

Bannock Transportation Planning Organization's

INNOVATIVE TRANSPORTATION SOLUTIONS PROJECT REPORT

FOR THE USDOT SMART GRANT

REPORT DATED JULY 2025

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Innovative Transportation Solution Project

Bannock Transportation Planning Organization

FY 2022

Implementation Report

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Prepared By

Mori Byington, Planning Director

Bannock Transportation Planning Organization

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Part 1 Project Description

When the Bannock Transportation Planning Organization (BTPO) submitted its first-ever US DOT grant application for the Innovative Transportation Solution Project, the metropolitan planning organization sought to identify an approach that would improve vehicle and pedestrian detection, increase the data that feeds the existing Automated Traffic Signal Performance Measures (ATSPM) allowing for enhanced signal operations during both coordinated and uncoordinated traffic conditions. Detection of vehicles beyond the stop bar, detection of pedestrians in the crosswalk or on the curb, obtaining real-time and historical travel time information, and the limited data availability to support the existing ATSPM are four challenges addressed in the project, which will be addressed with at-scale implementation.

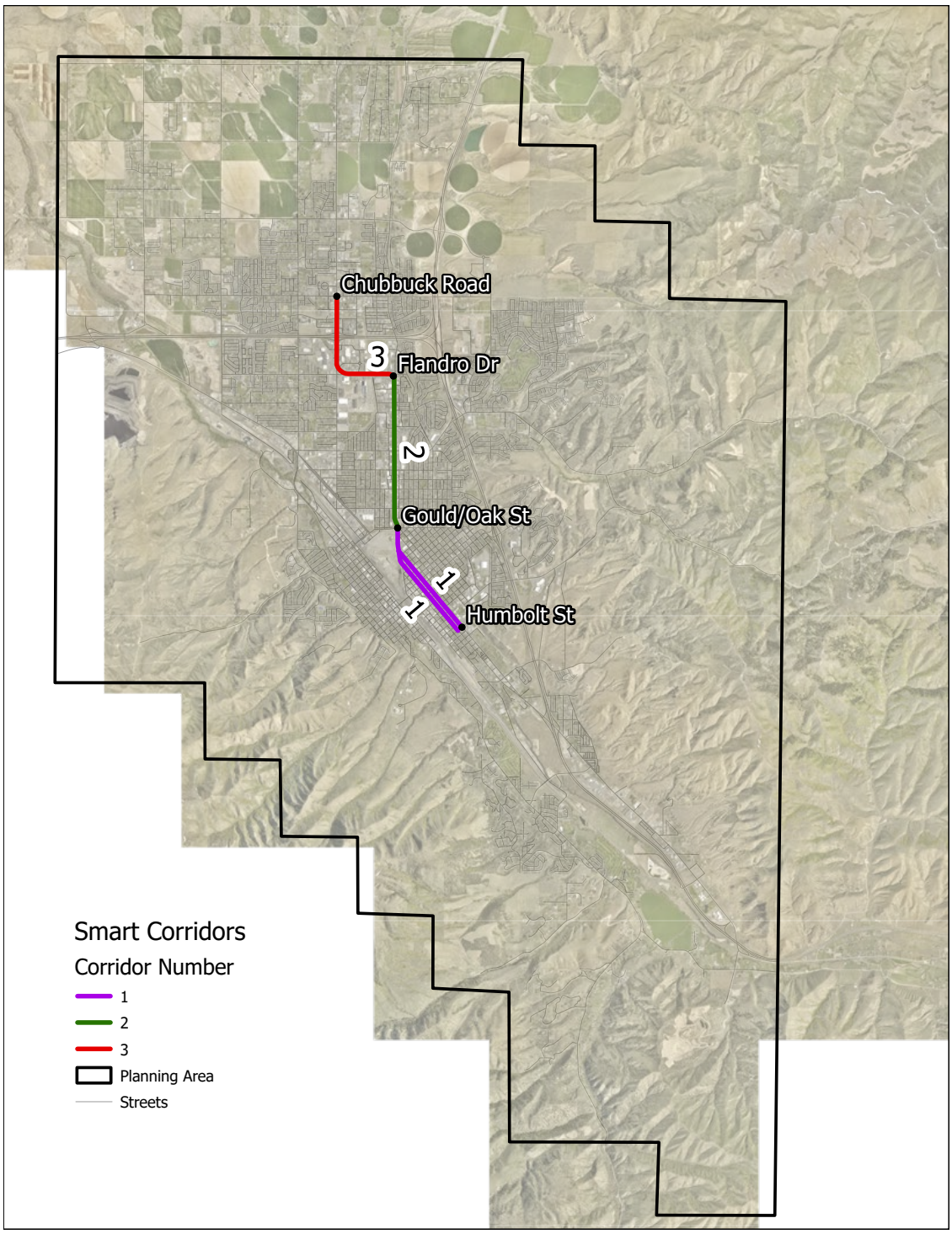
The real-world problems addressed by the Stage One grant include improved signal timing, enhancements to pedestrian crossings, and increased truck flow during free-flow operations. Maintaining and improving signal timing requires extensive data collection or the purchase of large data sources. Installing advanced detection beyond the stop bar will enable BTPO and our partners to have the data necessary to identify issues with traffic progression and adjust timing plans more efficiently and cost-effectively. The project installed sensors that provide inputs to the traffic controller, which the ATSPM can track. Expanding the performance measures information available on the ATSPM allows for increased data to be used in monitoring and adjusting the coordinated traffic plans on an ongoing basis.

Before the project, the region lacked passive pedestrian detection, necessitating manual review of cameras or on-site inspections to assess pedestrian activity. There have been several pedestrian crashes in the region and along the corridor. Passively detecting pedestrians and determining their speed and trajectory can provide all the necessary inputs into the controller, which can extend walk time or trigger a full red phase to prevent vehicles from entering the intersection when a pedestrian is present. With these corridors running centrally throughout the region and serving as the primary economic hubs, the lack of pedestrian comfort at intersections promotes reliance on vehicular travel, which further congests the corridor and forces low-income families to spend a greater portion of their expendable income on transportation instead of household savings, healthcare, or education. As the project progressed, it became impossible to track pedestrian trajectories. The change was made to detect the presence in the crosswalk detection zone and use that as input to the controller to extend the associated green phase when a pedestrian is detected, up to its maximum green time.

During free operations, the flow of High Profile Vehicles (HPV) (trucks) can be impacted and cause them to brake hard or experience stop-and-go conditions along the corridor, resulting in unsafe conditions for the freight driver and those around them, unreliable freight transportation, and increased emissions (the region is currently in maintenance of EPA non-attainment for air quality). Identifying the truck and determining its speed and expected arrival time can be used by the controller to extend the green time at the signal, thereby reducing travel delay and hard braking.

The Pocatello Urbanized Area, which includes the cities of Pocatello and Chubbuck, is the geographic area the project serves (Figure 1).

Figure 1: BTPO Planning Area and Phase 1 Corridors



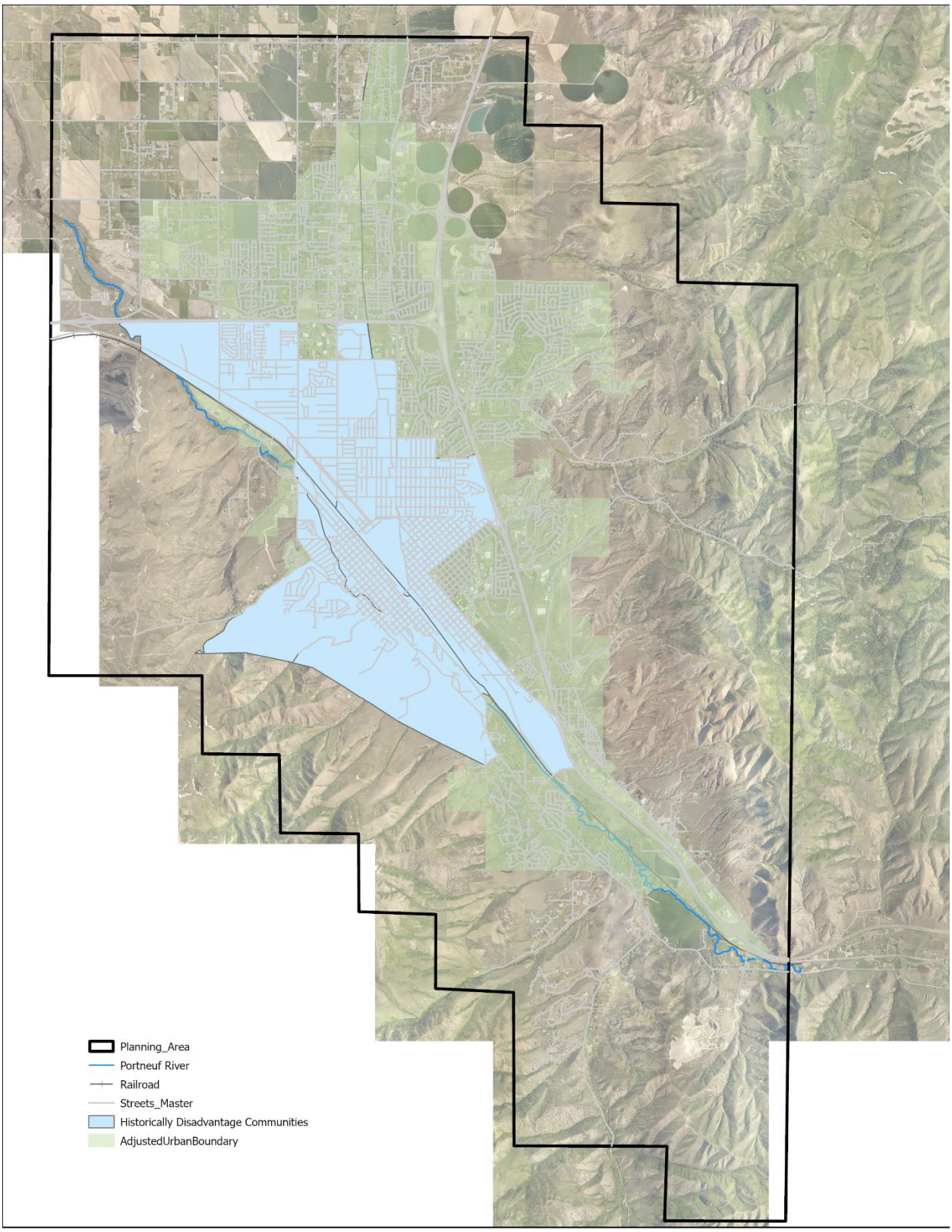
This smart technology traffic signal program project included both camera and radar technology. For areas with low pedestrian traffic and where reducing vehicle delays is crucial, advanced radar units from Wavetronix were utilized (Wavetronix Advanced 200-E Extended Range Smart Sensor). Three camera technologies and the Wavetronix Advanced 200-E Extended Range Smart Sensor were installed in locations with higher pedestrian traffic or disadvantaged communities. The camera systems evaluated included DERQ Edge (four intersections), GRIDSMART GS3 processor (two intersections), and SmartCity ITS Currux Vision system (four intersections). Additionally, every location includes Iteris Bluetooth travel time sensors to monitor the vehicle travel time, including six new travel time sensors.

The desired outcomes for at-scale development include system-wide improvements in reliability, reduced vehicle delays, increased pedestrian detection, and strengthened partnerships among the BTPO, its member agencies, and community stakeholders. At-scale development will enhance reliability by enabling the traffic control center to respond to changes in traffic patterns, thereby improving travel time in both coordinated and uncoordinated operations through the use of measures from the ATSPMs interface. The change will enable minor adjustments to occur between the existing three-year signal timing plan updates. The ability to decrease travel time and reduce delays will reduce vehicle emissions. Access is improved in pedestrian corridors by enhancing detection reliability and improving crossing safety.

