CLACKAMAS COUNTY BOARD OF COUNTY COMMISSIONERS

Study Session Worksheet

Presentation Date: April 16, 2013 **Approx Start Time**:1:30PM **Approx Length:** 30 minutes

Presentation Title: Traffic Safety Update

Department: Department of Transportation and Development and Clackamas County Sheriff's Office

Presenters: Joseph Marek, Captain Kevin Layng and Lieutenant Jeff Davis

Other Invitees:, Patty McMillan and Mike Bezner

WHAT ACTION ARE YOU REQUESTING FROM THE BOARD?
The purpose of this study session is to update the Board of County Commissioners on the status of traffic safety initiatives. No action is requested at this time.

EXECUTIVE SUMMARY:
The Clackamas County Safe Communities (CCSC) program was established in 2005 with a mission to "Reduce injuries and fatalities in Clackamas County". The program utilizes the 5E approach to traffic safety (Education, Emergency Medical Services, Enforcement, Engineering and Evaluation) to achieve program goals. Members of the Safe Communities Advisory Board recommended quarterly reports to the Board focused on collective traffic safety initiatives. The Advisory Board provides executive oversight of CCSC and is staffed with public and private public safety officials (roster attached). This is the first Board update which follows the adoption of the Transportation Safety Action Plan in November 2012.

This update will focus on four initiatives – the Beavercreek Road – Road Safety Audit, Teen Triple Threat – Safe Driving Contest, Automated License Plate Recognition technology and TACT (Targeted Aggressive Cars and Trucks) Operations.

FINANCIAL IMPLICATIONS (current year and ongoing):
There are no financial implications associated with this overview.

LEGAL/POLICY REQUIREMENTS:
There are no legal/policy requirements at this time.

PUBLIC/GOVERNMENTAL PARTICIPATION:
There is no public/government participation associated with this overview.

RECOMMENDATION:
None at this time.

ATTACHMENTS:
1. Safe Communities Advisory Board Roster

2. Beavercreek Road Safety Audit

SUBMITTED BY:
Division Director/Head Approval _____
Department Director/Head Approval _____
County Administrator Approval _____

For information on this issue or copies of attachments, please contact Joseph Marek@ 503-742-4705

Safe Communities Traffic Safety Update

STAFF

SAFE COMMUNITIES:
JOSEPH MAREK – PROGRAM DIRECTOR
PATTY MCMILLAN – PROGRAM COORDINATOR

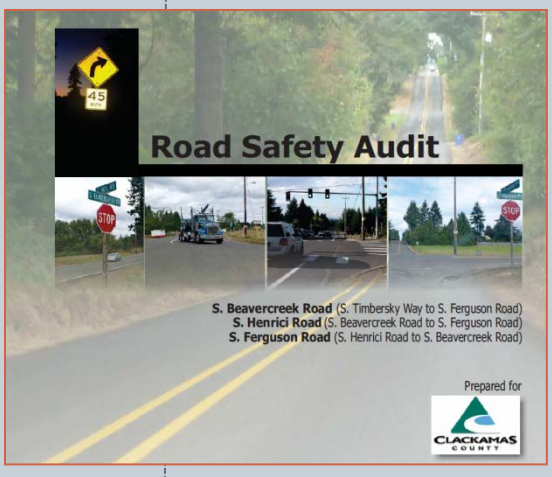
CLACKAMAS COUNTY SHERIFF'S OFFICE:
CAPTAIN KEVIN LAYNG
LIEUTENANT JEFF DAVIS

Purpose

- Safe Communities Advisory Board recommended quarterly reports to the BCC on traffic safety initiatives from CCSC and the CCSO
  - Clackamas County Safe Communities (CCSC) program was established in 2005 with a mission to:
    - "Reduce injuries and fatalities in Clackamas County"
  - Program utilizes 5E approach to traffic safety
    - Education
    - Emergency Medical Services
    - Enforcement
    - Engineering
    - Evaluation

Four Safety Initiatives Covered Today

- Beavercreek Road Safety Audit
- Teen Triple Threat – High School Safety Contest
- Automated License Plate Recognition Program
- TACT Operations



Beavercreek Road Safety Audit - Background

- The Hamlet of Beavercreek had concerns about safety
  - Beavercreek Road – OC limits to Ferguson
  - Henrici – Beavercrk. To Ferguson
  - Ferguson – Henrici to Beavcrk.
- Beavercreek Road
  - Minor Arterial – 8,000 veh/day

  Henrici Road

  Minor Arterial – 3,000 veh/day

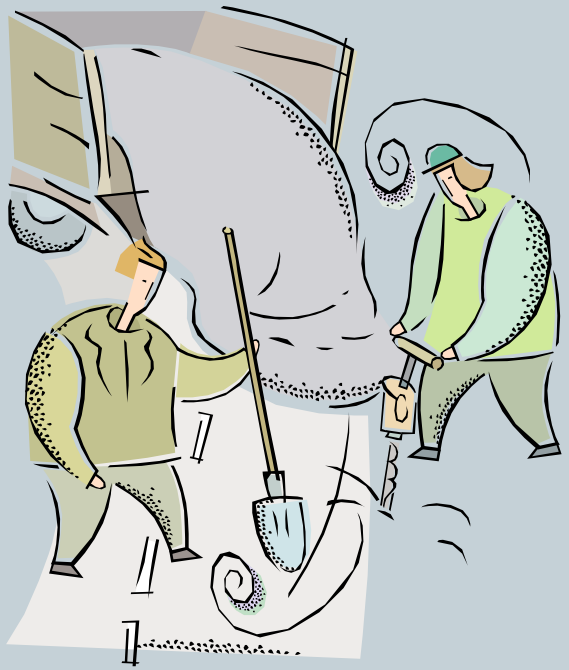
  Ferguson Road

  Local – 700 veh/day
- Examine safety – focus on Beavercreek Road
- The pilot project was funded through the Safe Communities Program from and ODOT-TSD grant

Goal of an Road Safety Audit

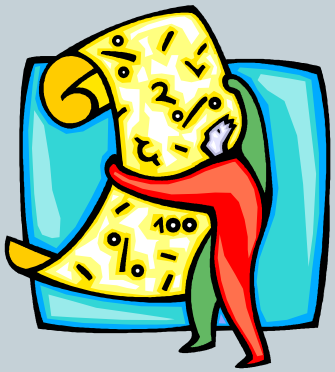
Answer the following questions:

1. What elements of the road present a safety concern:
   a) What extent
   b) Which road users
   c) Under what circumstances
2. What can we fix?



The Report

- Short and Long-term recommended improvements
- Recommendations prioritized based on:
  - Potential safety impacts
  - Cost



- Focus on short term projects:
  - Widen shoulders
  - Vegetation removal
  - Sign upgrades
  - Install turn lanes where warranted
- Identify improvements at Leland/Kamrath

Working with the Community

- Hamlet member was on RSA team
- Example of how we can engage and partner with Communities to improve safety
- Active community engagement in the process

- The pilot project has been well received and staff wishes to continue the program with one or two audits per year (as funding allows)

Outcomes

- Identified a number of short term strategies that are being implemented:
  - Trimming/removal of vegetation
  - Signing upgrades
  - Road shoulder improvements
  - Striping changes this summer
- Attended Hamlet of Beavercreek meeting on February 27th

Teen Triple Threat – Safe Driving Contest

The contest is conducted every other year and open to all high school students in the county.

We will combine the next TTT with the State Farm "Celebrate my Drive" contest. CMD raises funds for schools starting September 2013.

We currently are running smaller contests at Rex Putnam and Happy Valley (Posters and Coasters)

The program targets youth who are the 2nd highest contributing factor in county crashes.

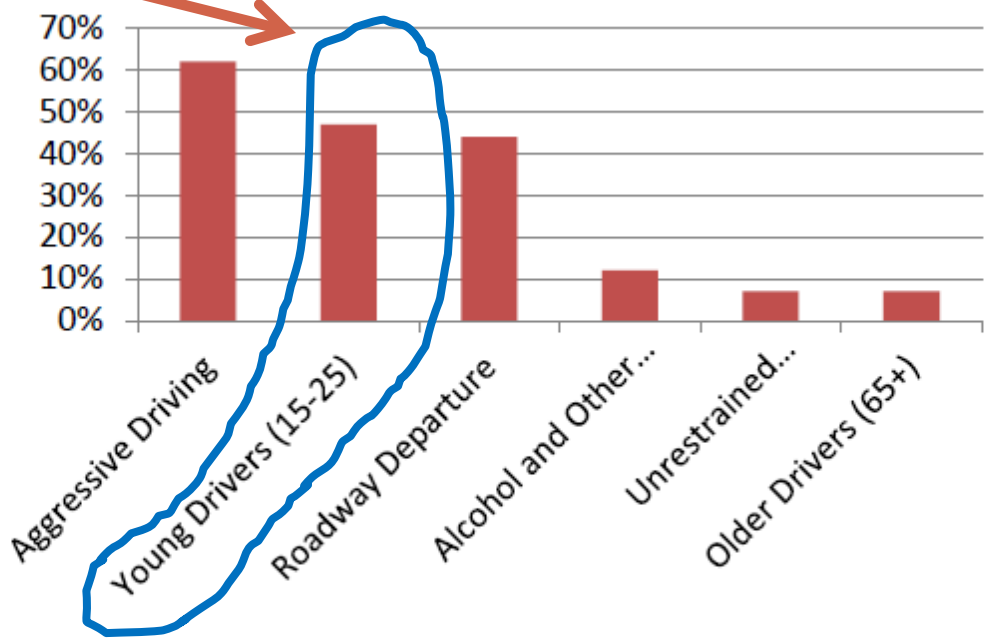


Figure 7 Six Highest Contributing Circumstances to Fatal and Severe Crashes on County-maintained Roads, 2005-2009

Source: Transportation Safety Action Plan

Past Contest Winner Brad Mills – Oregon City High School

TTT Community Involvement

- The media is shared with the community in a variety of methods:
  - Classroom presentations
  - Social Media
  - Community Events

- Other dividends
  - Radio exposure
  - Clackamas Review coverage
  - Recognition at school assemblies

Teen Triple Threat winners with broadcaster Savannah Jones at the Wolf Radio station. The station gave the students air time talking about their traffic safety ads.

Automated License Plate Recognition (ALPR) Program

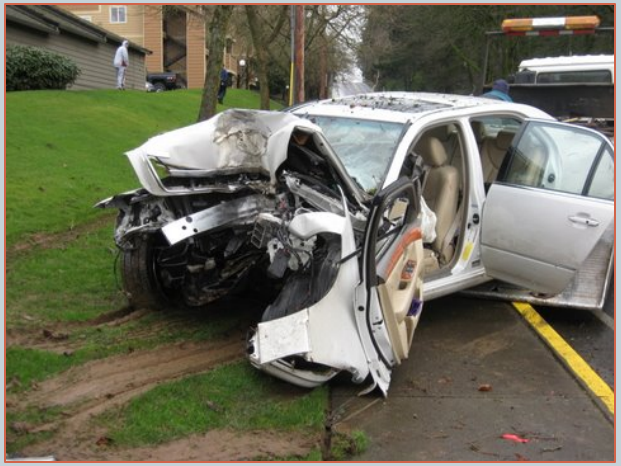
- What are ALPRs?
  - Infrared cameras
    - scan a license plate and instantly compare it against many databases, looking for things such as:
    - Stolen Vehicles
    - Amber Alerts
    - Suspended/Revoked Drivers etc.
- CCSO has 4 mobile ALPR units
  - 3 deployed in unincorporated Clackamas County
  - 1 unit assigned to Wilsonville Police Department.

Data Source: Department of Motor Vehicles

- CCSO working with DMV on up-to-date data delivery
  - Expanded the use of the ALPR to target suspended and revoked drivers.
- CCSO's innovative approach and partnership with ODOT will enable this information to be available Statewide in the near future.

Suspended -Revoked Drivers (S/R) Compared to Validly Licensed Drivers (V) and Crashes

- A California DMV research report found:
  - Compared to licensed drivers, those who drive without a valid license are nearly three times more likely to cause a fatal crash relative to their exposure.
  - The study results provide strong evidence that S/R and unlicensed drivers are much more hazardous on the road than validly licensed drivers.



