts and risks consider operational, safety, and mobility benefits, environmental benefits, and barriers to implementation from an equity perspective.

1.1 Introduction

Relative to other major urban areas in the United States, the Portland Metropolitan Area has a reputation for above average walkability and pedestrian facilities. However, problem areas still exist in the Portland Metropolitan Area with respect to pedestrian safety. This Concept of Operations aims to identify problem intersections, and apply Intelligent Transportation System (ITS) and Connected and Autonomous Vehicle (CAV) strategies to increase pedestrian safety.

1.2 Identification of Problem

To identify dangers that pedestrians face in the Portland Metropolitan Area, collision records from the Oregon Department of Transportation (ODOT) Geographic Information System (GIS) database were referenced. Collision records from the years 2010 through 2015 (6 years total) were reduced from all collisions in the state of Oregon down to collisions involving pedestrians in the Portland Metropolitan Area. The results of the data reduction can be seen in Figure 1.

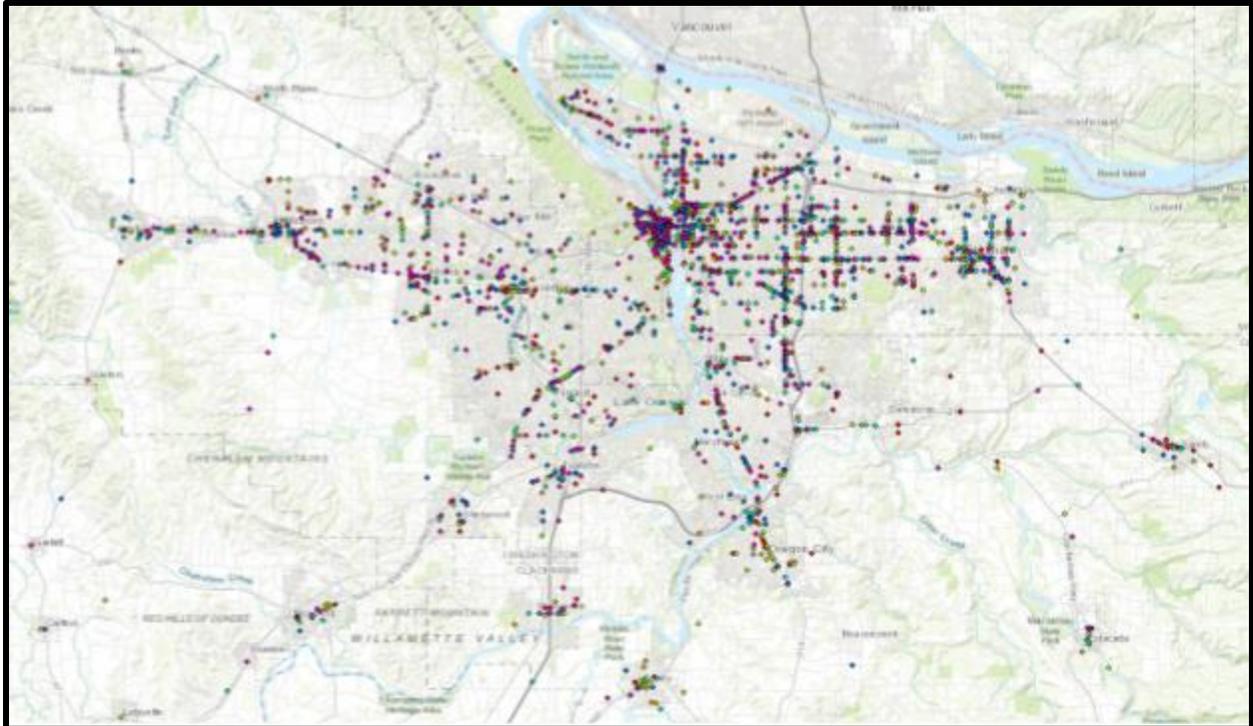


Figure 1: Collisions involving pedestrians in the Portland Metropolitan Area (different colors indicate the year of the collision between 2010 and 2015)

The reduced data output nearly 3,000 crash data points, which averages to nearly 500 collisions involving pedestrians per year between the years of 2010 to 2015. This is further evidence that there is room for improvement with respect to pedestrian safety in the Portland Metropolitan Area. The data was further reduced to include only crashes involving pedestrian fatalities, shown in Figure 2. The newly reduced dataset included 136 data points representing 138 pedestrian deaths (2 data points represented 2 pedestrian deaths each). Each death involved a motor vehicle, and averages to 23 pedestrian deaths per year between the years of 2010 and 2015. As Oregon attempts to achieve Vision Zero, it is clear that improvements in pedestrian safety will be a necessity.