Community Impact by At-Scale Implementation

The communities of Pocatello and Chubbuck within the BTPO boundary would be impacted by at-scale implementation; together as the Pocatello Metropolitan Statistical Area, the region has a population of 94,010 (2024 estimate). Approximately one-half of the at-scale project locations are within Historically Disadvantaged Communities Census Tracts (Figure 2). The at-scale implementation will connect the Historically Disadvantaged Communities in Historic Downtown Pocatello to the Stage 1 project location. The Pocatello-Chubbuck community will benefit from reduced travel time. Historically Disadvantaged Communities in the tracts around Yellowstone Avenue also experience reduced travel costs associated with traffic delays. In Historic Downtown Pocatello's Historically Disadvantaged Communities, Census Tracts, and near the Idaho State University campus area, vehicle detection improvements reduce delays and decrease travel times when driving. Improved detection of pedestrians in the crosswalk can improve safety at signalized intersection crossings.

Figure 2 Historically Disadvantaged Communities with Service Area



Scale of Stage 1 Development and At-Scale Implementation

The region's highest-volume corridor was selected for the Stage 1 implementation project. The corridor represented an ideal location to test solutions to our challenge of vehicle detection beyond the stop bar and pedestrian detection. The corridor was divided into three sections based on the type of technology used. The southern section of the corridor included the 4th/5th Avenue couplet. The corridor extends from East Humbolt Street to Oak Street. The southern section focused on utilizing advanced camera technology for stop bar and pedestrian detection, as well as radar for extending vehicle detection beyond the stop bar. The middle section, from Oak Street to Flandro Drive, focuses on radar technology for the stop bar and advanced detection. The north section between Pole Line Road and Chubbuck Road represented a location with tightly spaced intersections and a Diverging Diamond Intersection in a heavily commercial retail area. This section utilized advanced camera technology at two locations with high pedestrian volumes, and radar was deployed at other intersections. Velocity Bluetooth sensors were installed at six locations that previously lacked sensors to monitor the project's performance.

The Stage 1 corridor also featured traffic signal cabinets that could accommodate advanced technology and controllers. The At-Scale project would include upgrades to traffic signal cabinets that do not currently support the planned technology.

Table 1: Equipment Type for Stage 1 and At-Scale

Equipment Type	Stage 1 Unit Count	At-Scale Unit Count
Velocity Bluetootravel Time Sensors	6	20
Advanced Detecton	27	62
Radar Stop Bar Dection	36	62
Advanced Camer Technology Stop Bar and Pedestrian Detection	10	13

Intersection Location	Radar Vehicle Stop Bar Detection	Radar Vehicle Advanced Detection	Bluetooth Vehicle Travel Time Sensors	Video Detection Pedestrian Detection
Yellowstone & Chubbuck				
Yellowstone & Knudson				
I-86 DDI				
Yellowstone & Breneman				
Yellowstone & Pine Ridge				
Yellowstone & Pole Line				
Quinn & Hurley				
Yellowstone & Pearl				
Yellowstone & Pine				
Yellowstone & Maple				
Yellowstone & Oak				
4th & Clark				
5th & Clark				
4th & Center				
5th & Center				
4th & Benton				
5th & Benton				
5th & Carter				
5th & Humbolt				

Project Activity Summary

The summary of project activities is divided into administrative and milestone activities. These two activities are interwoven, but there are notable differences between them.

Administrative Activities

Transforming the application into a grant and then into a project consumed most of the project's first three months. Due to a lack of initial responses, getting a consultant to assist in the project's development took much longer than expected. Hiring a consultant and developing the evaluation and data management plans necessitated numerous stakeholder meetings and an understanding of the data management process. The evaluation and data management plans delayed the development of the request for bids for the equipment and installation. We also did not move forward with the equipment procurements as we misunderstood the need for NEPA and BABA clearance from USDOT. Going out to bids for equipment and contractor services

before the final clearance would have allowed for more implementation time. After the request for bids was issued for radar sensing technology, a significant portion of the Grant funds, the bids came in significantly higher than the allocated Grant funds. The additional cost was related to vendor-to-contractor device cost markups, and all contractors were busy, which limited their ability to complete work within the requested window. Therefore, we had to obtain approval from the USDOT to procure the radar sensing devices from a sole-source vendor and separately bid and procure installation services to bring the cost within the available Grant funds.

The Smart technology traffic signal projects formed a group that met monthly. That group was very helpful in navigating the process's complexities and clarifying evaluation criteria.

Milestone Activities

Milestone 1: Project Initiation

Planned Completion Date: 09/15/2023

Actual Completion Date: 09/15/2023

Stage 1 kicked off with the successful initiation of the project, meeting its planned completion date exactly as scheduled.

Milestone 2: Evaluation and Data Management Plan

Planned Completion Date: 12/01/2023

Actual Completion Date: 12/13/2023, revised 4/26/2024

Data Management Plan: 12/08/2023

Draft Evaluation Plan: 12/13/2023

This milestone involved developing a comprehensive Evaluation Plan and a Data Management Plan. Despite slight delays, both components were completed within a week of the planned dates. The evaluation plan development was more challenging than expected. The initial plan was to test every benefit identified for implementing smart sensor technology in the project area. Developing evaluation criteria for safety proved to be a challenging task. The comments on the evaluation plan were more extensive than anticipated. The committee has reviewed the comments and has resubmitted a revised Evaluation Plan that addresses the comments. Modifying the performance measures to be more quantitative was the biggest change.

Milestone 3: Data Management Plan

Planned Completion Data: 12/08/2023

Actual Completion Date: 12/13/2023

Developing the data management plan was a new process that none of the project team had experienced. The processes familiar to the project team are more related to the project findings in the appendices of the report. The team had to learn a new language and experienced issues

related to archiving and preservation of the data. The data management plan was revised several times to ensure all criteria were met.

Milestone 4: Design and Planning

Planned Completion Date: 03/15/2024

Actual Completion Date: 05/24/2024

Design and planning were related to developing and issuing the request for bids from vendors and contractors, which are the key activities in this milestone. The request for equipment bids ran into an issue early with the Iteris Velocity Bluetooth detectors. The detectors are needed to track travel time and delay along the corridor. The region's investment in this technology required the development of a sole source justified package for purchasing the technology. The sole source development would come into play when the project team identified that the three planned camera detection technologies were only sold by specific vendors and that there was no way to get a bid for all three from the same source. The last request for bids included supplying and installing the radar sensors. The initial submission bid exceeded the project budget and did not meet the project timeline. The decision was made to split the bid into equipment and installation. The hope was that delaying the installation would give contractors a later start date and allow additional bidders.

Milestone 5: Installation of Smart Sensors (Camera)

Planned Completion Date for camera installations: 07/30/2024

Actual Completion Date: 11/1/2024

Installing the advanced camera detection was the first step in implementing the project. Local partnering agencies installed the Grid Smart camera system (two locations) and the Currux Camera system (four locations). The vendor delays caused the installation and testing of the DERQ smart camera system to be delayed compared to the other systems. The data collection for pedestrians proceeded. The use of radar to augment the camera technology for corridor coordination and truck progression during non-coordination periods occurred in late September 2024.

Milestone 6: Installation of Smart Sensors (Radar)

Planned Completion Date for radar installations: 07/30/2024

Actual Completion Date: 11/13/24

Installing smart sensors, both radar and camera technology is a critical component in the project. Radar detection (stop bar and advanced) was installed and tested at 16 intersections. The testing included **Milestone 7: Implementation Report**

Planned Completion Date: 09/15/2024

The draft implementation analysis report is on schedule, with work progressing as planned.

Milestone 8: Testing and Quality Assurance

Planned Completion Date: 12/31/2024

Actual Completion Date: 4/30/2025

Testing of the timing plan and signal controller input adjustments is scheduled for later in the year. This Stage will ensure all systems function correctly and meet the project's quality standards. The performance for each technology was tested to determine if the equipment is performing to standards. Once the testing is completed, adjustments to the existing timing plan will provide the Evaluation Criteria results by evaluating the ATSPMS arrival on red and vehicle delay matrices. The Evaluation Criteria results for travel time and travel time index will come from the Bluetooth travel time monitors. The Evaluation Criteria results for pedestrian and bicycle detections, as well as accuracy in detecting and placing calls, will be derived from the cameras. The adjustments will be evaluated over a two-week period, and each performance measure will be compared to determine the level of success.

Milestone 9: Project Evaluation Report

Planned Completion Date: 02/15/2025

Actual Completion Date: 6/15/2025

The final evaluation will wrap up the project's progress and results. The project Implementation report was completed on July 24, 2025.

Attention from the Public and Professionals

The project received media coverage when it was announced. Since then, there has been little coverage. The rollout of the equipment is planned as an opportunity to re-engage with the public and stakeholders on the project's status.

Deviations or Changes from the Original Proposal

The project deviated from the original proposal by reducing the number of performance expectations. Installing the advanced sensors will improve safety and enhance transit performance. They are not the focus of the project. The real-world issues addressed by the project are improving operational travel time, reducing vehicle delays, and detecting pedestrians. The revised evaluation plan narrowed the performance measures to those related to improving travel time and pedestrian detection.

The original proposal was to use the ATSPMS data to retime the corridors. After evaluation of the data, the decision was made to update the Corridor Synchro files. The Synchro update resulted in a change in cycle time and some adjustments to the coordinated period. The updated Synchro plan was implemented, and two adjustments were made based on the ATSPMS data described here.

During the project development, the ability to collect walk speed and passively detect pedestrians became problematic. Only one video technology was able to collect walking speeds, and it had

issues with determining the difference between bicycle and pedestrian traffic, until the very end of the project. One technology has the ability, but a bug in its software prevented the tracking of individual object identification numbers. The third technology had numerous technical issues that prevented the system from operating, leaving no time for analysis. The passive detection ran into issues related to curb return radius and single pedestrian ramps. The third pedestrian performance measure tested if the minimum crossing time could be extended. The original proposal's purpose was to reduce the chance that there would be a person in the crosswalk when the opposing vehicle phase turned green. Due to issues, an alternate treatment was tested. The following change to one of the pedestrian evaluation questions and related performance measures occurred:

- Original Evaluation Question: Can video detection track pedestrian activity and send calls to the controller to extend or end the pedestrian phase?
- Revised Evaluation Question: Can video detection track pedestrian activity and send calls to the controller to extend the related vehicle phase while a pedestrian is present?

A pedestrian zone was established with the crosswalk, and when a pedestrian was detected a call to extend the related vehicle phase was placed. The extension was up to the maximum green time programmed for that phase. A new performance measure was added. Can a pedestrian be detected and extend the related vehicle phase while a pedestrian is present?

Part 2 Proof-of-Concept

The proof-of-concept is based on the evaluation plan criteria. The tables and methodology for the evaluation come from the evaluation plan. The evaluation questions are divided by the goal that is being addressed. The three issues are vehicle travel time and delay, large vehicle detection and reduced delay in non-coordinated operations, and pedestrian detection and operations.