Source: DMV California – Estimation of Fatal Crash Rates for Suspended/Revoked and Unlicensed Drivers in California – September 2012

Percent of Drivers in Fatal Crashes

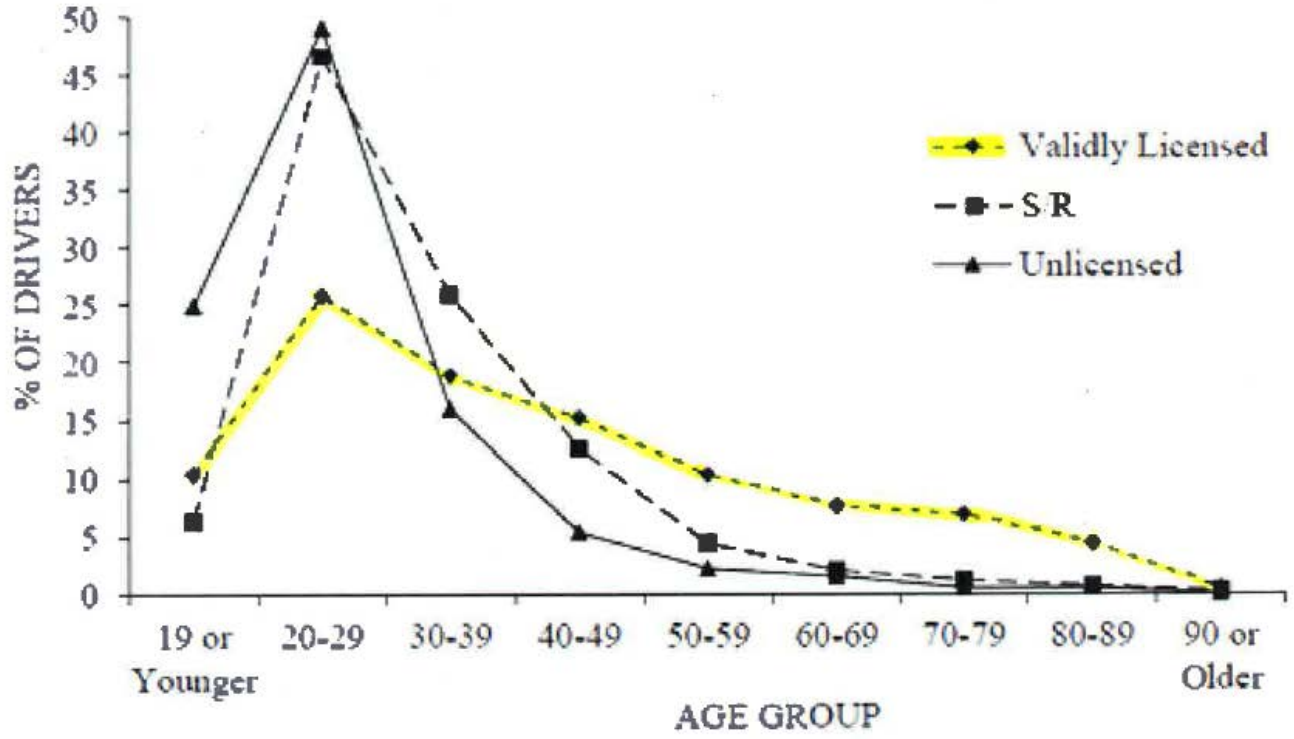


Figure 1. Percentage of drivers in the study's sample of two-vehicle fatal crashes from 1987 through 2009 by age group and license status.

Source: Ibid

Commercial Vehicle Safety

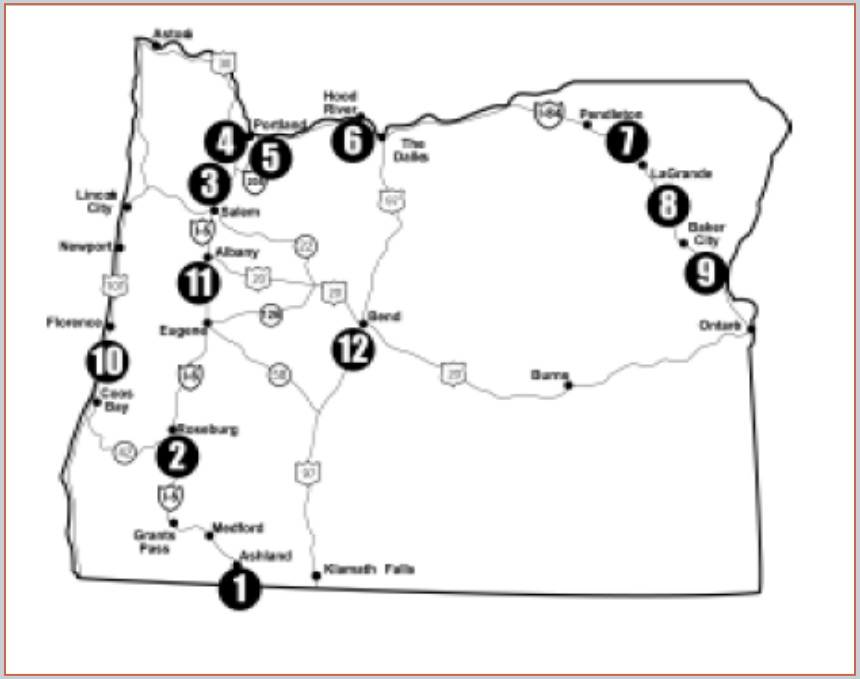
- CCSO is proactive in truck safety:
  - First in Oregon to conduct aggressive driving (AD) missions in and around commercial vehicles.
- Aggressive Driving is the leading cause of truck involved crashes.

Targeted Aggressive Cars and Trucks Operations

- CCSO conducts several TACT (Targeted Aggressive Cars & Trucks) operations yearly.
- Decoy trucks are used with an undercover deputy video taping AD's and relaying the info to Traffic Units to enforce.

Motor Carrier Safety Assistance Program

- Focused enforcement:
  - 268 road miles in 12 parts of the state where truck crashes are overrepresented
- Accident Intensified MCSAP (AIM) corridors include:
  - Areas in County
    - I-205 - West Linn to Clackamas, I-205, MP 8-14



Conclusion

- Safe Communities and the Clackamas County Sheriff's Office are committed to traffic safety.
- These projects are a sample of innovative, cost-saving programs focused on keeping our roads crash free.

- Stay safe!
- In partnership:

Clackamas County Safe Communities Program:
Joseph Marek, Director
Patty McMillan. Program Coordinator

Clackamas County Sheriff's Office:
Captain Kevin Layng
Lieutenant Jeff Davis

SAFE COMMUNITIES ADVISORY BOARD ROSTER April 2013

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Road Safety Audit

S. Beavercreek Road (S. Timbersky Way to S. Ferguson Road)
S. Henrici Road (S. Beavercreek Road to S. Ferguson Road)
S. Ferguson Road (S. Henrici Road to S. Beavercreek Road)

Prepared for

CLACKAMAS COUNTY

Prepared by

DKS

Audit Dates: August 29-30, 2012

Road Safety Audit

S. Beavercreek Road (S. Timbersky Way to S. Ferguson Road)

S. Henrici Road (S. Beavercreek Road to S. Ferguson Road)

S. Ferguson Road (S. Henrici Road to S. Beavercreek Road)

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Prepared by:
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Portland, Oregon 97205

In cooperation with:
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Clackamas County Project Manager: Joe Marek, P.E., PTOE
Consultant Project Manager: Scott Mansur, P.E., PTOE

October 2012

THIS DOCUMENT IS PROTECTED
UNDER THE PROVISIONS OF TITLE 23 UNITED STATES CODE SECTION 409 AS FOLLOWS:

Title 23 U.S.C. § 409
Discovery and admission as evidence of certain reports and surveys

Notwithstanding any other provision of law, reports, surveys, schedules, lists or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 144 and 148 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists or data.

Road Safety Audit Summary

An interdisciplinary team formed by Clackamas County conducted a Road Safety Audit (RSA) along three rural corridors (listed below) and at nine intersections Clackamas County, Oregon. The RSA documents the safety performance evaluation of these roadways and intersections. The RSA team identified existing safety related issues through analysis of crash records and a field assessment.

- S. Beavercreek Road (M.P. 11.27-13.54) S. Timbersky Way to S. Ferguson Road
- S. Henrici Road (M.P. 1.04-1.99) – S. Beavercreek Road to S. Ferguson Road
- S. Ferguson Road (M.P. 0.5-1.99) – S. Henrici Road to S. Ferguson Road

The RSA team conducted the field assessment on the 29th and 30th of August 2012 and the findings are included in this report. The safety related issues were categorized based on a qualitative risk scale. The RSA team identified the following general issues with more specific issues identified in the report:

S. Beavercreek Road

- No provisions for pedestrians or bicyclists
- Narrow roadway shoulders
- Pavement drop off in focused locations
- Stopping sight distance restricted by vertical curves
- Intersection sight distance restricted by vegetation/vertical curves
- Signing blocked by vegetation
- Inconsistent roadway delineation
- Unprotected steep ditches along the roadside
- Objects located within the roadway clear zone

S. Henrici Road

- No provisions for pedestrians or bicyclists
- Narrow roadway shoulders
- Stopping sight distance restricted by vertical curves
- Intersection sight distance restricted by vegetation/vertical curves
- Signing blocked by vegetation
- Objects located within the roadway clear zone

S. Ferguson Road

- Narrow roadway shoulders
- Stopping sight distance restricted by vertical curves
- Intersection sight distance restricted by vegetation/vertical curves
- Posted speed may be high for roadway functional classification
- Objects located within the roadway clear zone

The RSA team identified several improvements to address these issues and improve the safety along the

three roadways and at intersections. These improvements were categorized in terms of respective cost (low, medium, high) and are presented in this report.

RSA Process

RSAs are conducted by an independent multidisciplinary team to assess the safety performance of a roadway and/or intersection and suggest potential safety improvement options for all users (motor vehicle, bicyclists, and pedestrians). The goal of RSA's is to help improve roadway safety by identifying existing as well as potential future safety related issues, as well as promoting awareness of safe design, operational, and maintenance practices. The multidisciplinary team provides an unbiased view of safety issues and solution development. An RSA is a way to proactively address safety and identify low cost high value improvements by applying current safety evaluation techniques and engineering practices. The hope is to reduce the number and severity of all crash types.

Figure 1 shows the eight major steps for conducting an RSA consistent with Federal Highway Administration (FHWA) RSA Guidelines[1]. As shown in the figure the first two steps as well as the last two steps are conducted by the facility owner (Clackamas County). The RSA team is responsible for completing steps three through six. These steps are described in the following sections.

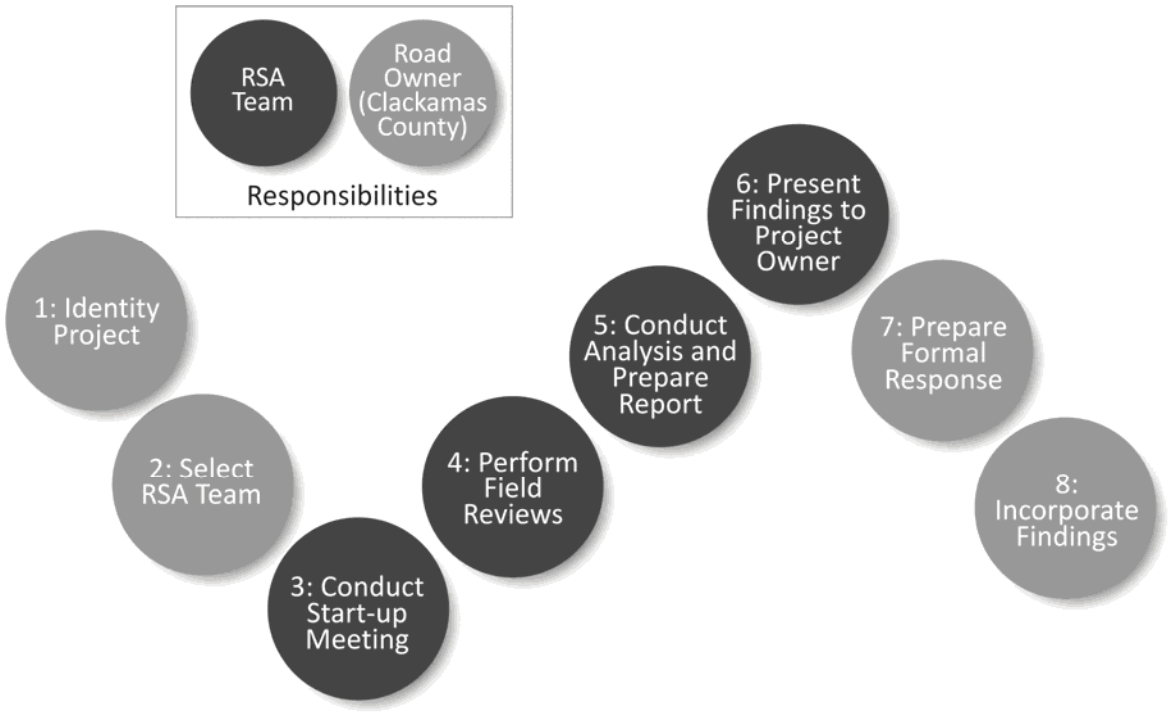


Figure 1: Road Safety Audit Process

[1] FHWA Road Safety Audit Guidelines, U.S. Department of Transportation Federal Highway Administration, Publication No. FHWA-SA-06-06.

Project Identification

The RSA involves assessing the safety performance of three rural roadway segments located just outside of the urban growth boundary within Clackamas County. These three corridors are listed below and are shown Figure 2.