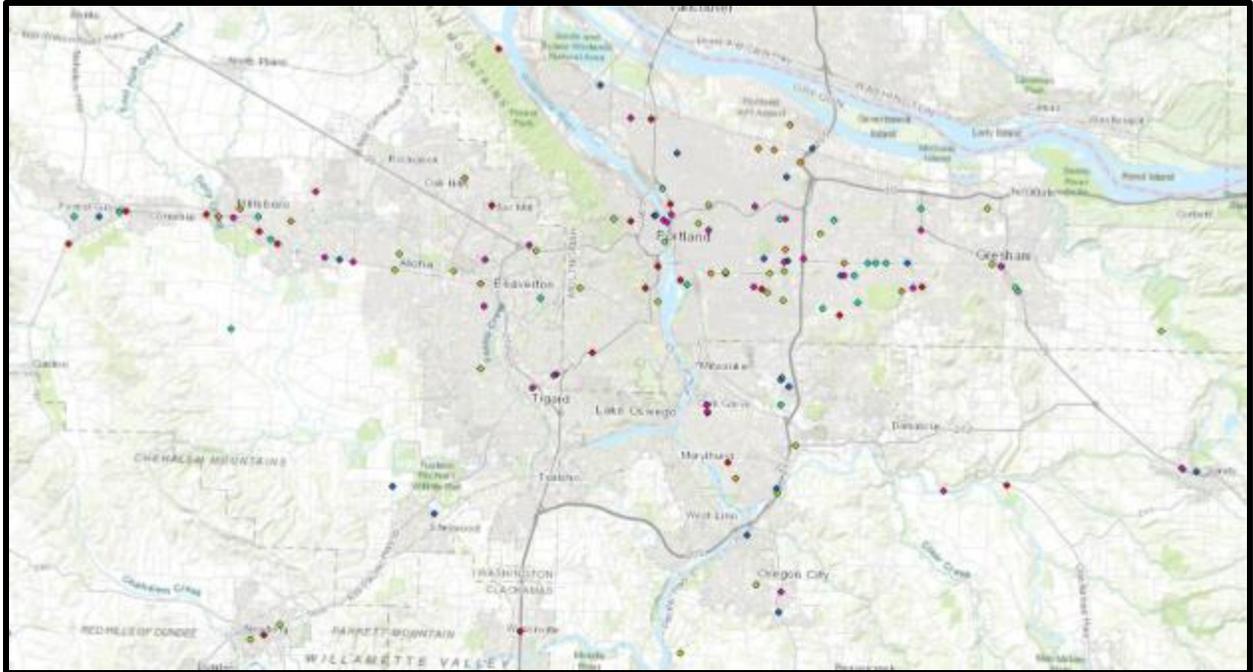


Figure 2: Collisions involving pedestrian fatalities in the Portland Metropolitan Area (different colors indicate the year of the collision between 2010 and 2015)

Two areas were identified along Portland arterials (NE Burnside, SE McLaughlin) as particularly dangerous for pedestrians. Each area experienced a number of pedestrian fatalities in the study period concentrated to a small area. The project team decided to focus the Concept of Operations on these locations for further study in order to identify the dangers pedestrians face that must be addressed. The identified arterials are shown in Figure 3.



Figure 3: (left) NE Burnside; (right) SE McLoughlin

To identify the factors that contributed to the collisions selected for this project, ODOT’s GIS attribute table data was utilized, which included details of the collision. Fatalities at each location occurred during the evening hours, and were a result of pedestrian jaywalking. Through virtual site visits, poor lighting in the areas where the collisions of interest occurred was also identified as a potential factor. Both intersections of interest also lacked pedestrian facilities, namely crosswalks and sidewalks. The arterials which these collisions occurred on are high volume and high speed (between 40 and 45 miles per hour), with two lanes in each direction of travel and one center turning lane. Both intersections are in mixed use areas (low density residential and commercial mixed use), and neighbor the more urban center of the City of Portland. Another important note is that the fatality at the NE Burnside location was a pedestrian in a motorized wheelchair, meaning our solution should consider Americans with Disabilities Act (ADA) code and requirements. Table 1 summarizes the factors identified in the collisions of interest.