The evaluation of each performance measure has four sections, which are:

- Summary of the Process – What was done
- Proof-of-concept equipment placement and validation
- Performance monitoring equipment placement
- Evaluation process – Identifies the evaluation process used for existing and post-treatment
- Data tables - The data tables provide the summarized results of the evaluation process
- Analysis – Analysis of the data as related to the performance measures

Table 2: Performance Measures for the Proof-of-Concept

Evaluation Question	Performance Measure	Performance Measure Target
How will installing advanced vehicle detection systems impact vehicle delays, traffic flow, and average travel times?	Percentage of Arrivals on Green (Mainline)	Increase the Percentage of Arrivals on Green
	Average Delay Per Vehicle per Approach	Reduce vehicle delay time in seconds in comparison to the existing vehicle delay.
	PM Peak Travel Time Index	Decrease the Planning Time Index along the Yellowstone Corridor
	Average travel time along the Yellowstone Corridor	Improve the average travel time along the Yellowstone Corridor compared to existing average travel times measured in seconds
Can advanced vehicle detection classify vehicles?	Classification of vehicles on approach at a distance of 600 feet	95% accuracy for classifying large vehicles
During non-coordinated operations, does advanced vehicle detection extend the green phase or place a call for service for large vehicles early?	Detecting large profile vehicles at an extended distance allows the controller to either extend the service window for that vehicle in non-coordinated fully actuated operations or ensure that an earlier call is placed for the movement to prevent the vehicle from hard braking at the stop bar	95% accuracy for the placement extension of the green phase to the controller for large vehicles
		95% accuracy in placing an earlier call for service before the large vehicle stops Improved average split for the phases where advanced detection is present.
Can video detection technologies accurately collect pedestrian walking speed?	Average feet per second crossing the street	The video detection walking speeds are equal to the observed walking speed.
How do video detection technologies compare regarding their ability to call for service passively?	The percentage of pedestrian service calls	95% detection from the correct direction of travel.
Can video detection track pedestrian activity and send calls to the controller to extend the related vehicle phase while a pedestrian is present?	The presence of pedestrians in the crosswalk after the minimum crossing time is reached.	100% accuracy when calls are made, compared to video

The radar evaluation segments for the Yellowstone Corridor are divided into three corridors, each with two segments, to assess the reduction in travel time. Table 3 lists the corridors and segments, and Figure 3: Radar Evaluation Corridors shows the location of the radar corridors.

Table 3: Radar Evaluation Corridor and Segments

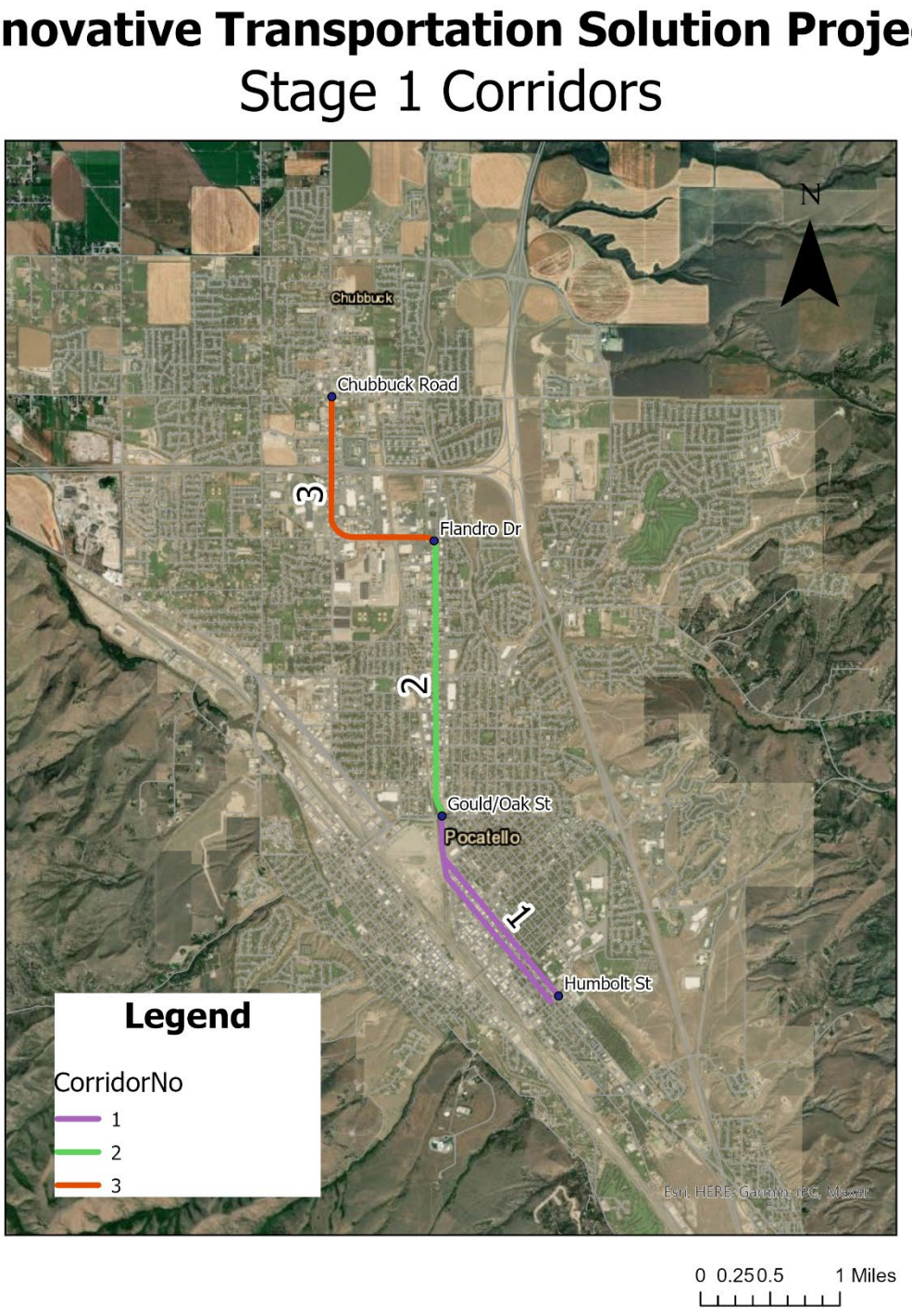
Corridor Number	Corridor Description	Segment Number	Segment Description
1	4th/ 5th from Humbolt Street to Oak Street	1	5th Avenue: Humbolt Street to Oak Street (Northbound)
		2	4th Avenue: Oak Street to Benton Street (Southbound)
2	Yellowstone Avenue: from Oak Street to Flandro Drive	3	Yellowstone Avenue: from Oak Street to Flandro Drive (Northbound)
		4	Yellowstone Avenue: from Flandro Drive to Oak Street (Southbound)
3	Yellowstone Avenue: from Flandro Drive to Chubbuck Road	5	Yellowstone Avenue: from Flandro Drive to Chubbuck Road (Northbound)
		6	Yellowstone Avenue: from Chubbuck Road to Flandro (Southbound)

How will installing advanced vehicle detection systems impact vehicle delays, traffic flow, and average travel times?

Summary of the Process

The base Synchro model was updated with data from the ATSPM. No additional data was collected. Based on the updated Synchro model, a new timing plan for the PM Peak (15:00 to 18:00) was developed for the corridors. The timing plans were implemented and adjusted using the ATSPM data. The updated plans changed the cycle length of the corridor.

Figure 3: Radar Evaluation Corridors



Process Evaluation of Arrival on Green (AoG)

The average approach delay and AoG will be measured using the Wavetronix Advanced 200-E Extended Range Smart Sensor from the Automated Traffic Signal Performance Measures (ATSPMSs). The main line approach delay per intersection will be collected in seconds for both baseline and post-implementation conditions. The main line AoG percentages will be collected for baseline and implementation conditions. The current conditions will be thirty days after the installation of the advanced traffic detection.

The evaluation data will include the following:

- AoG for weekday traffic for the peak PM period (15:00 – 18:00) for each mainline approach, the percentage of AoG will be tracked for each hour. The average over three days will be compared to the three-day average baseline.
- Approach delays for weekday traffic during peak PM periods (15:00 to 18:00) for each mainline approach will be tracked, including the average delay per vehicle, for the selected time period.

Arrival on Green

Table 4 details the change in AoG from the baseline to implementation. Overall, there were positive changes in the percentage of AoG. The northbound direction for the entire corridor saw a 10.62 percent increase in AoG. Northbound Segment 1 and Segment 3 saw large increases in AoG percentages. Segment 6, which includes a diverging diamond Interchange, saw the lowest increase in AoG percentage. The southbound direction for the entire corridor saw a -0.57 percent decrease in AoG. The timing changes affected the southbound direction. Segment 2 and Segment 6 experienced decreases in the AoG percentage of -2.69 and -5.93 percent, respectively. The changes to time patterns changed the priority to the northbound direction in the PM peak period.

Several sections within the corridor were not coordinated in the baseline case. Those intersections are:

- Yellowstone Avenue and Pearl Street
- Yellowstone Avenue and Flandro Drive
- West Quinn Road and Hurley Drive

Table 4: Arrival on Green Baseline and Implementation 15:00 - 18:00

Roadway	Direction	Intersection	Phase	Baseline				Implementation				Percent Change
				11/12/2024	11/13/2024	11/14/2024	Average	5/20/2025	5/21/2025	5/22/2025	Average	
				Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	
Segment 1												
5th	Northbound	South 5th Avenue @ East Carter Street	6	68%	67%	68%	68%	73%	71%	71%	72%	5.58%
5th	Northbound	South 5th Avenue @ East Center Street	6	59%	56%	59%	58%	71%	72%	72%	72%	19.07%
5th	Northbound	South 5th Avenue @ East Clark Street	6	59%	63%	62%	61%	70%	70%	69%	70%	11.96%
Segment 2												
4th Ave	Southbound	South 4th Avenue @ East Clark Street	2	56%	56%	57%	56%	57%	57%	56%	57%	0.59%
4th Ave	Southbound	South 4th Avenue @ East Center Street	2	71%	72%	73%	72%	74%	74%	73%	74%	2.26%
4th Ave	Southbound	South 4th Avenue @ East Benton Street	2	67%	68%	68%	68%	61%	60%	62%	61%	-10.93%
Segment 3												
Yellowstone	Northbound	Yellowstone Avenue @ Gould Street / East Oak Street	6	40%	40%	43%	41%	71%	67%	72%	70%	41.43%
Yellowstone	Northbound	Yellowstone Avenue @ West Maple Street	6	69%	69%	70%	73%	71%	67%	72%	86%	14.73%
Yellowstone	Northbound	Yellowstone Avenue @ West Pine Street	6	80%	78%	80%	79%	80%	78%	81%	80%	0.42%
Yellowstone	Northbound	Yellowstone Avenue @ West Cedar Street	6	50%	49%	54%	51%	51%	48%	51%	50%	-2.00%
Segment 4												
Yellowstone	Southbound	Yellowstone Avenue @ Alameda Road	2	42%	40%	40%	41%	41%	42%	41%	41%	1.61%
Yellowstone	Southbound	Yellowstone Avenue @ West Cedar Street	2	51%	40%	41%	44%	73%	71%	73%	72%	39.17%
Yellowstone	Southbound	Yellowstone Avenue @ West Pine Street	2	78%	79%	78%	78%	83%	79%	83%	82%	4.08%
Yellowstone	Southbound	Yellowstone Avenue @ West Maple Street	2	82%	82%	81%	82%	77%	74%	76%	76%	-7.93%
Yellowstone	Southbound	Yellowstone Avenue @ Gould Street / East Oak Street	2	29%	28%	30%	29%	30%	27%	28%	28%	-2.35%
Segment 5												
Yellowstone	Northbound	Yellowstone Avenue @ Pole Line Road	6	46%	47%	44%	46%	61%	61%	59%	60%	24.31%
Yellowstone	Northbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	6	96%	84%	83%	88%	73%	71%	73%	72%	-21.20%
Yellowstone	Northbound	Yellowstone Avenue @ Knudsen Boulevard	6	84%	83%	93%	87%	81%	81%	80%	81%	-7.44%
Yellowstone	Northbound	Yellowstone Avenue @ Chubbuck Road	6	32%	33%	31%	32%	45%	44%	45%	45%	28.36%
Segment 6												
Yellowstone	Southbound	Yellowstone Avenue @ Chubbuck Road	2	38%	42%	36%	39%	39%	35%	34%	36%	-7.41%
Yellowstone	Southbound	Yellowstone Avenue @ Knudsen Boulevard	2	58%	58%	55%	57%	61%	58%	57%	59%	2.84%
Yellowstone	Southbound	I-86 Ramps @ Yellowstone Avenue	2	55%	55%	60%	57%	61%	0%	0%	61%	7.10%
Yellowstone	Southbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	2	79%	78%	79%	79%	74%	74%	76%	75%	-5.36%
Yellowstone	Southbound	Yellowstone Avenue @ Pole Line Road	2	69%	68%	71%	69%	55%	55%	54%	55%	-26.83%

The Per-vehicle delay

Approach Delay reports how long vehicles wait at an intersection before they get a green light. For each phase, it reports the total delay and the average delay per vehicle. The measure requires advanced detection. The change in average vehicle delay from the baseline to the implementation was positive, resulting in a 3.89 percent decrease in the average vehicle delay for the entire corridor in both directions (Table 5). Segment 1 experienced a 19.51% decrease in overall vehicle delay. However, South 5th Avenue and East Clark experienced an increase in average vehicle delay. Most of the improvements in average vehicle delay occurred in Corridor 2. Both directions experienced a decrease in average vehicle delay. Within the corridor, there were large increases and decreases in vehicle delay within segments 3 and 4. The most consistent change was in the section from Maple Street to Cedar Street, where the signal spacing is consistent.