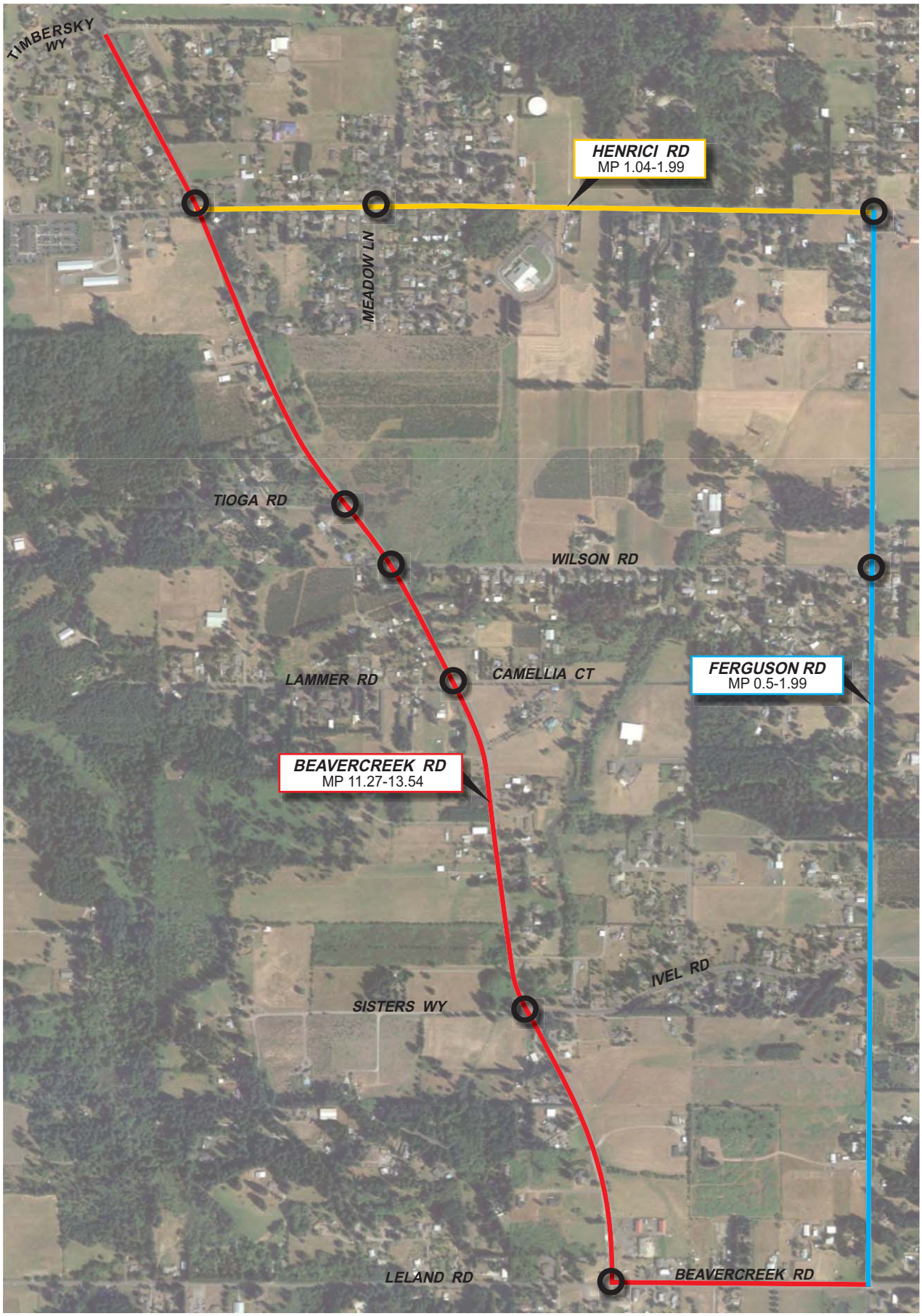
- S. Beavercreek Road (M.P. 11.27-13.54) S. Timbersky Way to S. Ferguson Road
- S. Henrici Road (M.P. 1.04-1.99) – S. Beavercreek Road to S. Ferguson Road
- S. Ferguson Road (M.P. 0.5-1.99) – S. Henrici Road to S. Ferguson Road

RSA Team

The RSA team members are listed in Table 1 along with their primary area of expertise. The goal is to have an independent, experienced, and multidisciplinary team.

Table 1: Road Safety Audit Team

Name	Agency	Specialty
Scott Mansur, P.E., PTOE	DKS Associates	RSA Team Leader /Transportation Engineer
Michael Tomasini, P.E., PTOE	DKS Associates	Transportation Engineer
Jim Peters, P.E., PTOE	DKS Associates	Transportation Engineer
Steve Boice, E.I.T.	DKS Associates	Transportation Engineer
Christian Snuffin, P.E.	Clackamas County	Transportation Engineer
Rick Nys, P.E., PTOE	Clackamas County	Transportation Engineer
Nick Fortey, P.E.	Federal Highway Administration	RSA Experience
Elizabeth Graser Lindsey	Citizen/Hamlet of Beavercreek Member	Public Knowledge



LEGEND

- Study Intersection
- Study Corridor (as labeled/color coded)

MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure **2**

STUDY AREA

RSA Startup Meeting

An RSA start-up meeting was held at Clackamas County offices on August 29th, 2012. The RSA Team was given a presentation to inform them of the existing site conditions including surrounding land uses, motor vehicle volumes, crash records, speed survey results, and previous intersection improvement efforts. Additional RSA training was also provided before heading out to the field to investigate the safety performance of the three study roadways. Training consisted of identifying key elements to look including roadway geometry, operations, road users, and environment. Each team member was provided an RSA checklist in which they could use to help facilitate the evaluation process and is included in the Appendix.

Preliminary review of crash records over the previous five years (2007-2011) revealed that there were several specific locations along each roadway where groups of crashes occurred. These locations were primarily within the vicinity of an existing intersection as listed below:

- S. Beavercreek Road/S. Henrici Road
- S. Beavercreek Road/S. Tioga Road
- S. Beavercreek Road/S. Wilson Road
- S. Beavercreek Road/S. Lammer Road-S. Camelia Court
- S. Beavercreek Road/S. Ivel Road
- S. Beavercreek Road/S. Leland Road-S. Kamrath Road
- S. Henrici Road/S. Meadow Lane
- S. Henrici Road/S. Ferguson Road
- S. Ferguson Road/S. Wilson Road

These intersections were the primary focus of the RSA team; however, a thorough review of all roadways and intersections was completed to address potential safety issues.

RSA Field Investigation

The RSA team observed and investigated the three roadway segments and intersections during peak and off-peak hours during the morning, afternoon, and evening on the 29th and 30th of August, 2012. Both of these days featured dry sunny weather. The RSA schedule is provided in Table 2. Observations focused on the roadway and roadside environment, existing roadway geometry, motor vehicle operations, and driver behaviors. During these field visits team members were responsible for identifying and documenting safety issues.

Table 2: Road Safety Audit Schedule

Wednesday August 29, 2012	
3:00 pm to 4:00 pm	RSA Team Presentation/Training
4:00 pm to 5:00 pm	Afternoon safety performance evaluation
5:00 pm to 6:00 pm	P.M. Peak hour safety performance evaluation
6:00 pm to 6:30 pm	Dinner and debrief
6:30 pm to 8:00 pm	Evening safety performance evaluation
Thursday August 30, 2012	
6:30 am to 9:00 am	Morning safety performance evaluation
9:30 am to 11:30 am	Analysis, improvement options, and findings

RSA Analysis

The RSA team identified and categorized observed safety performance issues based on a qualitative risk scale as shown in Table 3. This risk scale was based on the probability of a potential crash and its associated severity based on FHWA's crash prioritization methodology.

Crash Frequency: Indicates the potential for how often a crash could occur.

- **Frequent:** Five or more crashes per year
- **Occasional:** One to five crashes per year
- **Infrequent:** One crash every six years
- **Rare:** Less than one crash every six years

Crash Severity: Indicates the potential for the outcome of a crash.

- **High:** Fatality or debilitating injury crash
- **Medium:** Non-debilitating injury crash, but medical assistance is required
- **Low:** Non-debilitating injury crash without need for medical assistance
- **Negligible:** property damage only type crashes

Table 3: Crash Prioritization Matrix

FHWA Crash Prioritization Risk Category		Severity			
		Negligible	Low	Medium	High
Crash Frequency Category	Frequent	C	D	E	F
	Occasional	B	C	D	E
	Infrequent	A	B	C	D
	Rare	A	A	B	C

This table assigns a letter score between A and F based on the potential combinations of crash frequency and crash severity. A score of "F" indicates that there would be a high probability of frequent and severe crashes – a poor situation that should be addressed with highest priority. Conversely, a score of "A" indicates that the probability of a crash would be rare to infrequent and the severity of the crash would be negligible to low.

RSA Study Area

The RSA study area including existing roadway characteristics, surrounding land use, motor vehicle traffic volumes and crash history over the previous five years is discussed in the following sections.

Roadway Characteristics

All three roadways included in this RSA are rural roadways that have two travel lanes with either a narrow paved or gravel shoulder and a posted speed limit ranging from 35 to 45 miles-per-hour (mph). The Clackamas County roadway classification guidelines are included in the Appendix. All roadways feature a continuous double yellow line (no passing zones within study area segment). S. Beavercreek Road features several horizontal curves and rolling terrain. Both S. Henrici Road and S. Ferguson Road are straight roadway segments and also feature rolling terrain. All roadways feature numerous driveways on both sides of the roadway and none have sidewalks nor designated bike lanes with the exception of bike lanes on S. Beavercreek Road north of S. Henrici Road.

The existing roadway characteristics along with the measured 85th percentile speeds[2] are summarized in Figures 5, 6, and 7. The 85th percentile speed is 4 mph over the posted speed on S. Ferguson Road, whereas on S. Beavercreek Road and S. Henrici Road, it ranges from 4-12 mph over the posted speed.

Figure 3: Looking South on S. Beavercreek Rd near S. Henrici Rd

There is one traffic signal located at the intersection of S. Beavercreek Road/S. Henrici Road. At this location, both the S. Beavercreek Road and S. Henrici Road roadway segments widen for an additional turn lane as shown in Figure 3. All other intersections are unsignalized with the minor street being stop controlled.

Surrounding Land Use

Surrounding land uses within the study area include rural, unincorporated community residential and rural commercial as shown in Figure 4[3]. The majority of the study area is rural, with the community of Beavercreek centered on the intersection of S. Beavercreek Road/S. Leland Road-S. Kamrath Road.

There are several land uses within and around the study area which contribute to traffic flow patterns. The Trinity Lutheran Church & School is located on S. Henrici Road between S. Beavercreek Road and S. Ferguson Road. The Oregon City Golf Club is located on S. Beavercreek Road, about half a mile north of the intersection at S. Henrici Road. The Oregon City High School is located about a half a mile north of the Golf Club on S. Beavercreek Road. Additionally the close proximity of the City of Oregon City influences traffic patterns.

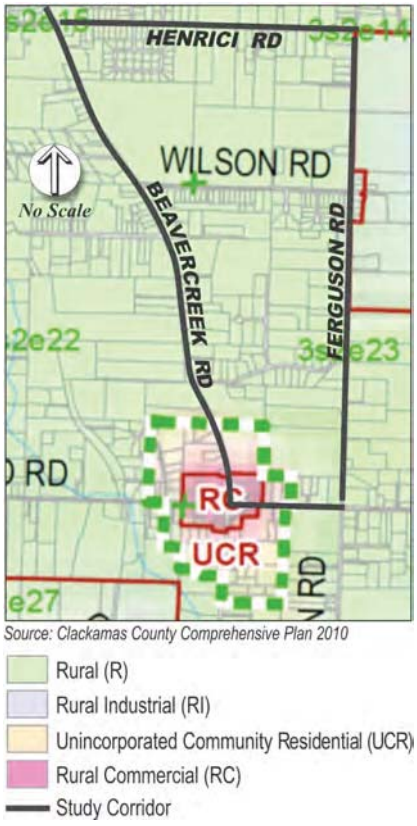
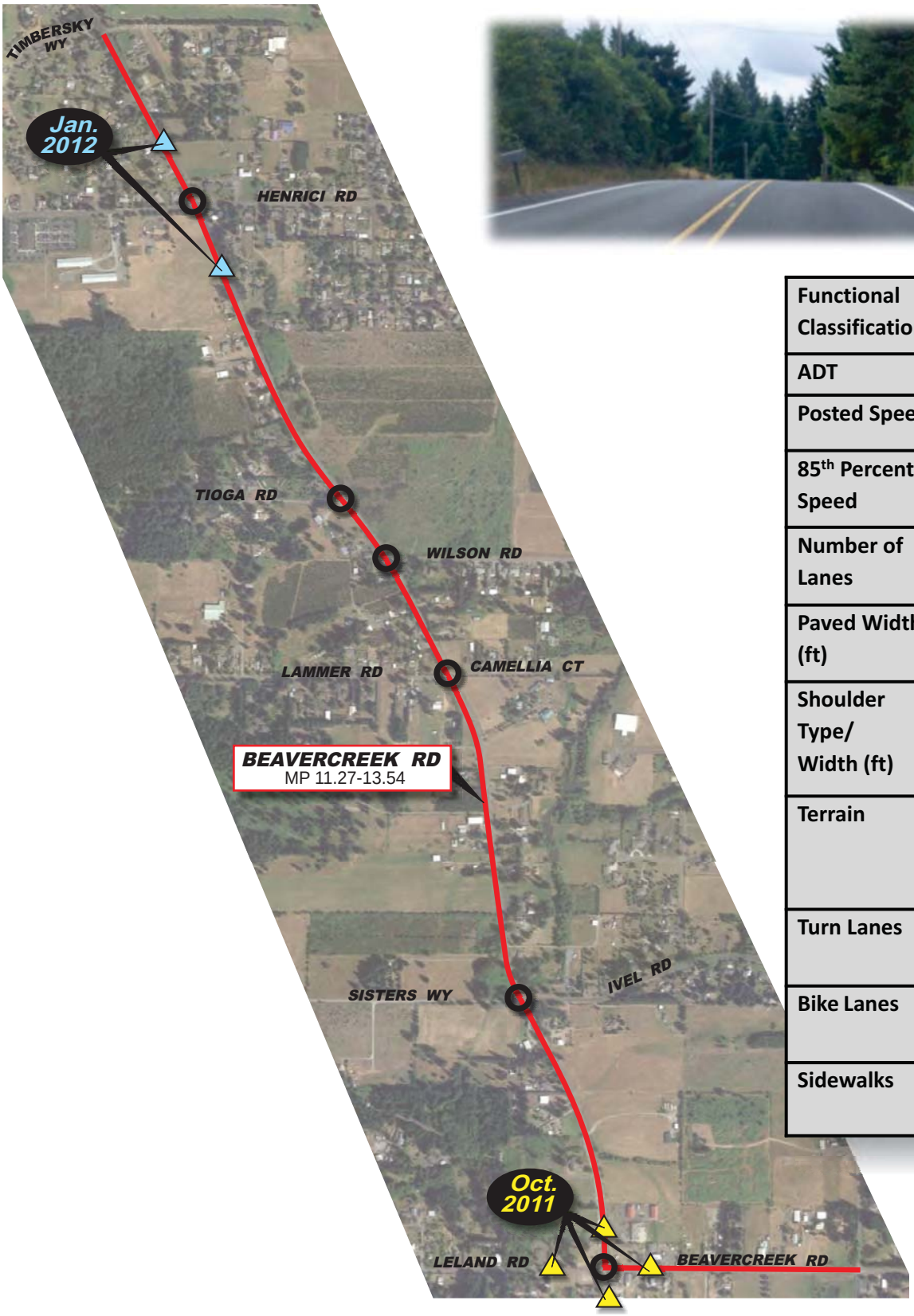


Figure 4: Surrounding Land Use

[2] Speed study conducted by Clackamas County on October 27th, 2011
[3] Clackamas County Comprehensive Plan. 2010.