Table 1: Factors in Collisions on NE Burnside and SE McLoughlin

Physical Environment	Pedestrian	Motor Vehicle
<ul style="list-style-type: none"> Poor lighting Evening Lack of Ped Facilities 	<ul style="list-style-type: none"> Jaywalking Disabled 	<ul style="list-style-type: none"> High speed High volume

1.3 Scope of Solution

The scope of the solution will be to address visibility issues (for both pedestrians and motor vehicles) and the underlying reasons which may cause pedestrians to jaywalk using ITS and CAV solutions. The solution will not prevent jaywalking because of the free nature of pedestrians, nor will the solution induce changes to the roadway's volume, capacity, or level of service.

1.4 Stakeholders

Stakeholders for these improvements include public users of the infrastructure, specifically pedestrians and users of motor vehicles in the areas surrounding the intersections of interest. State and city departments of transportation will also have stake, as well as business owners who rely on both motor vehicle and pedestrian traffic from the arterials of interest for business.

2. Solution

The solution is divided by implementation timelines: short-term and long-term.

2.1 Short-Term Solution

Adaptive signal timing and adaptive lighting should be implemented at these intersections. Signal timing should be calibrated for pedestrians, and could be triggered upstream by vehicles or downstream by pedestrians to give pedestrians an adequate and safe amount of time to cross the road. Construction of this facility could include:

- A crosswalk and/or pedestrian island
- Lighting triggered by incoming traffic
- Lighting on crosswalk triggered by pedestrian
- Adaptive signal timing devices triggered by pedestrian button at crosswalk

The construction of a crosswalk facility will give pedestrians clear points to cross busy corridors such as SE McLoughlin. These facilities must be strategically placed to provide maximum convenience for pedestrians, minimizing reason that they may enter the roadway illegally. Adaptive lighting solves the lighting and visibility problem stated above by giving approaching drivers ample visibility of critical areas in which pedestrians may be present. This is especially important at night, where a specific well-lit area may increase driver's visual attention to the area of potential conflict. Adaptive lighting protects pedestrians by giving pedestrians a specific safe time to cross when traffic is much less likely to be present. Much like at a classic signalized intersection, a crosswalk button could dictate the timing of a signal upstream to create a gap in traffic during which a pedestrian may safely cross the corridor.

2.2 Long-Term Solution

The long-term solution is a smartphone application that communicates with CAVs and ITS in the surrounding area, producing a dynamic and intelligent transportation network. The application may be sponsored by the city department of transportation, and contributes to an adaptive transportation network.

3. Concept of Operations

The Concept of Operations will be expressed from the viewpoint of the user of interest: the pedestrian.

3.1 Short-Term Solution

The pedestrian will approach the intersection of interest. Upon approaching the area of interest, adaptive lighting may turn on depending on the time of day. The pedestrian will trigger the adaptive timing, which will signal drivers upstream to stop. The pedestrian will be given a signal, which is appropriately timed, to cross.

3.2 Long-Term Solution

The pedestrian will approach the intersection of interest. Upon approaching the area of interest, CAVs surrounding the pedestrian will be notified of the pedestrian's proximity to the roadway. If the pedestrian chooses to cross the intersection, they will alert surrounding CAVs through the phone application. The transportation system will determine an optimal time to signal to the pedestrian when it is safe to cross.

4. Development and Implementation

The anticipated timeline of this project is one month. To implement the solutions discussed above, five main steps are proposed in the following order (each of these steps is relevant to both intersections of interest):

1. Surveying
2. Developing ITS and installation
3. Pedestrian island construction
4. Striping
5. Developing application

4.1 Surveying

To start the entire renovation in the area, a construction team will survey and develop a plan of locating pedestrian crossing sign, traffic signal devices, stripping geometry, and necessary pavement renovation.

4.2 Developing ITS and Installation

A smart crossing signal and button will be installed on each side of the road. A pedestrian can be confused whether they are seen by the drivers or the vehicles are slowing down at the intersection. Therefore, once the crossing button is pressed, the traffic device will detect the approaching vehicles and signal the pedestrians to cross until all the vehicles come to a complete stop. To help people with vision ability, a speaker will be installed with the crossing button. The device will not signal the vehicles to move until a single pedestrian left the crossing.