Table 5 Per Vehicle Delay from 1500 - 18:00

Roadway	Direction	Intersection	Phase	Baseline				Implementation				Percetage Change
				11/12/2024	11/13/2024	11/14/2024	Average	5/20/2025	5/21/2025	5/22/2025	Average	
				Average Delay Per Vehicle (Seconds)	Average Delay Per Vehicle (Seconds)	Average Delay Per Vehicle (Seconds)	Average Delay Per Vehicle (Seconds)	Average Delay Per Vehicle (Seconds)	Average Delay Per Vehicle (Seconds)	Average Delay Per Vehicle (Seconds)	Average Delay Per Vehicle (Seconds)	
Segment 1												
5th	Northbound	South 5th Avenue @ East Carter Street	6	4.00	4.00	4.00	4.00	2.00	3.00	3.00	2.67	33.33%
5th	Northbound	South 5th Avenue @ East Center Street	6	5.00	5.00	5.00	5.00	3.00	3.00	3.00	3.00	40.00%
5th	Northbound	South 5th Avenue @ East Clark Street	6	17.00	19.00	18.00	18.00	20.00	20.00	22.00	20.67	-14.81%
Segment 2												
4th Ave	Southbound	South 4th Avenue @ East Clark Street	2	7.00	6.00	6.00	6.33	6.00	6.00	6.00	6.00	5.26%
4th Ave	Southbound	South 4th Avenue @ East Center Street	2	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	0.00%
4th Ave	Southbound	South 4th Avenue @ East Benton Street	2	4.00	4.00	4.00	4.00	4.00	5.00	4.00	4.33	-8.33%
Segment 3												
Yellowstone	Northbound	Yellowstone Avenue @ Gould Street / East Oak Street	6	14.50	18.00	17.00	16.50	17.00	17.00	17.00	17.00	-3.03%
Yellowstone	Northbound	Yellowstone Avenue @ West Maple Street	6	4.00	4.00	4.00	4.00	4.00	5.00	5.00	4.67	-16.67%
Yellowstone	Northbound	Yellowstone Avenue @ West Pine Street	6	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	33.33%
Yellowstone	Northbound	Yellowstone Avenue @ West Cedar Street	6	14.00	14.00	13.00	13.67	12.00	13.00	14.00	13.00	4.88%
Yellowstone	Northbound	Yellowstone Avenue @ Pearl Street	6	6.00	5.00	5.00	5.33	4.00	4.00	4.00	4.00	25.00%
Yellowstone	Westbound	Yellowstone Avenue @ Flandro Drive	6	26.00	25.00	27.00	26.00	20.00	20.00	20.00	20.00	23.08%
Segment 4												
Yellowstone	Southbound	Yellowstone Avenue @ Flandro Drive	2	26.00	26.00	25.00	25.67	18.00	17.00	17.00	17.33	32.47%
Yellowstone	Southbound	Yellowstone Avenue @ Pearl Street	2	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00%
Yellowstone	Southbound	Yellowstone Avenue @ Alameda Road	2	18.00	18.00	18.00	18.00	23.00	23.00	23.00	23.00	-27.78%
Yellowstone	Southbound	Yellowstone Avenue @ West Cedar Street	2	14.00	12.00	16.00	14.00	9.00	5.90	9.00	7.97	43.10%
Yellowstone	Southbound	Yellowstone Avenue @ West Pine Street	2	4.00	3.00	3.00	3.33	3.00	3.00	3.00	3.00	10.00%
Yellowstone	Southbound	Yellowstone Avenue @ West Maple Street	2	4.00	5.00	4.00	4.33	4.00	5.00	4.00	4.33	0.00%
Yellowstone	Southbound	Yellowstone Avenue @ Gould Street / East Oak Street	2	25.00	25.00	24.00	24.67	23.00	25.00	25.00	24.33	1.35%
Segment 5												
Yellowstone	Westbound	West Quinn Road @ Hurley Drive	6	8.00	7.00	9.00	8.00	3.00	4.00	3.00	3.33	
Yellowstone	Northbound	Yellowstone Avenue @ Pole Line Road	6	17.00	16.00	20.00	17.67	13.00	12.00	11.00	12.00	32.08%
Yellowstone	Northbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	6	2.00	2.00	2.00	2.00	4.00	4.00	3.00	3.67	-83.33%
Yellowstone	Northbound	Yellowstone Avenue @ Knudsen Boulevard	6	3.00	4.00	4.00	3.67	4.00	5.00	5.00	4.67	-27.27%
Yellowstone	Northbound	Yellowstone Avenue @ Chubbuck Road	6	21.00	21.00	23.00	21.67	22.00	22.00	24.00	22.67	-4.62%
Segment 6												
Yellowstone	Southbound	Yellowstone Avenue @ Chubbuck Road	2	23.00	23.00	25.00	23.67	24.00	27.00	25.00	25.33	-7.04%
Yellowstone	Southbound	Yellowstone Avenue @ Knudsen Boulevard	2	10.00	10.00	7.30	9.10	12.00	15.00	14.00	13.67	-50.18%
Yellowstone	Southbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	2	3.00	3.00	3.00	3.00	4.00	4.00	3.00	3.67	-22.22%
Yellowstone	Southbound	Yellowstone Avenue @ Pole Line Road	2	7.00	7.00	7.00	7.00	8.00	8.00	9.00	8.33	-19.05%
Yellowstone	Eastbound	West Quinn Road @ Hurley Drive	2	6.00	6.00	6.00	6.00	2.00	4.00	3.00	3.00	50.00%

Average travel time along the Yellowstone Corridor

As stated, the ATSPM data approach, which includes approach volume and turning counts, provided additional data to help update the Corridor's Synchro model. The intersections with video stop bar detection allowed for complete turning counts, whereas the intersections with radar required a right turn factor. The AoG and Approach Delay were used to fine-tune the timing, improving the platoons and reducing the delay at intersections. The travel time is the measure used to determine if all the changes made improved the travel time through the corridor. The Corridor travel time (Table 6) indicates that every segment, except Segment 6, experienced significant improvements in travel time. When directionality is considered, the northbound segments experienced a 4.75% improvement in travel time. In comparison, the southbound segments remained flat with a 0.59% decrease.

Figure 4: Corridor 1 Segment 1

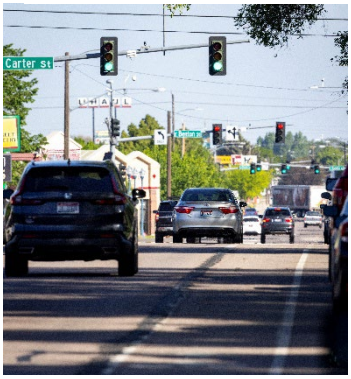


Table 6 Corridor Travel Time

Roadway	Direction	Origin Cross Street	Destination Cross Street	Baseline				Implementation				Change is Seconds	Percent Change
				11/12/2024	11/13/2024	11/14/2024	Average	5/20/2025	5/21/2025	5/22/2025	Average		
				Travel time in Seconds				Travel time in Seconds					
Segment 1													
5th	Northbound	Humbolt	Benton	88	84	81	84	72	74	73	73	11	13.44%
5th	Northbound	Benton	Center	61	61	55	59	44	46	46	45	14	23.16%
5th	Northbound	Center	Clark	19	20	19	19	16	16	16	16	3	17.24%
5th	Northbound	Clark	Oak	104	96	96	99	93	93	92	93	6	6.08%
Segment 1 Summary				272	261	251	261	225	229	227	227	34	13.14%
Segment 2													
4th Ave	Southbound	Oak	Clark	107	104	102	104	103	102	106	104	1	0.64%
4th Ave	Southbound	Clark	Center	19	20	18	19	19	19	19	19	0	0.00%
4th Ave	Southbound	Center	Benton	43	44	43	43	40	40	39	40	4	8.46%
4th_Humbolt	Southbound	Benton	Humbolt	76	80	85	80	71	68	73	71	10	12.03%
Segment 2 Summary				245	248	248	247	233	229	237	233	14	5.67%
Segment 3													
Yellowstone	Northbound	Oak	Pine	92	94	92	93	89	93	91	91	2	1.80%
Yellowstone	Northbound	Pine	Alameda	112	109	102	108	95	103	104	101	7	6.50%
Yellowstone	Northbound	Alameda	Pearl	86	85	83	85	77	81	80	79	5	6.30%
Yellowstone	Northbound	Pearl	Flandro	63	62	65	63	60	62	62	61	2	3.16%
Segment 3 Summary				353	350	342	348	321	339	337	332	16	4.59%
Segment 4													
Yellowstone	Southbound	Flandro	Pearl	59	80	58	66	59	59	58	59	7	10.66%
Yellowstone	Southbound	Pearl	Alameda	79	104	81	88	73	88	77	79	9	9.85%
Yellowstone	Southbound	Alameda	Pine	109	81	102	97	86	88	85	86	11	11.30%
Yellowstone	Southbound	Pine	Oak	83	104	82	90	81	85	85	84	6	6.69%
Segment 4 Summary				330	369	323	341	299	320	305	308	33	9.59%
Segment 5													
Yellowstone	Westbound	Flandro	Pole Line	123	121	130	125	109	110	107	109	16	12.83%
Yellowstone	Northbound	Pole Line	I86	119	147	144	137	126	110	120	119	18	13.17%
Yellowstone	Northbound	I86	Knudsen	27	26	27	27	26	27	26	26	0	1.25%
Yellowstone	Northbound	Knudsen	Chubbuck	52	56	57	55	48	50	49	49	6	10.91%
Segment 5 Summary				321	350	358	343	309	297	302	303	40	11.76%
Segment 6													
Yellowstone	Southbound	Chubbuck	Knudsen	52	56	68	59	56	67	70	64	-6	-9.66%
Yellowstone	Southbound	Knudsen	I86	58	71	56	62	61	82	72	72	-10	-16.22%
Yellowstone	Southbound	I86	Pole Line	57	56	61	58	79	78	65	74	-16	-27.59%
Yellowstone	Eastbound	Pole Line	Flandro	55	64	134	84	105	107	101	104	-20	-23.72%
Segment 6 Summary				222	247	319	263	301	334	308	314	-52	-19.67%

Analysis

After installing advanced detection along the corridor and making adjustments to the signal timing during the PM Peak using data from the installed devices to monitor changes, all performance measures showed improvements. The changes were more than expected and should be sustainable by using the method to monitor the corridor and make small adjustments as needed in the future. Corridor 6 (Southbound Yellowstone for Chubbuck to Pole Line), which includes a Diverging Diamond Interchange, is the only corridor to have a negative change in travel time. The data now available will enable regional partners to study the interchange and provide additional recommendations to improve travel times.