CLACKAMAS COUNTY



Functional Classification	Rural Minor Arterial
ADT	6,190-9,320
Posted Speed	35-45 mph
85th Percentile Speed	47-50 mph
Number of Lanes	2
Paved Width (ft)	25-39
Shoulder Type/ Width (ft)	Pavement - Gravel/1' -15'
Terrain	Horizontal curves with rolling terrain
Turn Lanes	At S. Henrici Rd signal
Bike Lanes	North of S. Henrici Rd
Sidewalks	No

LEGEND

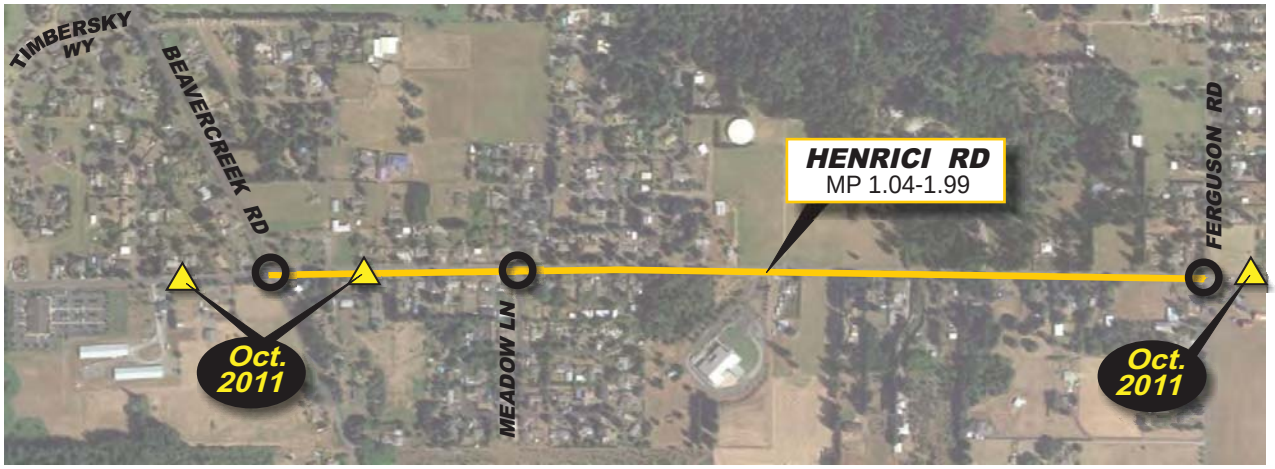
- Study Intersection
- Count Location
- Study Corridor
- MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure **5**

S. Beavercreek Road
(S. Timbersky Way to S. Ferguson Road)



Functional Classification	Rural Minor Arterial
ADT	2,270-3,645
Posted Speed	40 mph
85th Percentile Speed	44-52 mph
Number of Lanes	2
Paved Width (ft)	22-37
Shoulder Type/Width (ft)	Pavement-Gravel/0'-15'
Terrain	Straight segment with rolling terrain
Turn Lanes	At S. Beavercreek Rd signal
Bike Lanes	No
Sidewalks	No

LEGEND

- Study Intersection
- Count Location
- Study Corridor
- MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure **6**

S. e r c Road
(S. ea er reek Road to S. Ferguson Road)

Functional Classification	Rural Local
ADT	680-700
Posted Speed	45 mph
85th Percentile Speed	44-49 mph
Number of Lanes	2
Paved Width (ft)	22
Shoulder Type/Width (ft)	Gravel/1’
Terrain	Straight segment with rolling terrain
Turn Lanes	No
Bike Lanes	No
Sidewalks	No

LEGEND

- Study Intersection
- Count Location
- Study Corridor

MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure **7**

S. er o Road
(S. enri i Road to S. ea er reek Road)

Motor Vehicle Traffic Volume

Hourly traffic patterns for the three study area roadways were examined via 24-hour tube counts[4]. The hourly volume profiles for each roadway are shown in Figure 8. As can be seen the hourly traffic patterns along S. Beavercreek Road and S. Henrici Road demonstrate the commuter nature of traffic in the area. Volumes peak in the morning commute period as well as in the afternoon/evening commuter period. Traffic volumes are highest along S. Beavercreek Road with approximately 6,190-9,320 average daily vehicles (ADT). S. Henrici Road carries approximately 2,270-3,645 vehicles per day while S. Ferguson Road carries approximately 680-700 vehicles.

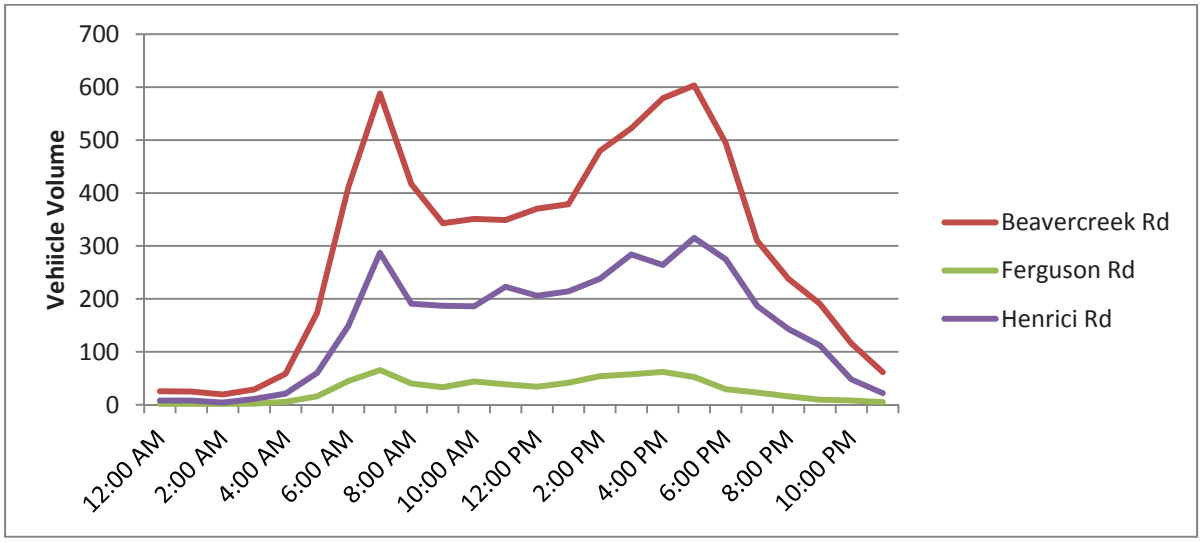


Figure 8: Hourly Traffic Patterns

Vehicle classifications over a 24-hour period are shown in Table 4 for all three roadway segments. Heavy vehicles (the sum of single unit truck, tractor/trailer, and tractor/multi-trailer categories) make up approximately 10-17 percent of the total vehicles. On S. Beavercreek Road approximately 11 percent of the vehicles are trucks (see Figure 9), S. Ferguson Road has approximately 17 percent, and S. Henrici Road has 10 percent. The largest truck measured within the study area was a tractor multi-trailer.

Figure 9: Heavy vehicle observed on S. Beavercreek Rd at S. Laland Rd-S. Kamrath Rd.

[4] Traffic counts conducted by Clackamas County conducted in October 2011 and January 2012.

Table 4: Daily Roadway Vehicle Classification

Roadway	Vehicle Classification				
	Passenger Car	Bike	Single Unit Truck	Tractor/Trailer	Tractor/Multi-Trailer
S. Beavercreek Rd	6308	48	689	103	4
S. Henrici Rd	565	19	108	5	0
S. Ferguson Rd	3276	9	315	37	0

Passenger Car = Vehicle class 1, 2, and 3
Single Unit Truck = Vehicle class 4, 5, 6, and 7
Tractor/Trailer = Vehicle class 8, 9, and 10
Tractor/Multi-Trailer = Vehicle class 11, 12, and 13

Approximately 50 bicyclists were counted along S. Beavercreek Road (see Figure 10), 20 along S. Henrici Road, and 10 along S. Ferguson Road. There are bike lanes on S. Beavercreek Road north of S. Henrici Road and no bike lanes on the other two roadways. The peak period for cyclists is between 2 -4 pm, with around 10 cyclists per hour (as shown in Figure 11). The bicycle activity during this time period could be due to the Oregon City High School. The highest cyclist activity occurs south of the high school along S. Beavercreek Road, in addition to, east of the high school along S. Henrici Road. The bicycle activity was low on Ferguson with less than 10 cyclists per day. Pedestrian activity within the study area is low and there are currently no sidewalks within the area except for a minor segment on S. Beavercreek Road near S. Leland Road-S. Kamrath Road.

Figure 10: Bicyclist observed on S. Beavercreek Rd at S. Laland Rd-S. Kamrath Rd.

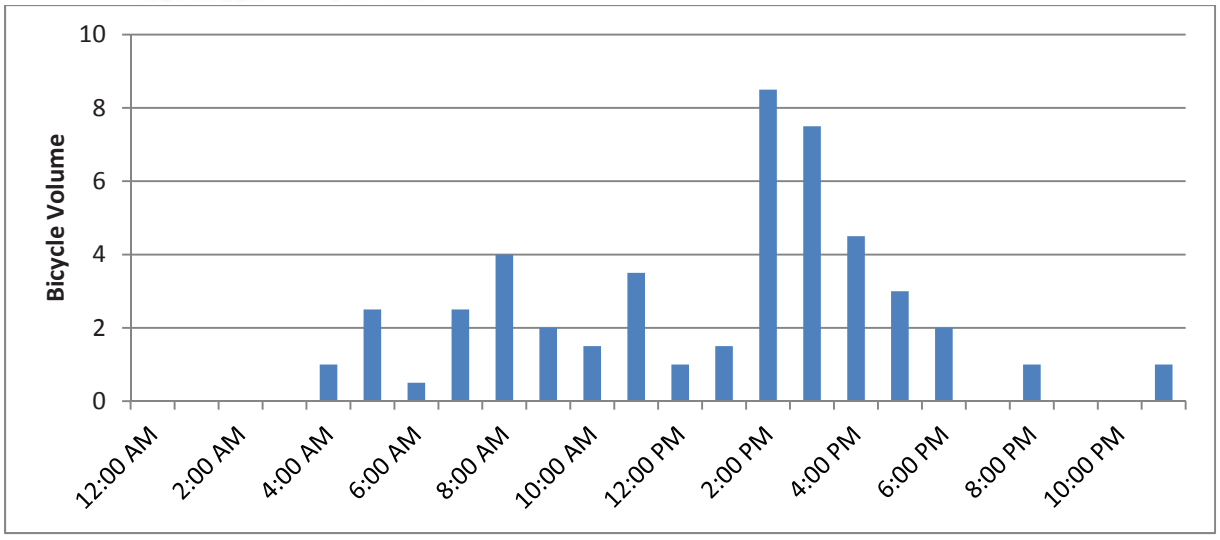


Figure 11: Hourly Bicycle Volumes along S. Beavercreek Rd

Crash History

The RSA team examined recorded crash records for the five year period from 2007 to 2011 along each roadway. There were a total of 58 crashes in the study area[5]. Figure 12 illustrates crash type by roadway, demonstrating that most of the crashes occurred on S. Beavercreek Road (roadway with the highest traffic volumes). Crashes that occurred at intersections involving more than one of the study corridors were included in both corridors' crash statistics. The majority of the crashes on S. Beavercreek Road were rear ends, whereas the majority of crashes on S. Henrici Road were turning or angle crashes. The following sections break down the crashes by roadway segment and at the intersection level.