Adaptive LED lighting posts will be installed around the area so that the light will turn on when the crossing button is pressed. Using solar panel to charge the lighting could be an optional depending on the budget and source of electricity in the area.

The last installation is a pedestrian crossing sign about 30 feet away from the actual crossing location to warn the drivers. When the intelligent cars are widely used, they will detect the pedestrian warning sign.

4.3 Pedestrian Island Construction

About 10 to 15 feet of existing turning lanes starting from the intersection or pedestrian crossing will be placed with a small pedestrian island and an optional parklet in the middle of the road. Pedestrians with all kinds of movement ability, especially elderly and people on wheelchairs, could rest in the middle when the crossing is too long. The pedestrian island alone should not extend the full 10 or 15 feet but cars are better not allowed to turn at the crossing for safety reasons.

4.4 Striping

Striping could be accomplished when the traffic volume is the lowest throughout a day, typically at night.

4.5 Developing an Application

An application can be developed when everyday vehicles are driverless within 20 years or so. The application can be downloaded into the vehicle's intelligent system to receive the pedestrian information at the crossing and to signal the crossing device that the vehicle will slow down and stop so that the pedestrians can cross safely.

5. Anticipated Impacts and Risks

Adaptive signaling and eventually utilization of a smartphone application will aid in increasing the safety pedestrians. In areas with particularly low visibility and limited pedestrian infrastructure, human and autonomous drivers alike run the risk of not detecting a pedestrian or cyclist. By implementing

adaptive signaling first in areas with high pedestrian use and low lighting, there will be overall increased safety regardless of level of automation.

Increasing pedestrian safety can have broader societal implications associated with safer roads. One study reported that autonomous vehicles may help pedestrians and cyclists feel more confident on roads knowing that there is less potential human error (Alessandrini et al, 2015). Both adaptive signaling and smartphone applications will contribute to the overall effectiveness of autonomous vehicles and therefore the confidence of the pedestrians and cyclists. Confidence in safety of the technology can increase active transportation creating healthier communities and more livable cities.

The long term solution utilizing specific smartphone application can improve safety in areas that traditionally not beneficiaries of continuous infrastructure improvements implemented by local municipalities. Portland has recognized that McLoughlin Boulevard is an area of concern for pedestrian safety and has a history of being both a major roadway for vehicles and community corridors creating a complex safety dynamics (Beebe, 2016). The other corridor in highlighted in the report is located within Gresham, where approximately 20% of the population lives below the poverty line (US Census Bureau, 2016). Utilization of a smartphone application can be relatively affordable solution to assisting in improving safety in low income communities.

The inclusion of adaptive signaling and smartphone applications can improve mobility by improving traffic flow. Vehicles will be able to plan and respond to pedestrians on the roadway ahead of time allowing for increased safety but also more time to slow down and signal to other vehicles. This can help improve traffic flow and create more improved roadways in general.

There are several barriers to implementation of the long-term solution for a smartphone application signaling to AVs when a pedestrian is preparing to enter the roadway. A community based transportation needs survey completed in Portland showed that while many individuals have a smartphone there is a lack of access to data and reliable cell service due to high costs (Golub et al., 2018). A solution to this barrier is for the City of Portland to provide citywide WiFi that can be accessed by smartphones. Public WiFi can also aid in ensuring connectivity in vehicles and infrastructure.

Language barriers and lack of education are potential challenges to implementing smartphone applications. Respondents in the Portland community based assessment expressed the need to provide smartphone applications in range of languages to accommodate for non-English speakers (Golub et al., 2018). In Portland, approximately 19% of the populations speaks a language other English (ACS, 2016). The most common languages include Spanish, Vietnamese, Chinese, and Russian (City of Portland, 2012). As the population continues to grow in Portland, it will be important to accommodate the diverse range of languages used in the City in smartphone applications to account for the safety of non-English speakers. Certain populations, such as aging population and non-native English speakers, may also benefit from specific trainings on how to use the application. These populations are less familiar with technology or unable to understand the technology due to language barriers. Trainings would have to accessible by accommodating location and language needs.

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