Reliability

The Planning Time Index (TTI) is the average travel time ratio compared to the free-flow travel time. The individual sub-segments will be averaged to get a segment TTI. Only the weekday PM traffic is included in the analysis, as it is the only coordinated time period along Yellowstone Avenue.

Evaluation Segments

The Yellowstone Corridor will be divided into six segments to evaluate TTI changes. The segments are:

Corridor Number	Corridor Description	Segment Number	Segment Description
1	4th/ 5th from Humbolt to Oak Street	1	5th Avenue: Humbolt to Oak Street (Northbound)
		2	4th Avenue: Benton Street to Oak Street (Southbound)
2	Yellowstone Avenue: from Oak Street to Flandro Drive	3	Yellowstone Avenue: from Oak Street to Flandro Drive (Northbound)
		4	Yellowstone Avenue: from Flandro Drive to Oak Street (Southbound)
3	Yellowstone Avenue: from Flandro Drive to Chubbuck Road	5	Yellowstone Avenue: from Flandro Drive to Chubbuck Road (Northbound)
		6	Yellowstone Avenue: from Chubbuck Road to Flandro (Southbound)

Evaluation Process

- Existing Conditions – The average travel time (15:00 to 18:00) was determined for the period from November 12, 2024, to November 14, 2024. The Free Flow travel time (00:00 to 06:00) was determined for the period from November 12, 2024, to November 14, 2024.
- After Evaluation – Once the signal coordination improvements have been made and controller inputs are updated, bi-directional data was collected. The evaluation TTI will be compared to the existing travel time.

The evaluation was revised based on the data evaluation report. Due to the delay in implementation, there was no time to compare the data for the thirty days before and after. The decision was made to use the same baseline and implementation dates as the rest of the study.

Table 7: Travel Time Index Comparison Baseline to Implementation

Roadway	Direction	Origin Cross Street	Destination Cross Street	Baseline 11/12/2024 - 11/24/2024			Implementation 5/20/2025 - 5/22/2025			Percent Change
				Average Travel Time	Free Flow Travel Time	TTI	Average Travel Time	Free Flow Travel Time	TTI	
				Travel time in Seconds			Travel time in Seconds			
Segment 1										
5th	Northbound	Humbolt	Benton	84	85	0.99	73	73	1.00	1.18%
5th	Northbound	Benton	Center	59	40	1.48	46	34	1.35	-9.02%
5th	Northbound	Center	Clark	19	13	1.46	16	12	1.33	-9.62%
5th	Northbound	Clark	Oak	99	76	1.30	92	76	1.21	-7.61%
Segment 1 Summary				261	214	5.23	227	195	4.90	-6.75%
Segment 2										
4th Ave	Southbound	Oak	Clark	104	90	1.16	103	91	1.13	-2.09%
4th Ave	Southbound	Clark	Center	19	14	1.36	19	14	1.36	0.00%
4th Ave	Southbound	Center	Benton	43	35	1.23	40	35	1.14	-7.50%
4th Humbolt	Southbound	Benton	Humbolt	80	66	1.21	71	69	1.03	-17.80%
Segment 2 Summary				246	205	4.95	233	209	4.66	-6.28%
Segment 3										
Yellowstone	Northbound	Oak	Pine	93	63	1.48	91	65	1.40	-5.44%
Yellowstone	Northbound	Pine	Alameda	107	51	2.10	101	50	2.02	-3.86%
Yellowstone	Northbound	Alameda	Pearl	85	59	1.44	79	59	1.34	-7.59%
Yellowstone	Northbound	Pearl	Flandro	63	42	1.50	49	42	1.17	-28.57%
Segment 3 Summary				348	215	6.51	320	216	5.93	-9.94%
Segment 4										
Yellowstone	Southbound	Flandro	Pearl	60	48	1.25	59	50	1.18	-5.93%
Yellowstone	Southbound	Pearl	Alameda	80	59	1.36	79	64	1.23	-9.85%
Yellowstone	Southbound	Alameda	Pine	105	58	1.81	86	58	1.48	-22.09%
Yellowstone	Southbound	Pine	Oak	82	58	1.41	83	59	1.41	-0.50%
Segment 4 Summary				327	223	5.83	307	231	5.30	-9.92%
Segment 5										
Yellowstone	Westbound	Flandro	Pole Line	125	81	1.54	109	81	1.35	-14.68%
Yellowstone	Northbound	Pole Line	I86	137	84	1.63	120	82	1.46	-11.45%
Yellowstone	Northbound	I86	Knudsen	27	27	1.00	26	27	0.96	-3.85%
Yellowstone	Northbound	Knudsen	Chubbuck	55	36	1.53	49	39	1.26	-21.60%
Segment 5 Summary				344	228	5.70	304	229	5.03	-13.39%
Segment 6										
Yellowstone	Southbound	Chubbuck	Knudsen	66	36	1.83	65	44	1.48	-24.10%
Yellowstone	Southbound	Knudsen	I86	57	39	1.46	71	37	1.92	23.84%
Yellowstone	Southbound	I86	Pole Line	60	51	1.18	74	58	1.28	7.79%
Yellowstone	Eastbound	Pole Line	Flandro	130	81	1.60	104	80	1.30	-23.46%
Segment 6 Summary				313	207	6.08	314	219	5.97	-1.75%

Analysis

The TTI from baseline to implementation decreased, indicating less congestion. Each segment showed a decrease in the TTI, although not every section within the corridor experienced this decrease. The southbound section from Knudsen to I-86 showed a large increase in the TTI. The primary reason was the increase in the free-flow travel time in the May period. The data is consistent with the travel time analysis, except for segment 6, which did not show an increase in the TTI.

Can advanced vehicle detection classify vehicles?

The Wavetronix Advanced 200-E Extended Range Smart Sensor approximates vehicle classification. It is essential to note that the classification is not a true classification, but rather an identification of trucks or High Profile Vehicles (HPVs).

The detection zone of the Wavetronix Smart Sensor was placed to provide detection as far upstream as possible. During the setup of the Wavetronix Smart Sensor, the distance from the sensor location to large profile vehicles and other vehicles was noted at each approach. Detection and count zones were created for the large profile vehicle and all vehicles.

Evaluation process – For each location where an advanced smart sensor was installed, an HPV detection zone was established at a distance (between 500 and 650 feet) where the sensor cannot detect passenger cars. Various screenshots show the setup of the advanced sensor HPV and advanced detector zones (Figure 5). The left screen is where the trucks are detected. A verification occurred during the sensor setup. Staff observed the traffic during the setup and identified when an HPV was detected, as well as the distance from the sensor location. The distance where HPVs were detected for each advanced detector (Table 8).

Figure 5 Wavetronix Advance Sensor Configuration

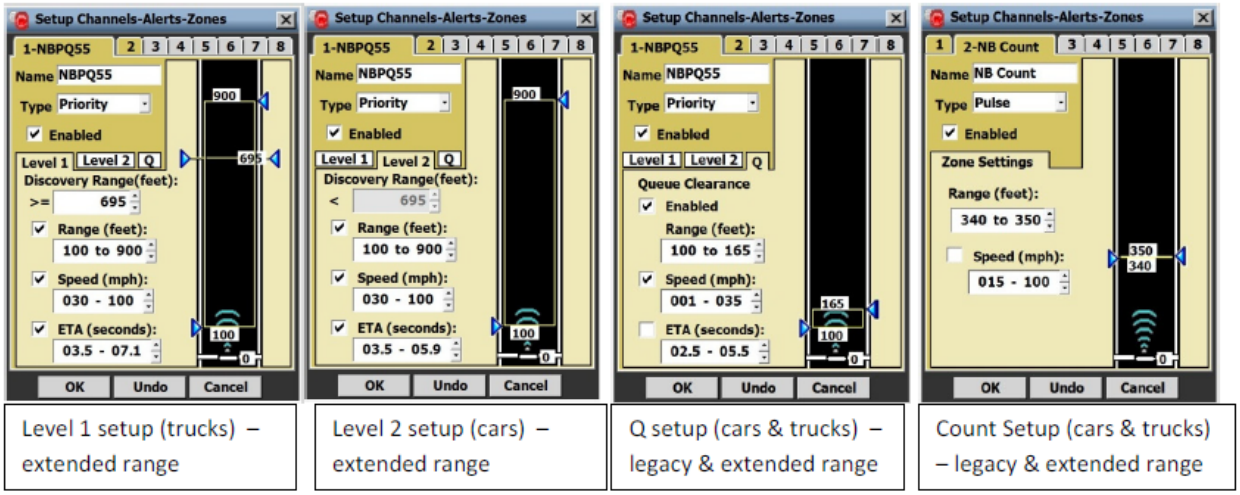


Table 8: Advanced Truck Sensor Distance from Intersection

Intersection Name	Sensor Name	Advance Truck Count Detector Distance
4th & Benton	4th & Benton SB Adv	700
4th & Clark	4th & Clark SB Adv	760
5th & Benton	5th & Benton NB Adv	660
5th & Carter	5th & Carter NB Adv	700

Intersection Name	Sensor Name	Advance Truck Count Detector Distance
5th & Center	5th & Center NB Adv	680
5th & Humbolt	5th & Humbolt NB Adv	685
Quinn & Hurley	EB ADV Quinn & Hurley	675
	WB ADV Quinn & Hurley	675
Yellowstone & Chubbuck	ADV NB PHASE 6	760
	ADV SB PHASE 2	740
Yellowstone & Knudsen	Advance NB Phase 6	760
	ADVANCE SB PH 2	
Yellowstone & Maple	NB Maple and Yellowstone	660
	SB Maple and Yellowstone	710
Yellowstone & Oak	ADV EB PH 8	610
	ADV NB Ph6	650
	ADV SB PH2	685
Yellowstone & Pearl	NB ADV Yellowstone and Pearl	725
	SB ADV Yellowstone & Pearl	725
Yellowstone & Pine	NB Yellowstone & Pine Adv	660
	SB Yellowstone & Pine Advance	670
Yellowstone & Pineridge/TJ Maxx	NB ADV Yellowstone & Piner	780
	SB ADV Yellowstone & Pineridge	760
Yellowstone & Pole Line	NB ADV Yellowstone & Pole Line	510
	SB ADV Yellowstone & Pole Line	685

Advance presence is the call from any of the advanced zones (up to three) that get combined in the Advance sensor software to call and extend the phase for that vehicle in the dilemma zone. Channel 51 (CH 51). The other outputs from the advance to count the approach at 400' (should be catching all vehicles), Channel 52 (CH 52), and then at 650' for those HPVs, Channel 56 (CH 56). Figure 6 shows a screenshot from the ATSPM data, which indicates when an advanced presence call is made by the HPV (advanced count: 650 ft.). The red line indicates what the staff is looking for to determine if the detection calls were made correctly.

Figure 6: Advanced Presence and Car and High Profile Vehicle Detection



Figures 7 and 8 are examples of the large profile vehicle detection working correctly.