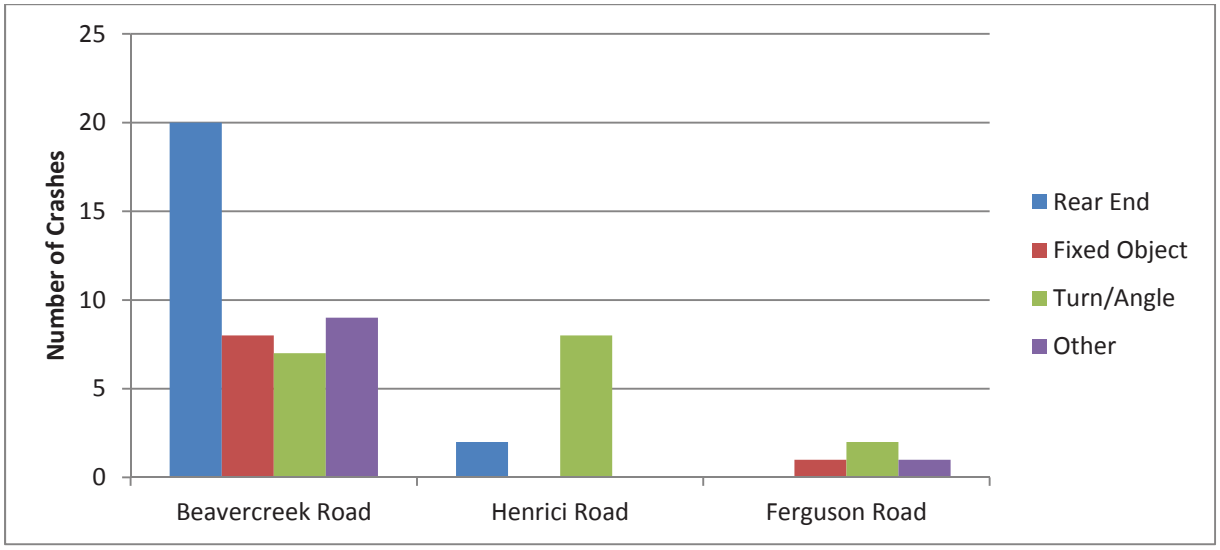


Figure 12: Crash Type by Roadway

[5] ODOT collision records, January 1, 2007 to December 31, 2011.

S. Beavercreek Road

There were 44 recorded crashes on S. Beavercreek Road. Some items of note include:

- The most common type of crash was rear end (45%)
- The second most common type of crash was fixed object (18%)
- One fatality occurred (motorcycle crash south of S. Ivel Road)
- Approximately 43% of the crashes resulted in property damage only
- Two-thirds of the crashes occurred during daylight conditions
- Approximately 38% of the crashes occurred between 4 -7 pm
- No crashes involved pedestrians or bicyclists
- Approximately 70% of the crashes occurred on dry pavement

For the crashes that were not intersection related, many were rear end or fixed object crashes that occurred along S. Beavercreek Road well-spaced from one another. S. Beavercreek Road has many driveways and features rolling terrain, which could be the cause for some of the rear end crashes. Generally the reported cause for the majority of crashes was either following too closely or driving too fast. A number of these crashes occurred at the intersection of S. Beavercreek Road/S. Leland Road-S. Kamrath Road (Figure 13).

Figure 13: S. Beavercreek Rd/S. Leland Rd-S. Kamrath Rd (looking south)

S. Henrici Road

A total of 10 crashes were reported along S. Henrici Road. Some items of note include:

- The most common type of crashes were turning & angle (combined 80%)
- No fatalities occurred
- The majority of the crashes resulted in injury (60%)
- One crash at the intersection of S. Ferguson Road involved a bicyclist
- One crash occurred during the evening
- Approximately 90% of the crashes occurred on dry pavement

Figure 14: S. Beavercreek Rd/S. Henrici Rd (looking south)

All of the crashes recorded along S. Henrici Road occurred at intersections, primarily the signalized intersection at S. Beavercreek Road/S. Henrici Road (Figure 14). The traffic signal is the primary causal factor for most of the turning and angle related crashes.

S. Ferguson Road

There were 4 recorded crashes on S. Ferguson Road. Some items of note include:

- Half of the crashes were turning or angle crashes
- Three of the four crashes involved injury
- No fatalities occurred
- One crash involved a backing vehicle
- One crash occurred during the evening
- Three of the four crashes occurred on dry pavement

Most of these crashes occurred near the intersection of S. Wilson Road (Figure 15).

Figure 15: S. Ferguson Rd/S. Wilson Rd (looking south)

Intersections

Ten intersections were analyzed by creating crash diagrams. The crash diagrams are included in the Appendix and show the crash type, severity, direction of travel, and crash identification number. This information is useful in identifying crash related trends. The collision records are included in the Appendix.

The study intersections are listed in Table 5 along with a summary of the crashes that occurred including the crash severity and type. The two intersections with the largest number of crashes are:

- S. Beavercreek Road/S. Henrici Road (12 crashes)
- S. Beavercreek Road/S. Leland Road-S. Kamrath Road (10 crashes)

The intersection of S. Beavercreek Rd/S. Henrici Road is a signalized intersection while the intersection of S. Beavercreek Rd/S. Leland Road/S. Kamrath Road is an unsignalized intersection with unfamiliar geometry. There was one fatality recorded at the intersection of S. Beavercreek Road/S. Ivel Road which involved a motorcycle.

Table 5: Intersection Crash Severity & Type

Intersection	Crash Severity			Crash Type				Total
	Fatal	Injury	PDO[a]	Rear	Fixed	Turn/Angle	Other	
S. Beavercreek Rd/S. Henrici Rd	0	2	10	4	1	4	3	**12**
S. Beavercreek Rd/S. Tioga Rd	0	4	1	3	2	0	0	**5**
S. Beavercreek Rd/S. Wilson Rd	0	3	1	3	0	0	1	**4**
S. Beavercreek Rd/S. Lammer Rd-S. Camellia Ct	0	1	2	1	2	0	0	**3**
S. Beavercreek Rd/S. Ivel Rd	1	1	0	0	0	0	2	**2**
S. Beavercreek Rd/S. Leland Rd-Kamrath Rd	0	4	6	4	0	2	1	**10**
S. Ferguson Rd/S. Beavercreek Rd	0	1	1	1	1	5	0	**2**
S. Ferguson Rd/S. Wilson Rd	0	2	1	1	1	1	0	**3**
S. Ferguson Rd/S. Henrici Rd	0	5	2	2	0	5	0	**7**
S. Henrici Rd/S Meadow Ln	0	1	1	1	0	1	0	**2**
Total	**1**	**24**	**25**	**20**	**8**	**12**	**7**	**50**

[a]PDO = Property damage only

Road Safety Audit Team Findings Summary

As previously mentioned the RSA team considered the following observation categories during the field reviews to determine safety related factors:

- Geometric Issues: horizontal curves, vertical curves, gradient, cross section, clearance, sight distance, clear zone obstructions
- Operational Issues: congestion, signing, striping, traffic control operations, speeding, queuing, turning movements
- Road User Observations: motorists, bicyclists, pedestrians, special need users
- Environmental Observations: weather, lighting conditions, surrounding land uses

All of these categories can play an important role in the safety performance of a roadway/intersection. The following sections provide a brief overview of these categories as observed by the RSA team with particular safety related issues presented the subsequent section.

Geometric Observations

All three roadways feature rolling terrain with vertical curves (see Figure 16), which restrict intersection sight distance and stopping sight distance at several locations. Other items noted during the field investigation included multiple objects such as utility poles, mailboxes, fences, and trees within the roadway clear zone. All roadways feature narrow shoulders and there is a moderate pavement drop off in some locations

Figure 16: Rolling terrain on S. Ferguson Road (looking south near S. Henrici Rd)

Operational Observations

Operational observations were made at nine intersections. The RSA team made several observations at the intersection of S. Beavercreek Road/S. Leland Road-S. Kamrath Road during the evening peak period. This intersection consists of the westbound to northbound and southbound to eastbound main movements along S. Beavercreek Road uncontrolled. The westbound through/left turn movement on S. Beavercreek Road is stop controlled (right turn permitted without stopping as shown in Figure 17) while S Leland Road and S. Kamrath Road are stop controlled. Observations at this intersection showed that the uncommon traffic control can lead to driver confusion at the intersection during peak periods.

Another item noted by the RSA team is that all roadways featured a continuous no passing zone within the study area.

Figure 17: Right Turn Permitted without Stopping Sign

Road User Observations

The majority of users observed were motor vehicles of various classifications as previously mentioned. Several bicyclists were observed along all roadways and pedestrian use is minimal; although there are signs of pedestrian usage within the study area. The team noted that all roadways featured no provisions for pedestrians or bicyclists with the exception of bike lanes on S. Beavercreek Road north of S. Henrici Road. Due to the rural location other users of the roadway include farm equipment and equestrian riders.

Figure 18: Pedestrian usage at S. Beavercreek Rd/S. Leland Rd-S. Kamrath Rd.

Environmental Observations

Field observations for all roadways took place during a dry, sunny, summer day in August. Sun glare in the morning and evening was visibly noticed by the team along S. Henrici Road (east-west roadway). The signalized intersection of S. Beavercreek Road/S. Henrici Road is the only study intersection that currently features street lighting. Night time observations indicate that the lighting provided at this intersection was adequate. Night time observations also indicated that both striping and signing produced acceptable visibility along all roadways (see Figure 19). The team identified a few signs where the retro-reflectivity was substandard. Traffic patterns along S. Beavercreek Road and S. Henrici Road resemble commuter patterns due to the surrounding rural residential land use.

Figure 19: Sign retro-reflectivity

RSA Issue and Suggestion Prioritization

This section summarizes the safety related issues identified by the RSA team along each roadway segment and nine study intersections. Each issue identified is categorized based on a qualitative risk scale previously discussed. Accompanying each identified issue is a recommended improvement option. Where possible, improvement options are associated with a crash modification factor (CMF), which is a multiplicative factor that can be used to aid with the estimation of the expected number of crashes after an improvement has been implemented. Respective CMF's were developed with the use of the Crash Modification Factors Clearinghouse[6]. The clearing house provides available research based CMF's, so there may not be an associated CMF for all improvement options. Finally, each improvement option is categorized as high cost, medium cost, or low cost. The low cost improvements are those that could be easily implemented on a short term basis. The medium cost improvements would cost more and could typically be implemented within five years. The long term improvements are identified as high cost and could be implemented within the next 20 years. These items could be adopted into the County's policy documents so that funding could be obtained.

The following pages summarize the RSA team's findings along each of the three corridors and at the nine study intersections.

[6] Crash Modification Factors Clearinghouse, U.S. Department of Transportation Federal Highway Administration, http://www.cmfclearinghouse.org/

Location: S. Beavercreek Road (S. Timbersky Way to S. Ferguson Road), Clackamas County	
Milepoint: 11.27-13.54	
Roadway Characteristics: Beavercreek Rd.	
Posted Speed (mph)	35-45
ADT	6,190-9,320
Classification	Rural Minor Arterial
Overall CMF:	TBD
Preliminary Cost Estimate:	TBD

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Narrow gravel shoulder (currently ranges between 2-6 feet). This does not meet County standards for Minor Arterial.	Medium	Infrequent	C	Provide wider shoulder where shoulders are less than 6 feet. Shoulders should be built to County standard for the functional class.	0.52	$$
B	Obstructions located within clear zone (utility poles, mailboxes, trees)	High	Infrequent	D	Remove, protect, or delineate objects located within the roadway clear zone	0.62	$$
C	No provisions for pedestrians or bicyclists. This does not meet County standards for Minor Arterial.	High	Rare	C	Provide paved shoulder/bikeway for pedestrians and bicyclists consistent with County standards for Minor Arterial.	0.52	$$
D	Lack of visible residential address markers along roadway	Medium	Infrequent	C	Provide consistent address markers for residential land uses. This effort could be coordinated with the fire district. Address markers need to be installed in a safe location.		$
E	Vertical curves along roadway restrict stopping sight distance . The required stopping sight distance is 360 feet.	Medium	Infrequent	C	a) Provide "hill blocks view sign" (MUTCD W7-6) where stopping sight distance is restricted by vertical curves to less than the minimum required and install intersection warning signs where applicable. b) Evaluate the need for left turn lanes at intersections where vertical curve restricts stopping sight distance c) Flatten vertical curve	a)0.65 (Angle) b) 0.56 c) 0.80	$ $$ $$$

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
F	Pavement edge drop-off in focused locations	Medium	Infrequent	C	a) Install additional gravel in shoulder b) Install 45 degree pavement edge wedge		$ $$
G	Street name signs are not consistent	Negligible	Rare	A	Upgrade street name signs to County standard	0.85 (Injury) 0.93 (PDO)	$
H	Steep shoulder/ditch along both sides of Beavercreek Rd	High	Infrequent	D	Install pipe within ditch and fill in hole with gravel/rock	0.81	$$
I	Roadside vegetation blocks roadway signage	Medium	Rare	B	Trim vegetation clear of roadway signage		$
J	Storm water grates are hazardous for bicyclists	High	Rare	C	Replace existing storm water grates with bike safe grates		$
K	Roadway delineation is not consistent	Medium	Infrequent	C	Provide consistent delineation along roadway (chevron signs around horizontal curves, roadway pavement markers where warranted, edge of roadway delineators)	0.85 (Injury) 0.93 (PDO)	$
L	Inconsistent curve advisory speed signs	Medium	Infrequent	C	Verify appropriate speed designation of horizontal curves with ball bank indicator.	0.85 (Injury) 0.93 (PDO)	$

Existing Issues Photos

Reflective pavement markers are missing in newly paved sections

Lack of pedestrian and bike facilities

Existing Issues Photos (Continued)

Objects located within clear zone

Narrow shoulder

Pavement Drop off

Delineators broken, missing, or inconsistent

Storm water grates are hazardous for bicyclists

Unprotected ditches

Location: S. Ferguson Road (S. Henrici Road to S. Beavercreek Road), Clackamas County	
Milepoint: 0.50 – 1.99	
Roadway Characteristics: Ferguson Rd.	
Posted Speed (mph)	45
ADT	680-700
Classification	Rural Local
Overall CMF:	TBD
Preliminary Cost Estimate:	TBD