Figure 7: 5th and Carter Street Large Profile Vehicle Detection

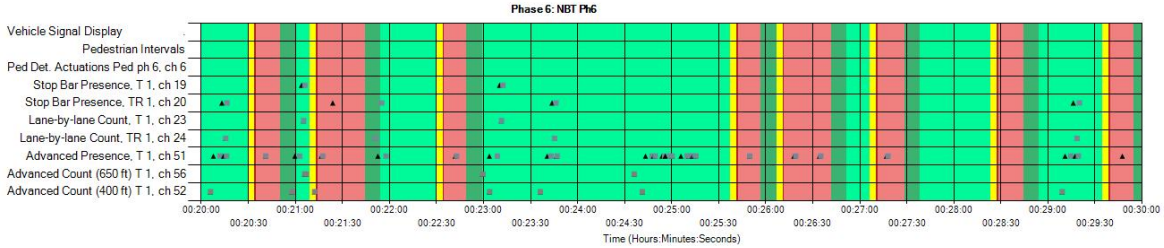
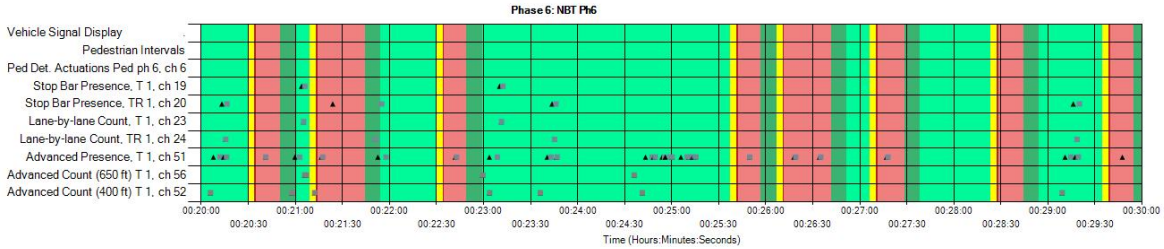


Figure 8: Yellowstone and Oak Large Profile Vehicle Detection



Analysis – A quantitative measure was not determined for the HPV. The qualitative analysis concluded that when large vehicles are detected, an advanced presence call is placed. The original performance measures called for 95 percent accuracy. The percentage was not calculated, but the detections were validated.

During non-coordinated operations, does advanced vehicle detection extend the green or place a call for service for HPV early?

The Wavetronix Advanced 200-E Extended Range Smart Sensor was placed to provide detection as far upstream as possible. During the setup of the Wavetronix Smart Sensor, the distance from the sensor location to large profile vehicles and other vehicles was noted at each approach. Detection and count zones were created for the HPV and all vehicles. The input of the Wavetronix Smart Sensor is a detection input to the controller. The distance from the sensor to where HPV was detected averaged 650 feet. The detection input puts a call to extend the green during non-

Figure 9 Corridor 2 Segment 3



coordinated operations. Not all intersections were equipped with HPV detection due to the spacing of intersections or restricted line of sight.

Evaluation process – Identifies the evaluation process used for existing and post-treatment

The ATSPMs AoG determines the percentage of vehicles that arrive on a green. The AoG percentage before the installation of the Wavetronix Advanced 200-E Extended Range Smart Sensor was compared to the AoG percentage after the installation and configuration of the sensors and controllers. It was expected that detecting HPV early and providing a call to extend service would increase the percentage of vehicles AoG and reduce the delay of HPV.

Figure 10: Corridor 3



Table 9: Morning Uncoordinated Arrival of Green Percentage

Roadway	Direction	Intersection	Phase	Baseline				Implementation				Percent Change
				11/12/2024 Arrival on Green	11/13/2024 Arrival on Green	11/14/2024 Arrival on Green	Average Arrival on Green	5/20/2025 Arrival on Green	5/21/2025 Arrival on Green	5/22/2025 Arrival on Green	Average Arrival on Green	
Segment 1 00:00 - 07:00												
5th	Northbound	South 5th Avenue @ East Carter Street	6	91%	87%	86%	88%	89%	90%	90%	90%	1.86%
5th	Northbound	South 5th Avenue @ East Center Street	6	59%	56%	59%	58%	71%	72%	72%	72%	19.07%
5th	Northbound	South 5th Avenue @ East Clark Street	6	59%	63%	62%	61%	70%	70%	69%	70%	11.96%
Segment 2 00:00 -07:00												
4th Ave	Southbound	South 4th Avenue @ East Clark Street	2	90%	86%	91%	89%	86%	87%	86%	86%	-3.09%
4th Ave	Southbound	South 4th Avenue @ East Center Street	2	71%	72%	73%	72%	85%	88%	90%	88%	17.87%
4th Ave	Southbound	South 4th Avenue @ East Benton Street	2	67%	68%	68%	68%	60%	64%	61%	62%	-9.73%
Segment 3												
Yellowstone	Northbound	Yellowstone Avenue @ Gould Street / East Oak Street	6	41%	42%	42%	42%	42%	41%	42%	42%	0.00%
Yellowstone	Northbound	Yellowstone Avenue @ West Maple Street	6	71%	69%	69%	70%	70%	60%	54%	61%	-13.59%
Yellowstone	Northbound	Yellowstone Avenue @ West Pine Street	6	85%	83%	83%	84%	79%	79%	81%	80%	-5.02%
Yellowstone	Northbound	Yellowstone Avenue @ Pearl Street	6	79%	79%	81%	80%	78%	78%	78%	78%	-2.14%
Segment 4												
Yellowstone	Southbound	Yellowstone Avenue @ Pearl Street	2	87%	87%	88%	87%	84%	85%	84%	84%	-3.56%
Yellowstone	Southbound	Yellowstone Avenue @ West Pine Street	2	80%	76%	78%	78%	77%	79%	81%	79%	1.27%
Yellowstone	Southbound	Yellowstone Avenue @ West Maple Street	2	70%	67%	68%	68%	68%	60%	54%	61%	-12.64%
Yellowstone	Southbound	Yellowstone Avenue @ Gould Street / East Oak Street	2	31%	29%	32%	31%	33%	30%	31%	31%	2.13%
Segment 5												
Yellowstone	Westbound	West Quinn Road @ Hurley Drive	4	63%	63%	64%	63%	73%	70%	72%	72%	11.63%
Yellowstone	Northbound	Yellowstone Avenue @ Pole Line Road	6	46%	47%	44%	46%	50%	46%	54%	50%	8.67%
Yellowstone	Northbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	6	52%	48%	48%	49%	44%	44%	44%	44%	-12.12%
Yellowstone	Northbound	Yellowstone Avenue @ Knudsen Boulevard	6	63%	61%	62%	62%	61%	59%	58%	59%	-4.49%
Yellowstone	Northbound	Yellowstone Avenue @ Chubbuck Road	6	84%	83%	84%	84%	81%	81%	83%	82%	-2.45%
Segment 6												
Yellowstone	Southbound	Yellowstone Avenue @ Chubbuck Road	2	52%	48%	48%	49%	44%	44%	44%	44%	-12.12%
Yellowstone	Southbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	2	84%	83%	84%	84%	81%	81%	83%	82%	-2.45%
Yellowstone	Southbound	Yellowstone Avenue @ Pole Line Road	2	55%	61%	55%	57%	55%	53%	53%	54%	-6.21%
Yellowstone	Eastbound	West Quinn Road @ Hurley Drive	8	63%	63%	63%	63%	66%	67%	69%	67%	6.44%

The segments were not coordinated in the baseline condition. The percentage represents the total day.

Table 10: Late Evening Uncoordinated Arrival of Green Percentage

Roadway	Direction	Intersection	Phase	Baseline				Implementation				Percent Change
				11/12/2024	11/13/2024	11/14/2024	Average	5/20/2025	5/21/2025	5/22/2025	Average	
				Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	Arrival on Green	
Segment 1 19:30 - 24:00												
5th	Northbound	South 5th Avenue @ East Carter Street	6	82%	81%	78%	80%	84%	86%	79%	83%	3.21%
5th	Northbound	South 5th Avenue @ East Center Street	6	82%	82%	76%	80%	79%	78%	78%	78%	-2.13%
5th	Northbound	South 5th Avenue @ East Clark Street	6	63%	70%	69%	67%	70%	73%	69%	71%	4.72%
Segment 2 00:00 -07:00												
4th Ave	Southbound	South 4th Avenue @ East Clark Street	2	75%	78%	75%	76%	76%	77%	78%	77%	1.30%
4th Ave	Southbound	South 4th Avenue @ East Center Street	2	70%	69%	70%	70%	79%	78%	76%	78%	10.30%
4th Ave	Southbound	South 4th Avenue @ East Benton Street	2	56%	54%	52%	54%	60%	55%	53%	56%	3.57%
Segment 3												
Yellowstone	Northbound	Yellowstone Avenue @ Gould Street / East Oak Street	6	36%	45%	42%	41%	36%	38%	24%	33%	-25.51%
Yellowstone	Northbound	Yellowstone Avenue @ West Maple Street	6	76%	73%	73%	74%	74%	61%	70%	68%	-8.29%
Yellowstone	Northbound	Yellowstone Avenue @ West Pine Street	6	86%	86%	86%	86%	81%	83%	79%	81%	-6.17%
Yellowstone	Northbound	Yellowstone Avenue @ Pearl Street	6	79%	79%	81%	80%	84%	84%	86%	85%	5.91%
Segment 4												
Yellowstone	Southbound	Yellowstone Avenue @ Pearl Street	2	87%	87%	88%	87%	86%	86%	88%	87%	-0.77%
Yellowstone	Southbound	Yellowstone Avenue @ West Pine Street	2	83%	84%	86%	84%	82%	83%	81%	82%	-2.85%
Yellowstone	Southbound	Yellowstone Avenue @ West Maple Street	2	75%	77%	76%	76%	71%	59%	65%	65%	-16.92%
Yellowstone	Southbound	Yellowstone Avenue @ Gould Street / East Oak Street	2	36%	34%	37%	36%	36%	38%	24%	33%	-9.18%
Segment 5												
Yellowstone	Westbound	West Quinn Road @ Hurley Drive	4	63%	63%	63%	63%	66%	67%	69%	67%	6.44%
Yellowstone	Northbound	Yellowstone Avenue @ Pole Line Road	6	41%	41%	48%	43%	50%	48%	47%	48%	10.34%
Yellowstone	Northbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	6	79%	78%	81%	79%	78%	82%	78%	79%	0.00%
Yellowstone	Northbound	Yellowstone Avenue @ Knudsen Boulevard	6	81%	80%	76%	79%	75%	76%	71%	74%	-6.76%
Yellowstone	Northbound	Yellowstone Avenue @ Chubbuck Road	6	60%	59%	59%	59%	49%	54%	49%	51%	-17.11%
Segment 6												
Yellowstone	Southbound	Yellowstone Avenue @ Chubbuck Road	2	61%	56%	52%	56%	47%	43%	40%	43%	-30.00%
Yellowstone	Southbound	Yellowstone Avenue @ Pine Ridge Mall / TJ Maxx	2	81%	81%	83%	82%	79%	78%	76%	78%	-5.15%
Yellowstone	Southbound	Yellowstone Avenue @ Pole Line Road	2	69%	70%	66%	68%	55%	50%	54%	53%	-28.93%
Yellowstone	Eastbound	West Quinn Road @ Hurley Drive	8	63%	63%	63%	63%	66%	67%	69%	67%	6.44%

The segments were not coordinated in the baseline condition. The percentage represents the total day.

Analysis – Using the Wavetronix Advanced 200-E Extended Range Smart Sensor to detect and place extension calls for HPV yielded mixed performance. Within the corridors, some intersections showed improvements in both periods, while others showed decreases. There are several potential reasons for this result. During non-coordinated periods, the rest in the green direction is along the corridor. When an HPV is detected and there is no side street call, the HPV would travel through the intersection without the need for an extension. Another factor is that the estimated arrival time is below the extended range and would not create a dilemma zone. There is sufficient evidence from the ATSPM data to suggest that advanced detection of HPV can extend the green phase, where the truck would otherwise be in a dilemma zone.

Pedestrian Detection

No intersection along the corridor had passive pedestrian detection before Stage 1 implementation. GRIDSMART/Currux/DERQ will be utilized for pedestrian detection after implementation to improve safety and conflict avoidance with integration with the ATSPM data. No baseline data will be collected.

Evaluation Segments

The evaluation segments for the video detection are:

- Yellowstone Avenue: from Pole Line Road to Breneman Street (Northbound)
- Yellowstone Avenue: from Breneman Street to Pole Line Road (Southbound)
- 4th Avenue: from Clark Street to Benton Street
- 5th Avenue: from Humbolt Street to Clark Street

Evaluation Process for Pedestrian Detection

For each evaluation intersection, the following process will be followed:

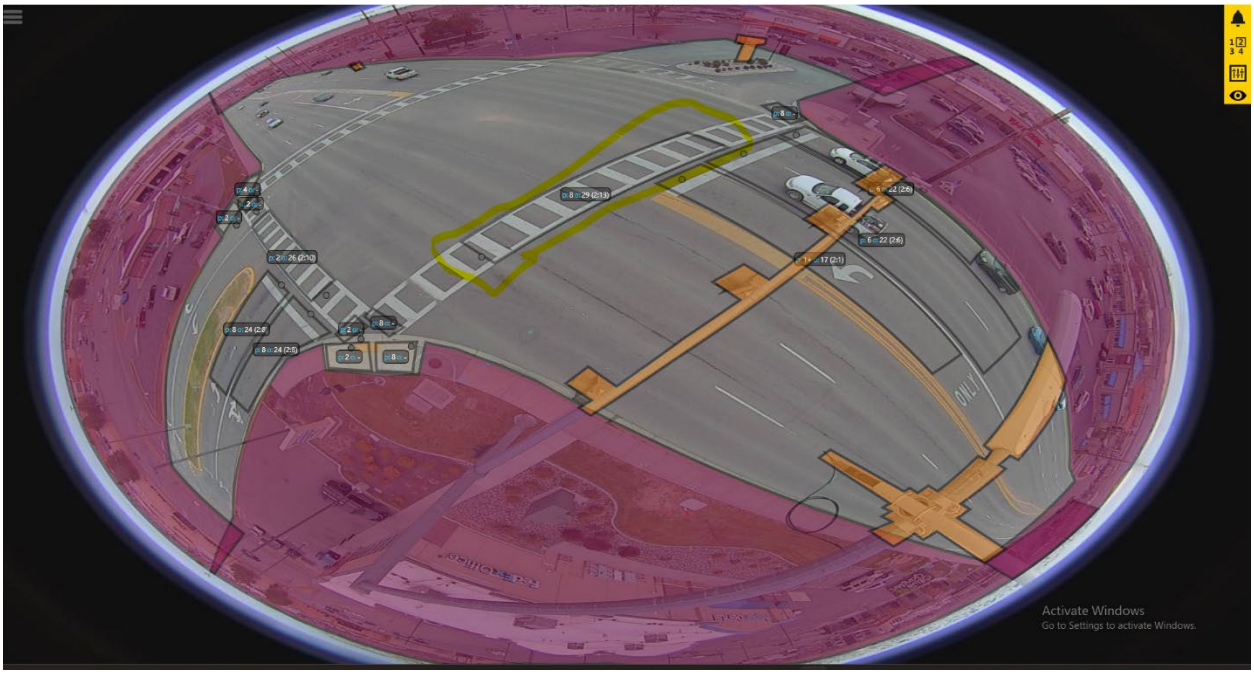
- Establish a detection zone for each approach to the intersection
- Test if each detection zone can call the controller for service or evaluate latency issues
- Walk Speed Determination
    - For each evaluation intersection, the video or radar detection will be evaluated to determine the average walking speed while crossing the street. Data for five intersections has been obtained from Currux and shown below.
    - Review of Video Data – A sample period with a high number of crossings will be selected. A predetermined point on each side of the street will measure the time (in seconds) it takes to cross the street from curb to curb.
    - Independent video determination of walking speed.
- Test if the pedestrian clearance time can be extended to protect pedestrians within the crosswalk. (Original test)
    - Once the crossing time has been established, a pedestrian clearance time will be programmed into the traffic controller.
    - Controller walk time will be programmed to extend the phase if a pedestrian is still in the crosswalk. The conflicting roadway approaches and movements remain red if a pedestrian is detected.
- Test if pedestrian detection can be used to extend the associated vehicle phase when a pedestrian is in the zone.

Establish a Detection Zone and Input into the Controller

The Currux and GRIDSMART were able to establish detection zones for the crosswalks. A detection zone for the curbs was established. Due to the radius of the curb or the use of combination ADA curbs, the zones conflicted with each other or with turning vehicles. Passive detection of pedestrians was not pursued.

Detection zone length became an issue. A screenshot from an intersection with GRIDSMART detection (Figure 11) shows the shortened pedestrian detection zone (circled yellow). The shortened pedestrian zone was necessary to prevent conflicts with right-turning vehicles, which led to false pedestrian detections. The zones were able to input data into the controller effectively. The GRIDSMART and Currux units completed this test.

Figure 11: Screenshot from Grid Smart Camera at Yellowstone and Pine Ridge Mall



The inputs were mapped to the controller as pedestrian extension and the phase associated with the detection zone.

Walk Speed Determination

Determining the walk speed became problematic for all three vendors. The Currux system had issues displaying the difference in speed between bicycles and pedestrians within the crosswalk. The issue was solved extremely late in the project. For the five intersections with Currux, the average pedestrian speed in feet/second is shown in Table 11. The report shows the average speed for the entire period. Within each evaluation period, only the number of pedestrians is shown, not the walking speed. The GRIDSMART units track speed by monitoring the object's position and the duration it remains within the zone. The GRIDSMART App 24.2 can export raw data; however, the object ID field displays -1 instead of the actual object ID. GRIDSMART is working on a fix to the issue, but that fix will occur after the phase 1 reporting period. The issues with getting the DERQ cameras to work with our existing system and the advanced detector sensors installed were numerous. The DERQ system is operational, and the interface contains a significant amount of data related to near misses and crosswalk compliance. The actual walking speed is not a data point available within the software. The project was unable to determine a method to get walking speed within the crosswalk. Since we were unable to determine the walk time late in the project period, the field verification did not occur.

Can Pedestrian Clearance Time be Extended?

The test required pedestrian walking speed data, which we were unable to obtain. Without the data, it is not possible to extend the clearance time. Instead, the project team worked to

determine an alternative that still provided pedestrian protection. The switch to extending the related phase green to the max available with a pedestrian was detected.

Table 11: Existing Conditions -Currux (May 1 to May 31, 2025)

Intersection	Location of Crosswalk	Pedestrians	Average Speed ft/s Pedestrian
South 5th Avenund East Humbolt Steet	EB Phase 8	1077	8.95
	NB Phase 6	1085	9.24
	WB Phase 4	1758	8.06
	SB Phase 4	897	7.92
South 5th Avenund East Carter Strt	EB Phase 8	1077	8.95
	NB Phase 6	1085	9.24
	WB Phase 4	1758	8.07
	SB Phase 4	897	7.92
South 4th Avenund East Benton Strt	EB Phase 8	1512	8.21
	NB	1000	10.56
	SB Phase 2	1375	7.35
	WB Phase 4	958	3.37
South 5th Avenund East Benton Strt	WB Phase 4	1223	11.14
	EB Phase 8	932	12.62
	NB Phase 6	643	11.00
	SB Phase 4	746	10.27
Yellowstone Avenund Pearl Street	NB Phase 1 & 6	225	9.98
	SB Phase 2 & 5	0	
	EB Phase 8	269	8.66
	EB Phase 4	559	7.78

Pedestrian Detection to Extend the Associated Vehicle Phase

The adjustment to extending the associated vehicle phase is a way to protect pedestrians in the crosswalk. For each intersection where Currux and GRIDSMART were installed, a detector was established to track pedestrian movement and labeled with the corresponding vehicle phase. For example, Phase 2 southbound corresponds to the east crosswalk.

Pedestrian clearance time can be extended to protect pedestrians within the crosswalk.

How has Proof-of-Concept met the original project expectation

The proof-of-concept successfully met the project's goals of installing advanced detection to reduce delays and improve travel time. To achieve the goals of this project, the coordinated phase travel time and average vehicle delay will improve through the ability to monitor the ATSPMS data (Approach delay and Arrivals on Green) and to make adjustments to the coordinated timing plan. Success was measured in increased AoG, decreased average vehicle delay, and reduction of travel time. The ability to improve AoG and reduce delay was higher than expected. The proof-of-concept was limited to a four-hour window in the afternoon peak. The success of the project will allow us to update the morning and midday timing plans. The proof-of-concept opens the door to additional ATSPMs that were unavailable prior. The new data enabled easier updates to timing plans and provided a monitoring mechanism.

The performance measure to reduce uncoordinated delay for HPV yielded mixed results; however, we were able to demonstrate that HPV can be detected at ranges beyond those of the vehicle. A call can be placed if other factors, such as estimated arrival time, fall within the parameters. The expectation was a reduction in travel time, but the results were too mixed to suggest success.

The performance measures related to pedestrian detection did not meet the proof-of-concept expectations. The project was able to determine the travel speed with Currux system but was unable to determine direction with any of the units tested. Passively detecting pedestrians worked best with GRIDSMART due to the two cameras; however, the shared pedestrian space and curb radius limited the ability to determine which direction the pedestrian intended to travel. Extending protection for pedestrians in the crosswalk. The project was able to utilize the pedestrian zones within the travel lanes to extend the associated green phase with GRIDSMART and Currux, but this was not in the original grant proposal.

Part 3: Anticipated Costs and Benefits of At-Scale Implementation

Based on the findings discussed in Part 2 of this report, the anticipated/estimated impacts of at-scale implementation are:

- Reliability and Resiliency: The proof-of-concept will demonstrate that the reliability of all arterial corridors in the at-scale deployment will improve. There is no anticipated impact on the network's resiliency due to the at-scale deployment.

- Partnerships: The DERQ, Currux, and GRIDSMART detection systems were unable to provide the necessary data for analyzing pedestrian crossing times. Each system had

different issues, ranging from the inability to separate bicycles and pedestrians in a crosswalk to the reporting mechanism's inability to identify when a specific unit entered or left the zone. There were other benefits of the camera-based smart detection, including turning counts, near misses, and illegal turns. These benefits are worth pursuing, but not as part of this study. The project partnerships went through a transition and need to continue to expand to include higher education and the ability to cross-train staff members.

- Integration: The proof-of-concept and at-scale deployment will not directly impact the integration of the connected vehicle infrastructure. The deployment has enabled the detection of pedestrians and bicycles (both on-street and on sidewalks). These improvements can be leveraged as the system matures and connected vehicle technology continues to evolve.

- Workforce development: The proof-of-concept and at-scale deployment are not anticipated to have any impact on workforce development.

Proof-of-Concept and At-Scale Implementation Cost

The estimated cost for carrying out the proof-of-concept was $1,241,398.48, slightly under the grant amount. The anticipated cost for the at-scale implementation of advanced radar is approximately 4.6 million.

Anticipated Cost-Benefit or At-Scale Implementation

The expected cost of at-scale will be determined using an average time cost for travel time and intersection delay. Table 12 utilizes data from the travel time change (Table 5) to calculate the value of time saved by the project. Seconds saved were converted to hours saved per year. The value of time was derived from the Idaho Department of Transportation's TREDIS model. For vehicles, the value of time is $15.49 per hour, and for crew (commercial), the value of time is $35.02. Idaho Department of Transportation uses six percent of the volume for crew.