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Posted speed (45 mph) may be high for roadway classification.	Medium	Infrequent	C	Review the functional classification of Ferguson Road and consider speed zone reduction	1.01	$
B	Double yellow centerline striping may be inappropriate for local roadway classification	Negligible	Rare	A	Review the functional classification of Ferguson Road. Evaluate possibility of removing centerline striping.		$
C	Vertical curves along roadway restrict stopping sight distance and intersection sight distance.	Medium	Rare	B	a) Provide "hill blocks view sign" (MUTCD W7-6) where stopping sight distance is restricted by vertical curves to less than the minimum required or install intersection warning signs where applicable. b) Evaluate the need for left turn lanes at intersections where vertical curve restricts stopping sight distance c) Flatten vertical curve	a)0.65 (angle) b) 0.56 c) 0.80	$ $$ $$$
D	Narrow or non existent shoulders (paved and gravel). This does not meet County standards for rural local roadway.	High	Infrequent	D	Provide gravel shoulders especially in locations with limited sight distance. Shoulders should be built to County standard for the functional class.	0.52	$$
E	Lack of visible residential address markers along roadway.	Low	Rare	A	Provide consistent address markers for residential land uses. This effort could be coordinated with the fire district. Address markers need to be installed in a safe location.		$
F	Obstructions located within clear zone (utility poles, mailboxes, trees)	High	Infrequent	D	Remove, protect, or delineate objects located within the roadway clear zone	0.62	$$

Existing Issues Photos

Possible high posted speed for local roadway classification

Double yellow centerline striping may be inappropriate for local roadway classification

Vertical curves along roadway restrict stopping sight distance and intersection sight distance

Narrow or non existent shoulders

Obstructions located within clear zone

Location: S. Henrici Road (S. Beavercreek Road to S. Ferguson Road), Clackamas County	
Milepoint: 1.04 to 1.99	
Roadway Characteristics: Henrici Rd.	
Posted Speed (mph)	40
ADT	2,270-3,645
Classification	Rural Minor Arterial
Overall CMF:	TBD
Preliminary Cost Estimate:	TBD

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vertical curves along roadway restrict stopping sight distance (between Meadow Ln and Ferguson Rd)	Medium	Infrequent	C	a) Provide "hill blocks view sign" (MUTCD W7-6) where stopping sight distance is restricted by vertical curves or install intersection warning signs where applicable. b) Evaluate the need for left turn lanes at intersections where vertical curve restricts stopping sight distance c) Flatten vertical curve	a)0.65 (angle) b) 0.56 c) 0.80	$ $$ $$$
B	Narrow shoulders. This does not meet County standards for Rural Minor Arterial.	Medium	Rare	B	Widen shoulders to County standard for the functional class	0.81	$$
C	No provisions for pedestrians or bicyclists. This does not meet County standards for Rural Minor Arterial.	High	Infrequent	D	Widen shoulders to County standard for the functional class	0.81	$$
D	Obstructions located within clear zone (utility poles, mailboxes, trees)	High	Rare	C	Remove, protect, or delineate objects located within the roadway clear zone	0.62	$$
E	Lack of visible residential address markers along roadway. There is a high frequency of driveways	Low	Infrequent	B	Provide consistent address markers for residential land uses. This effort could be coordinated with the fire district. Address markers need to be installed in a safe location.		$

Existing Issues Photos

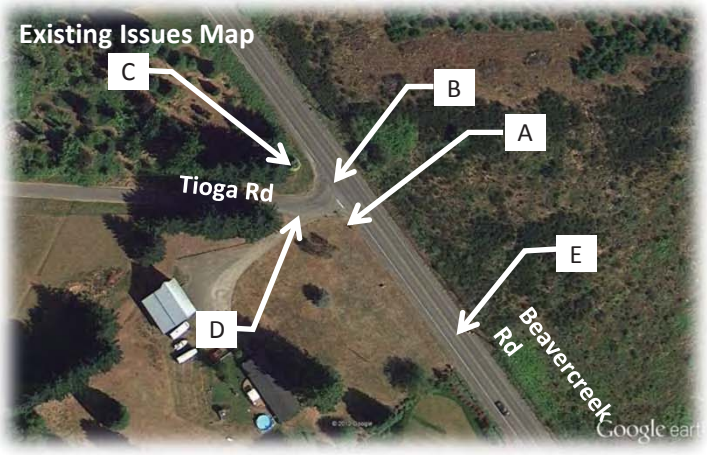
Vertical curve restricts stopping sight distance


Narrow shoulders


Obstructions located within clear zone


Lack of visible residential address markers along roadway

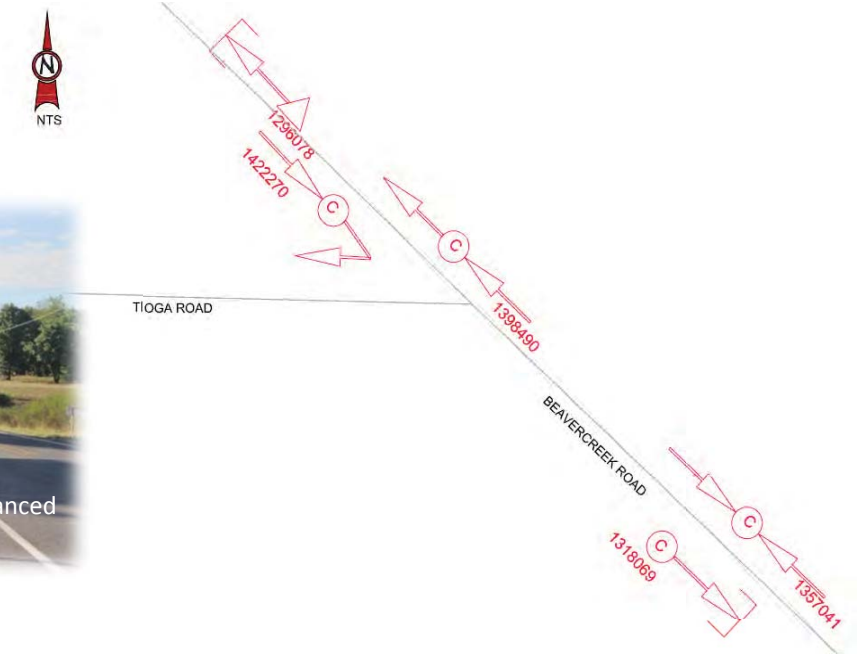
Location: S. Beavercreek Road at S. Tioga Road, Clackamas County		
Milepoint: 12.78		
Roadway Characteristics:		
	Beavercreek Rd.	Tioga Rd.
Posted Speed (mph)	45	Not posted
ADT	6,190-9,320	Unknown
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Street name sign for northbound Beavercreek Rd traffic is blocked by advanced intersection warning sign for Wilson Rd.	Negligible	Rare	A	a) Relocate existing intersection warning sign for Wilson Rd to the south or offset sign with respect to the Tioga Rd street name sign assembly.		$
B	Skewed intersection alignment causes undesired slowing and vehicle off tracking for turning vehicles on Tioga Rd.	Low	Occasional	C	a) Realign Tioga Road to intersect Beavercreek Road perpendicular and consider widening approach.		$$
C	Trees/vegetation restrict intersection sight distance to the north. The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing tree/vegetation on the northwest corner of intersection.	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
D	Driveway located in close proximity to intersection.	Negligible	Rare	A	Realign existing driveway to intersect Tioga Rd west of Beavercreek Rd.		$$
E	Vertical curve restricts intersection sight distance to the south. The required intersection sight distance is 500 feet.	Medium	Infrequent	C	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for northbound left turn lane c) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
F	No Advance intersection warning signs are provided along Beavercreek Road.	Low	Infrequent	B	Install advance intersection warning signs along Beavercreek Road in both travel directions.	0.65 (Angle)	$

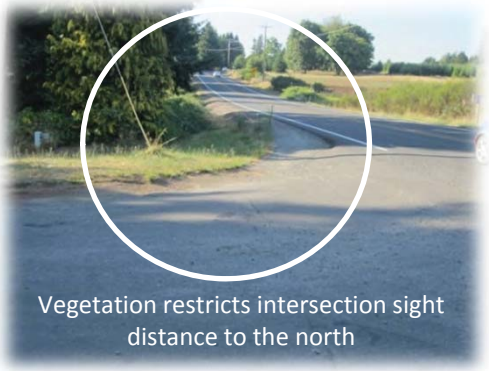
Collision Diagram (2007-2011)

Existing Issues Photos



Street name sign blocked by advanced intersection warning sign

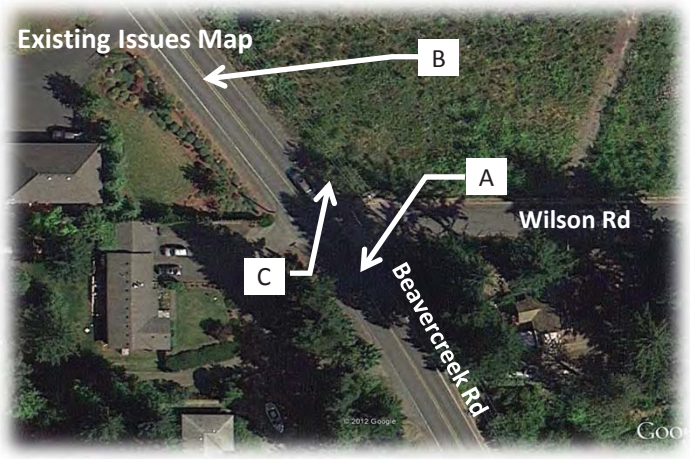
Skewed intersection alignment causes undesired slowing and vehicle off tracking



Vegetation restricts intersection sight distance to the north

Vertical curve restricts intersection sight distance to the south

Location: S. Beavercreek Road at S. Wilson Road, Clackamas County		
Milepoint: 12.68		
Roadway Characteristics:		
	Beavercreek Rd.	Wilson Rd.
Posted Speed (mph)	45	25
ADT	6,190-9,320	Unknown
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts intersection sight distance to the north and south (50 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing vegetation located on the southwest, northeast , and southeast corners of the intersection.	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Vertical curve restricts intersection sight distance to the south. The required intersection sight distance is 500 feet.	Low	Infrequent	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for northbound left turn lane. c) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
C	Large pavement drop off in the northeast quadrant.	Negligible	Rare	A	a) Install additional gravel in shoulder. b) Install 45 degree pavement edge wedge.		$$ $$

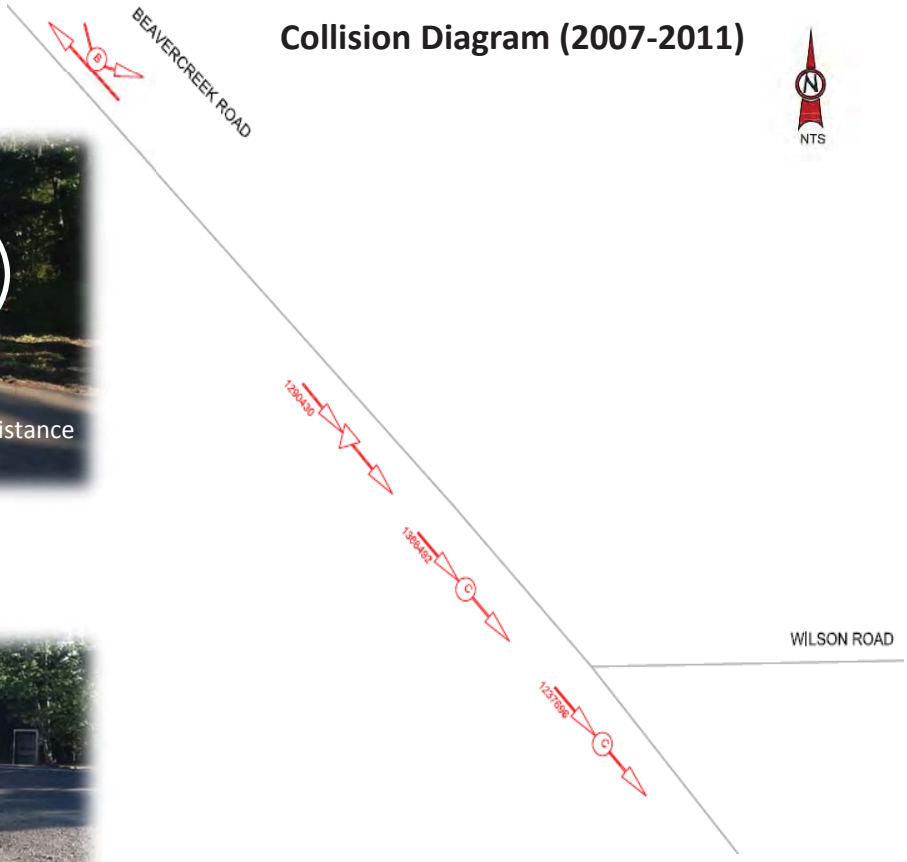
Existing Issues Photos

Vegetation restricts intersection sight distance to the north

Vegetation restricts intersection sight distance to the south

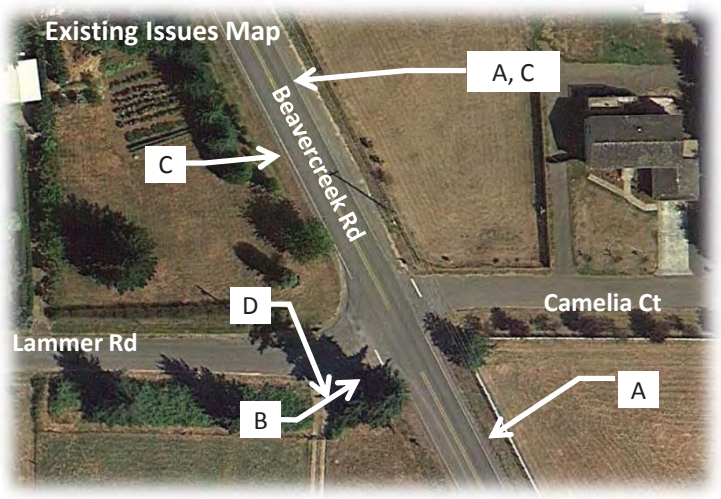
Vertical curve restricts intersection sight distance to the north