Table 12: Time Saving and Estimated Cost Benefit

Roadway	Direction	Origin Cross Street	Destination Cross Street	Baseline Average Travel Time	Implementation Average Travel Time	Change is Seconds	Voulme for Hours	Seconds Saved Time Period	Hours Saved Year	Value of Time Saved
Segment 1										
5th	Northbound	Humbolt	Benton	84	73	11	3669	41582	3014.7	$44,446.79
5th	Northbound	Benton	Center	59	45	14	3669	50143	3635.4	$53,580.30
5th	Northbound	Center	Clark	19	16	3	3669	12230	886.7	$13,131.91
5th	Northbound	Clark	Oak	99	93	6	3669	22014	1596.0	$23,570.21
Segment 2										
4th Ave	Southbound	Oak	Clark	104	104	1	3669	2446	177.3	$2,693.62
4th Ave	Southbound	Clark	Center	19	19	0	3669	0	0.0	$84.05
4th Ave	Southbound	Center	Benton	43	40	4	3669	13453	975.3	$14,436.70
4th Humbolt	Southbound	Benton	Humbolt	80	71	10	3669	35467	2571.4	$37,922.86
Segment 3										
Yellowstone	Northbound	Oak	Pine	93	91	2	3117	5195	376.6	$5,626.46
Yellowstone	Northbound	Pine	Alameda	108	101	7	3267	22869	1658.0	$24,482.38
Yellowstone	Northbound	Alameda	Pearl	85	79	5	3267	17424	1263.2	$18,673.26
Yellowstone	Northbound	Pearl	Flandro	63	61	2	3468	6936	502.9	$7,483.88
Segment 4										
Yellowstone	Southbound	Flandro	Pearl	66	59	7	3669	25683	1862.0	$27,484.57
Yellowstone	Southbound	Pearl	Alameda	88	79	9	3154	27335	1981.8	$29,246.69
Yellowstone	Southbound	Alameda	Pine	97	86	11	2695	29645	2149.3	$31,711.52
Yellowstone	Southbound	Pine	Oak	90	84	6	2026	12156	881.3	$13,052.97
Segment 5										
Yellowstone	Westbound	Flandro	Pole Line	125	109	16	1566	25056	1816.6	$26,815.64
Yellowstone	Northbound	Pole Line	I86	137	119	18	1718	30924	2242.0	$33,076.05
Yellowstone	Northbound	I86	Knudsen	27	26	0	2973	991	71.8	$1,141.32
Yellowstone	Northbound	Knudsen	Chubbuck	55	49	6	2233	13398	971.4	$14,378.02
Segment 6										
Yellowstone	Southbound	Chubbuck	Knudsen	66	64	1	2368	3157	228.9	$3,452.52
Yellowstone	Southbound	Knudsen	I86	56	67	-10	2888	-29843	-2163.6	-$31,754.31
Yellowstone	Southbound	I86	Pole Line	60	74	-14	1585	-22190	-1608.8	-$23,589.88
Yellowstone	Eastbound	Pole Line	Flandro	130	104	26	2476	64376	4667.3	$68,765.11
									Annual Savings	$439,912.64
									Life Cost (4 years)	$1,759,650.55
									Project Cost	1,241,925.56
									Benefit -Cost Ratio	1.42

With a Benefit cost over 1.0 from Stage 1, and assuming the results are similar, which is expected, the benefit-cost ratio will be over 1.0. In the proof-of-concept, only the peak PM period was analyzed. The region is currently working on adding a morning and midday timing plan using the same procedure established in Stage 1. At scale, the morning and midday peaks will also be addressed as part of the project.

Preliminary baseline data were collected in Stage 1 for an evaluation of at-scale implementation.

Most of the performance measures cannot be analyzed unless the project is implemented. One measure where data is available is the Travel Time Index. The three corridors in Stage 1 had a TTI ranging from 1.21 to 1.34. Table 13 shows the Travel Time Index for the PM peak period. The seven corridors range from 1.13 to 1.31. While five of the Stage 2 corridors are less than the Yellowstone Corridor, they are all experiencing a level of congestion that can be improved by implementing Stage 1 treatments.

Table 13: Stage 2 Travel Time Index 2024 for PM Peak Period

Corridor	Travel Time Index 2024
Pole Line Corridor	1.18
Jefferson Corridor	1.17
Center/Clark Corridor	1.17
Chubbuck Road Corridor	1.14
Olympus Corridor	1.13
Alameda/Pocatello Creek	1.24
Main/Arthur	1.31

Part 4: Challenges & Lessons Learned

The project is a partnership between BTPO (the MPO for the region) and the agencies that own and operate the traffic signals. The region has a Memorandum of Understanding (MOU) that establishes an operation and management committee to oversee the region's coordinated traffic control corridors. BTPO has managed this process for over ten years. This BTPO oversight has successfully maintained the partnership and improved the coordinated network. It did not prepare BTPO to manage a project of this size. For a smaller MPO like BTPO, the planning rules and regulations that have been well-known and utilized have not prepared us to manage a signal upgrade project. The timelines for procurement and the information needed to procure the equipment successfully were underestimated. The process should have occurred as soon as the grant was selected and updated after the grant approval. The NEPA and BABA caused delays in starting the procurement process, and BABA provided challenges in determining the requirements and getting that information from vendors.

A valuable lesson was learned from the project's vision through its implementation, despite the challenges. The project vision was developed over several years, during which traffic signal coordination was gradually improved and coordination challenges were addressed. The application was developed quickly and included all of the planned vision items for the region. The project's vast scope became a challenge in developing an evaluation plan. The scope needed to be decreased to include only the essential measures that address the issue of vehicle delay and improved travel time. Once the key issues were the project's focus, the evaluation plan was easier to develop.

Another lesson learned is to spend more time questioning the performance measures for the various evaluation criteria. For example, the High Profile Vehicle detection was set at 95% accuracy. In practice, the count zone established is not an accurate count due to double counting. The setup of the advanced radar sensors provided the most accurate determination of the sensors' performance. Determining if the HPV activated a call was another area where a percentage should not have been used. To get an accurate percentage would have required coordinating a person in the field with a person in the control center. Again, the setup of the advanced sensors and monitoring the control provided evidence that HPV detected placed a call.

The project team consisted of members from Pocatello (the agency responsible for the traffic management center), BTPO, and a consultant. The City of Chubbuck and the Idaho Transportation Department were involved in the application and at key points in the project. The project team was kept small to minimize confusion and delays. Key issues that could have been reduced were the equipment installation requirements and the level of traffic control needed. Traffic control changes for equipment installation were a strain on the project budget. The original budget relied on local resources to support the installation, enabling the training of local staff and facilitating future installations with local forces. Staff changes throughout the project's life cycle had an impact on our ability to provide that assistance. The lesson learned is not to rely on local resources to accomplish the installation, but rather to be present to learn and monitor the process.

The lack of an education partner prevented additional research questions from being asked or addressed. Several times during the project, the team encountered issues that required additional research. Having a higher education partner would be beneficial in future efforts.

The data management plan was difficult due to the unfamiliarity with the data requirements for research projects. The data guidance differs in transportation planning from research on transportation projects. Now that the process is known, a research partner would have greatly assisted in navigating it. The team at the National Transportation Library was extremely helpful in providing an overview of the requirements and offering comments that enabled the data management plan to be approved.

The workforce capacity was a challenge during the project. The experience level and ability to implement the project limited the team size. Using consultants allowed the project to be completed. Each participant had a different understanding of the process. Additional meetings with the project team and the entire committee would eliminate some confusion and delayed the development of the procurement documents.

The new radar and advanced camera sensor technology experienced issues related to the Synchronous Data Link Control (SDLC) bus. Signals from both the Wavetronix and Currux sensors went into flash after the sensors were installed. The issues were solved, and additional training was provided on the SDLC bus. The age of traffic cabinets can hinder technological upgrades, and in Stage 1, this resulted in increased installation time. The Stage 2 project should consider installing a newer signal cabinet before the smart sensors.

Part 5: Deployment Readiness

The pilot project was selected to address potential issues that may arise during at-scale deployment. The pilot project involved coordination across jurisdictions, which sometimes proved challenging. The challenges were related to having local jurisdictions provide some of the installation and programming of the technology. This stresses the local agencies and delayed implementation. The at-scale deployment will be done through a contract where the local agencies will only supervise the installation of the sensors. The equipment types and the process to improve the corridors are determined. The at-scale deployment will be easier due to the

lessons learned in this project. A successful at-scale implementation will require addressing the lessons learned. In the implementation phase, we will require more detailed plans for each intersection development, including the location of sensors and traffic control plans. The scale will necessitate splitting the implementation into corridors to facilitate deployment.

Contractor and vendor procurement for equipment and installation will also pose a hurdle to at-scale implementation, due to limited contractor availability and the requirement for sole sourcing of equipment from a few vendors.

One of the biggest obstacles to scaling the project is the incompatibility of some intersection technology at the traffic signal cabinet with smart equipment and sensors. The need for a new traffic signal cabinet is noted in the budget. It will necessitate increased planning and traffic control over Stage 1.

The other obstacle is workload capacity. Technology has increased the amount of data available to the traffic control center. The center's staffing can affect the ability to respond to the information provided by technology. The obstacle is being overcome by increasing the number of staff at all three organizations who understand the data and make recommendations on timing changes.

Maintenance and Operations

BTPO and its partners have developed a cooperative maintenance and operations agreement that covers over fifty percent of the operations of the signals in the region. The cooperative has experience in rolling out new equipment and maintaining this equipment. The group developed this pilot project to address the issues of maintaining and improving traffic signal timing without extensive data collection, on a more frequent basis. The constant evolution of the network is a product of agreement. At scale, the Traffic Coordination and Maintenance Cooperative Agreement will require modification to include assisting all traffic signals, not just those in the coordinated network. Under the existing agreement, the group upgraded the traffic controller, detection, and monitoring systems, as well as travel time outside the network. At-scale deployment will require focus signals and corridors outside the existing network. The previous experience will allow this to occur without many issues. Additional joint staff and training will be necessary to mitigate the impact of the current Central traffic control center staff.

Impact of New Technologies on Jobs

At-scale implementation would enable the region to continue improving the safe operation of signalized intersections and be better prepared for other changes that connected vehicles may require. The new technology supports both existing and new jobs. This type of technology requires specialized training, but electricians and technicians are responsible for the installation and maintenance of the hardware.

Part 6: Wrap-Up

The project's radar technology solutions and ATSPMS data met or exceeded expectations in terms of improved travel time and reduced delays. The technology benefited both coordinated and uncoordinated traffic operations. The data available with the advanced detection exceeded our expectations. The reduction in the corridor delay and travel time was larger than expected.

Video (camera) technologies reveal issues that have limited the project's ability to achieve its original intent. The advanced camera's interface from the different vendors provided more data than anticipated. While two of the three were able to set up passive zones to detect pedestrians, the intersection geometries made the application impossible. Pedestrian speed is not a focus of the technologies tested. The ability to detect a pedestrian or bicycle in an established crosswalk and send a signal to the controller to extend the green when a presence is detected partially meets the original intent but does not fulfill the passive pedestrian call.

BTPO proposes two changes for at-scale implementation. Utilizing more contractors to implement the changes and update the Central Traffic Control Center and ATSPM databases will help improve the speed of implementation and provide a single point of contact. Develop a training guide that focuses on monitoring the system and identifying when minor adjustments are needed. The guide will provide information to existing staff and help new staff get familiar with the coordination process.

The advice for other communities falls into two categories: scale and workload estimation. As discussed previously, BTPO has led a four-agency cooperative that implemented a central traffic control center and remote centers at each agency. The technological upgrades and the ability to improve signal timing and corridor progression have led us to desire further changes to achieve even larger improvements. The Stage 1 project was the next step in our progression.

The decision to tackle the largest corridor with the most intersections and issues may not have been wise. Focusing on fewer intersections in the corridor or identifying one or two pilot projects could have helped manage the project, allowing staff to place more emphasis on implementation rather than project delivery.

The cooperative has built the system from the ground up. We wanted a firsthand approach, but that desire should be balanced with experience and staffing resources. Staffing changes can put a strain on local agency resources. Using a contractor for implementation will provide smoother project execution and eliminate the need to account for potential changes in agency staff levels and workload.

The Innovative Transportation Solution Project was a success that advanced the ability to monitor and make changes to signal timing, demonstrating the project's success. The improvement to non-coordinated HPVs demonstrated other potential improvements that the region is now capable of doing. The pedestrian portion of the project was disappointing. The technologies chosen provided more information than previously available and will be utilized to continue improving pedestrian travel.