Collision Diagram (2007-2011)



Pavement drop off

Location: S. Beavercreek Road at S. Lammer Road- S. Camelia Court, Clackamas County			
Milepoint: 12.50			
Roadway Characteristics:			
	Beavercreek Rd.	Lammer Rd.	Camelia Ct.
Posted Speed (mph)	45	25	25
ADT	6,190-9,320	Unknown	Unknown
Classification	Rural Minor Arterial	Rural Local	Rural Local
Overall CMF:		TBD	
Preliminary Cost Estimate:		TBD	



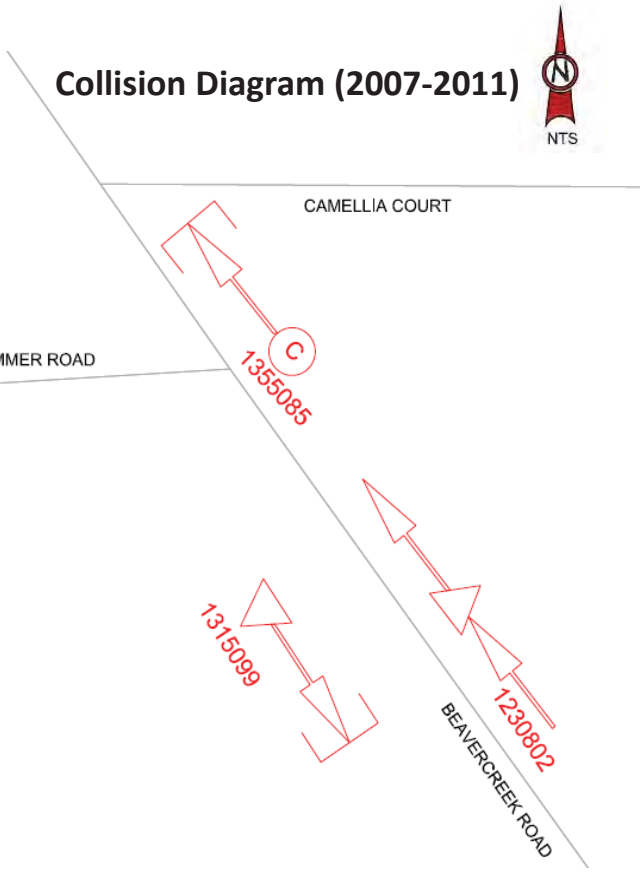
Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts Intersection sight distance to the south (420 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing vegetation located on the southwest corner of intersection	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Intersection street name sign on southwest corner is blocked by vegetation.	Negligible	Rare	A	Trim existing tree located on the southwest corner of intersection		$
C	Vertical curve restricts intersection sight distance to the north (520 feet). The required stopping sight distance is 500 feet.	Low	Infrequent	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for northbound left turn lane. c) Flatten roadway vertical curve.	a)0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
D	No Advance intersection warning signs are provided along Beavercreek Road.	Low	Infrequent	B	Install advance intersection warning signs along Beavercreek Road for in both travel directions.	0.65 (Angle)	$
E	Driveway located in close proximity to intersection	Negligible	Rare	A	Realign existing driveway to intersect Lammer Rd west of Beavercreek Rd		$

Existing Issues Photos

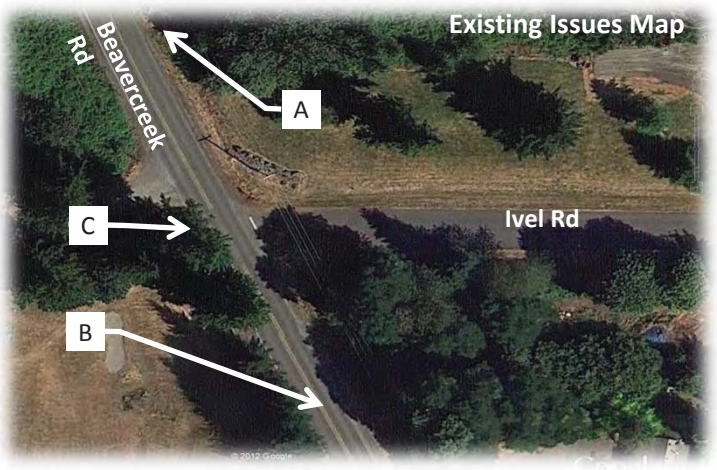
Vertical curve restricts intersection sight distance to the north

Vegetation restricts intersection sight distance to the south and sign blocked by vegetation

Collision Diagram (2007-2011)



Location: S. Beavercreek Road at S. Ivel Road, Clackamas County		
Milepoint: 12.02		
Roadway Characteristics:		
	Beavercreek Rd.	Ivel Rd.
Posted Speed (mph)	45	25
ADT	6,190-9,320	Unknown
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts intersection sight distance to the north (400 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing vegetation to the north along the inside of the horizontal curve	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Vertical curve restricts intersection sight distance to the south (475 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.80	$ $$$
C	Roadside obstructions within clear zone	High	Infrequent	D	a) Delineate obstructions within the clear zone by use of object markers b) Evaluate use of guardrail to protect obstructions within the clear zone c) Remove obstruction	0.62	$ $$ $$

Existing Issues Photos

Vegetation restricts intersection sight distance to the north


Vertical curve restricts intersection sight distance to the south

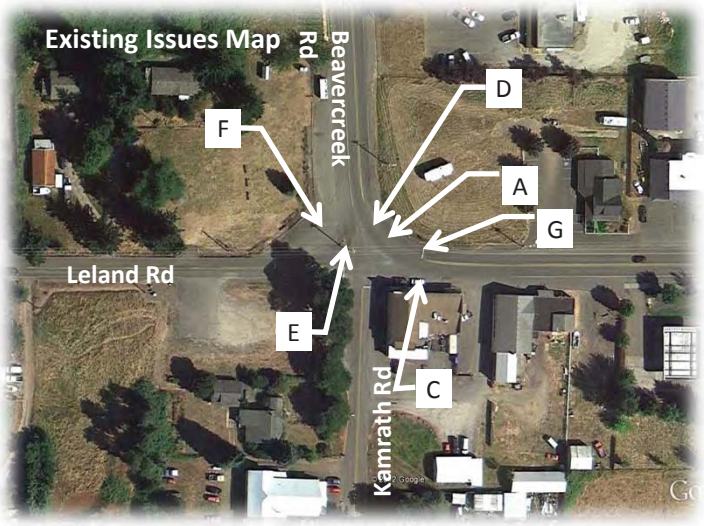

Steep ditch


Steep ditch


Steep ditch

Collision Diagram (2007-2011)

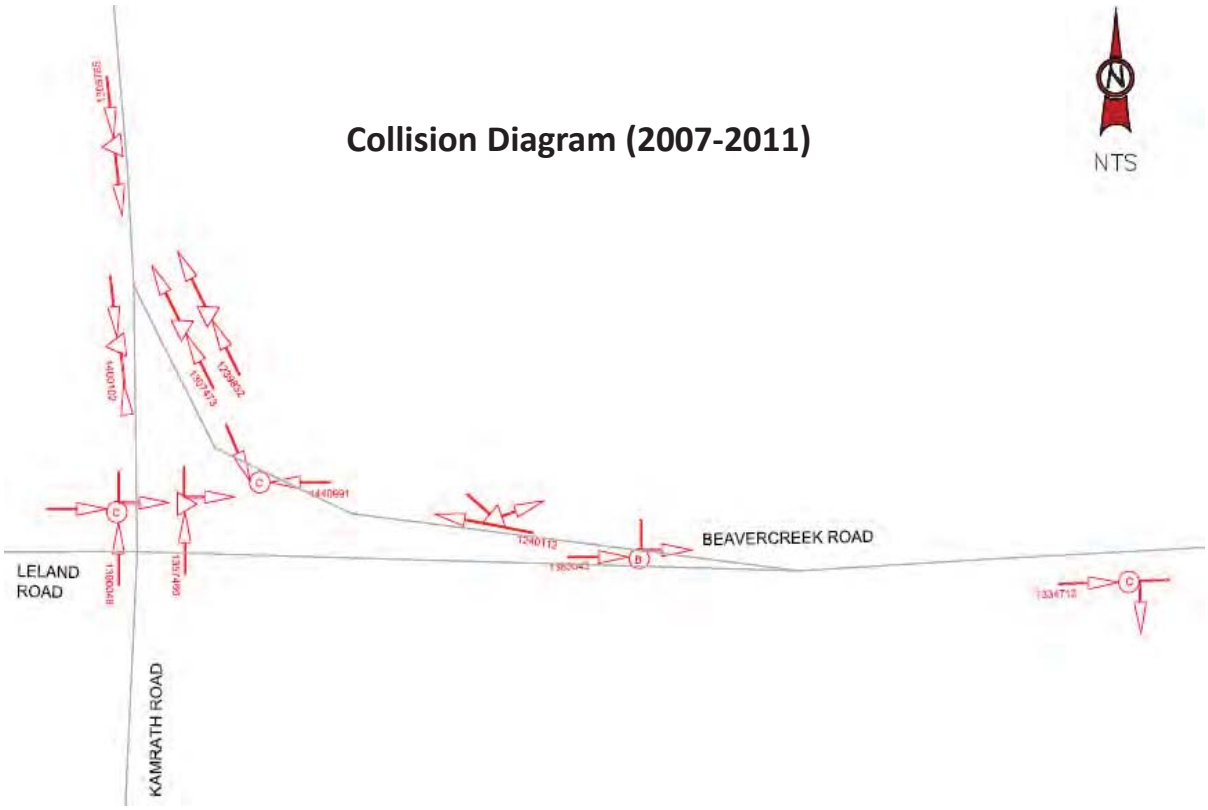
Location: S. Beavercreek Road at S. Leland Road- S. Kamrath Road, Clackamas County			
Milepoint: 11.62			
Roadway Characteristics:			
	Beavercreek Rd.	Leland Rd.	Kamrath Rd.
Posted Speed (mph)	45	45	45
ADT	6,190-9,320	1,540	1,230
Classification	Rural Minor Arterial	Rural Local	Rural Local
Overall CMF:		TBD	
Preliminary Cost Estimate:		TBD	



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	The superelevation for the horizontal curve along Beavercreek Road through the intersection causes vehicle off tracking. This off tracking has contributed to edge of pavement drop off and vehicles encroaching into the shoulder or oncoming traffic.	Low	Infrequent	B	Remove superelevation for the horizontal curve		$$
B	The grade differential between Beavercreek Road and Leland Road/Kamrath Road makes the intersection difficult to maneuver through from the minor streets.	Low	Infrequent	B	Modify intersection grade		$$
C	The permitted parking in front of the store located on the southeast corner restricts intersection sight distance at Kamrath Road. The existing stop bar along Kamrath Road is set too far back from the intersection.	Low	Infrequent	B	Restrict parking in front of store in order to improve intersection sight distance	0.80 (Injury) 0.73 (PDO)	$
D	There is no striping through the intersection (edge line, centerline). Additionally the stop bars for the eastbound and northbound stop bars are worn.	Low	Infrequent	B	Install 4" white/yellow dotted lines (WD/YD) for lane extensions along Beavercreek Road through the intersection (centerline, edge of pavement line). Install per TM500	0.76	$

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
E	Unprotected and nondelineated utility pole located on northwest corner causes difficult southbound right turn for larger vehicles and promotes the use of parking area on the right shoulder to execute the right turn maneuver.	Low	Rare	A	a) Relocate existing utility pole b) Install object marker on utility pole c) Provide southbound right turn lane from Beavercreek Road to Leland Road if utility pole is to be maintained to allow large vehicles to execute the right turn maneuver around the pole	a) 0.62	$$ $ $$
F	Congestion at the intersection in peak periods encourages the use of the parking lot for cut through/slip lane (southbound right turn and eastbound left turn)	Negligible	Rare	A	a) Enforce driver behavior during peak periods b) Provide striped parking spaces for the park located on the northwest corner of the intersection. Install curbing along the park property.		$ $$
G	Non-standard geometries (North/East legs being major movements) and traffic control ("Right Turn Permitted without Stopping" sign)	Medium	Occasional	D	a) Evaluate need for left turn lane for westbound Beavercreek Road at the intersection. Providing the left turn lane would separate turning traffic from through traffic. b) Modify intersection to modern roundabout. This would require significant R/W and have some design challenges.	a) 0.56	$$ $$$
H	Intersection street name signs are difficult to see and are older style	Low	Rare	A	Update street name to County standards and relocate signs so that they are visible	0.85 (Injury) 0.93 (PDO)	$
I	Lack of intersection illumination for non-standard traffic control. (The existing luminaires on wood utility poles are orientated towards the parking lot and not the roadway)	Low	Infrequent	B	Install new street lighting at intersection	0.62 (Injury)	$$
J	No intersection warning signs are provided along Beavercreek Road in advance of the intersection.	Low	Infrequent	B	Install advance intersection warning signs along Beavercreek Road in advance of intersection	0.65 (Angle)	$
K	Edge of roadway delineators along Beavercreek are worn/knocked down	Low	Rare	A	Replace roadway delineators		$

Collision Diagram (2007-2011)



Existing Issues Photos


There is no striping through the intersection


The grade differential makes the intersection difficult to maneuver through

Existing Issues Photos (Continued)

Parking in front of store restricts intersection sight distance

Unprotected and nondelineated utility pole

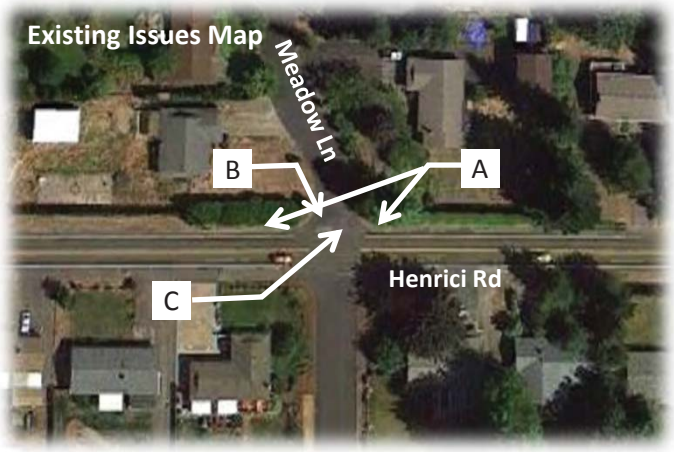
Vehicle offtracking

Delineators worn/knocked down

Parking lot used as cut through during peak periods

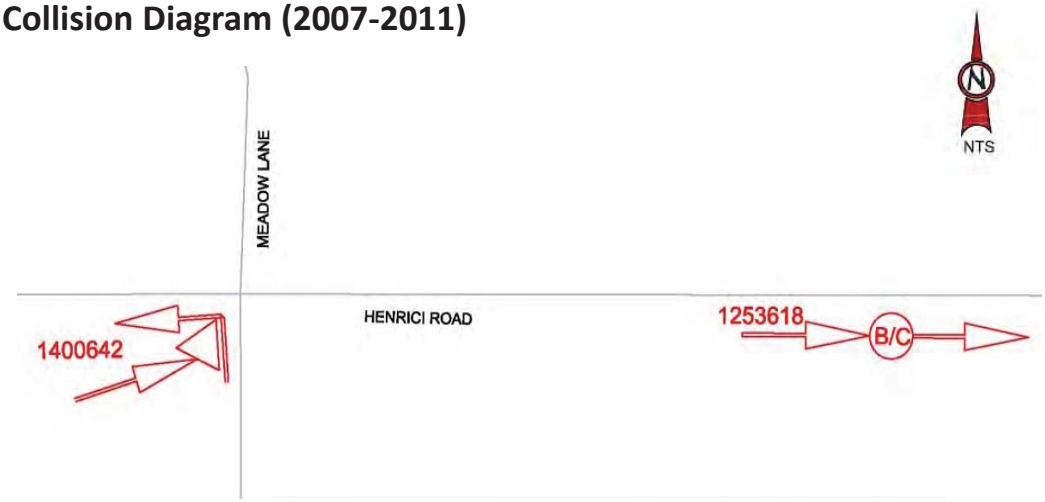
Utility pole makes right turn difficult for large vehicles

Location: S. Henrici Road at S. Meadow Lane, Clackamas County		
Milepoint: 1.29		
Roadway Characteristics:		
	Henrici Rd.	Meadow Ln.
Posted Speed (mph)	40	Not posted
ADT	2,270-3,645	Unknown
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation in NE and NW quadrants restrict intersection sight distance to the east and west	Medium	Rare	B	Trim existing vegetation in NE and NW quadrants of intersection	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Street name sign is blocked by vegetation – NW corner	Low	Rare	A	Trim vegetation to expose street name sign		$
C	Drivers cut corner from Henrici Rd to Meadow Ln. The intersection alignment allows higher speed through turn.	Negligible	Rare	A	Decrease width of road and radius at corner to lower speed		$
D	No advance intersection lane use signs on Henrici Rd	Low	Rare	A	Install advance intersection lane use signs on Henrici Rd in both travel directions.	0.65 (Angle)	$

Collision Diagram (2007-2011)



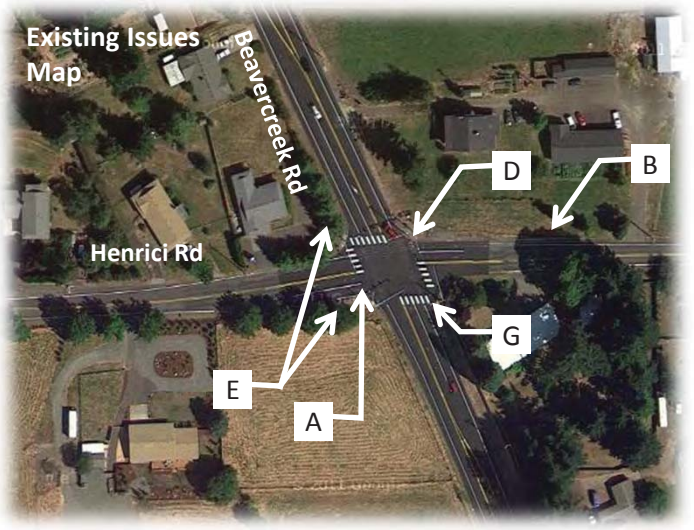
Existing Issues Photos


Vegetation restricts intersection sight distance to the west


Street name sign is blocked by vegetation – NW corner

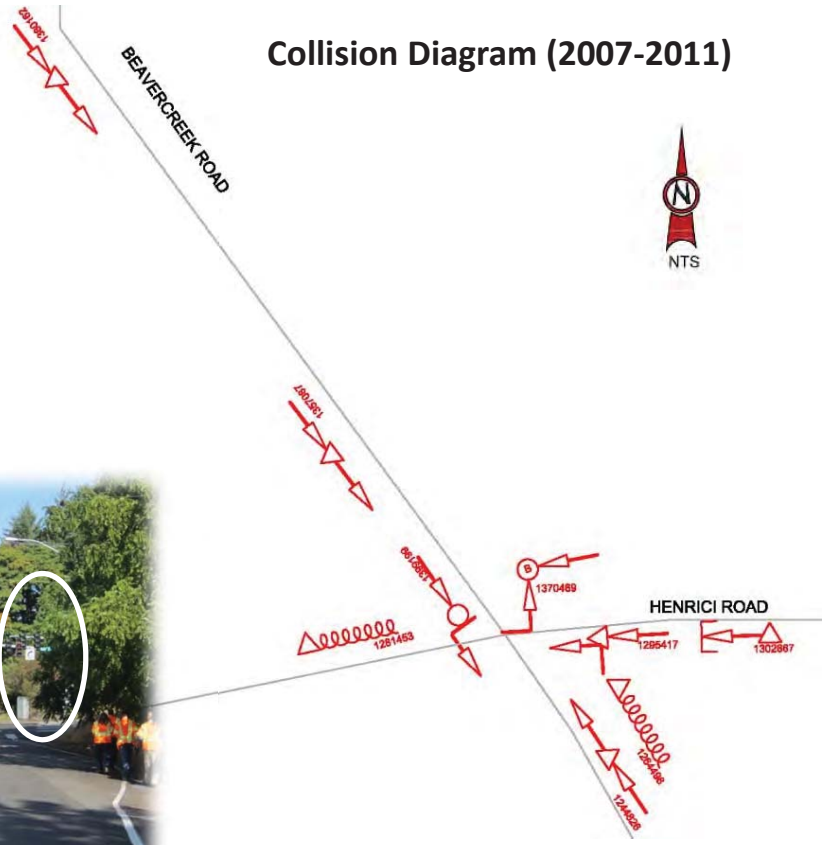

Drivers cut corner from Henrici Rd to Meadow Ln

Location: S. Beavercreek Road at S. Henrici Road, Clackamas County		
Milepoint: 13.25		
Roadway Characteristics:		
	Beavercreek Rd.	Henrici Rd.
Posted Speed (mph)	45	40
ADT	6,190-9,320	2,270-3,645
Classification	Rural Minor Arterial	Rural Minor Arterial
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Storm water grates are unsafe for bikes.	High	Rare	C	Replace all storm grates with bicycle-safe storm grates		$
B	Advance intersection lane use sign is missing on westbound approach.	Low	Rare	A	Install advance intersection lane use sign on westbound approach.	0.65 (Angle)	$
C	Street name signs are too small and do not meet County standard.	Low	Rare	A	Upgrade street name signs to MUTCD and County standards on all mast arms.	0.85 (Injury) 0.93 (PDO)	$
D	Utility pole is located in pedestrian ramp - NE corner	Medium	Rare	B	Relocate utility pole	0.62	$$
E	Trees & vegetation in NW and SW quadrants encroach on roadway, block lane use sign and restrict intersection sight distance to the north. The required intersection sight distance is 500 feet.	Medium	Infrequent	C	Trim vegetation in NW and SW quadrants	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
G	Crosswalk marking incomplete - SE corner	Low	Rare	A	Complete crosswalk marking on SE corner		$
H	Pedestrian ramps are not ADA compliant.	Low	Rare	A	Construct ADA compliant curb ramps and landings to provide access to pedestrian push buttons on all quadrants of intersection.		$$

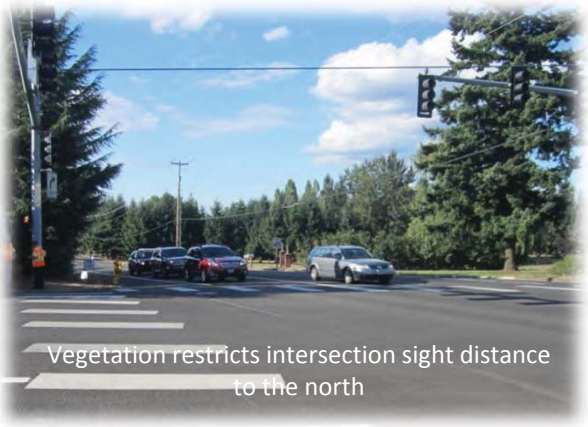
Collision Diagram (2007-2011)



Existing Issues Photos

Trees and vegetation encroach in roadway

Street name signs are too small



Vegetation restricts intersection sight distance to the north

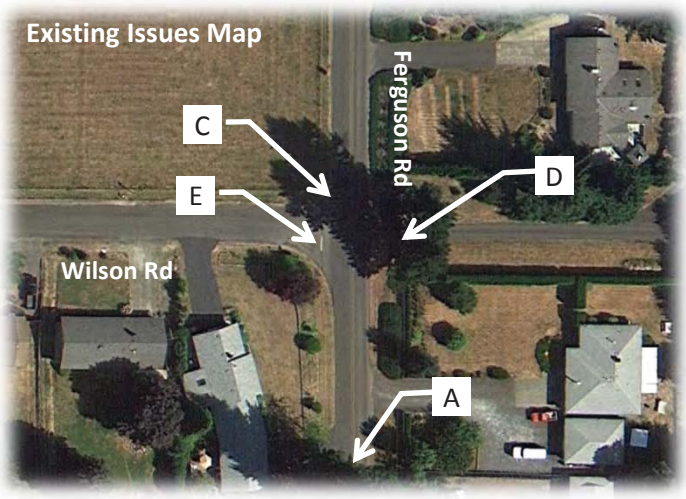
Existing Issues Photos (Continued)

Utility pole located in pedestrian ramp – NE corner

Pedestrian ramps are not ADA compliant

Storm water grates are unsafe for bikes

Location: S. Ferguson Road at S. Wilson Road, Clackamas County		
Milepoint: 1.49		
Roadway Characteristics:		
	Ferguson Rd.	Wilson Rd.
Posted Speed (mph)	45	25
ADT	680-700	Unknown
Classification	Rural Local	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



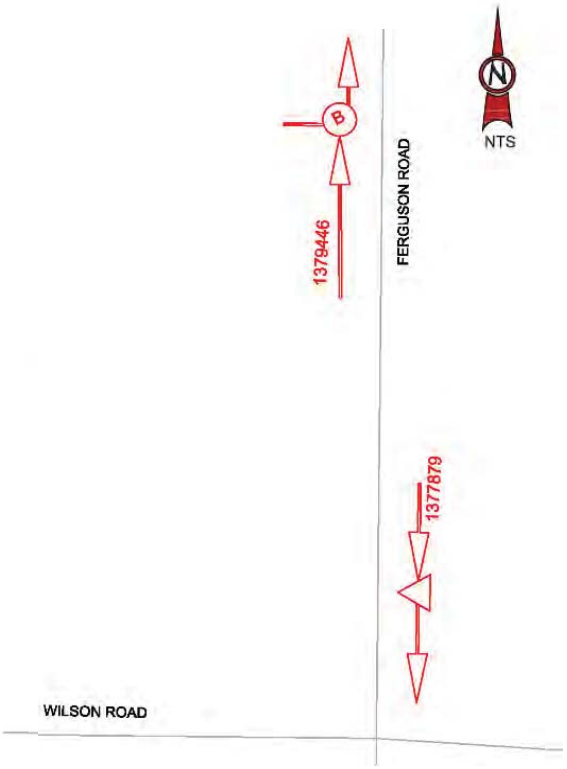
Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vertical curve restricts intersection sight distance to the south. The required intersection sight distance is 445 feet.	Medium	Rare	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for norbound left turn lane. c) Flatten roadway vertical curve.	a)0.65 (angle) b) 0.56 c) 0.80	$ $$$ $$$
B	No advance intersection warning signs on Ferguson Rd.	Low	Infrequent	B	Install advance intersection warning signs on Ferguson Rd in both travel directions.	0.65 (Angle)	$
C	Large brick mailbox located within the clear zone – NW corner.	High	Rare	C	Replace brick mailbox structure with a breakaway mailbox support.	0.62	$
D	Street name signs are too small and do not meet County Standard. They are also located on the east side only.	Low	Infrequent	B	Upgrade street name signs on the east side to MUTCD and County standards. Install new street name signs on west side.	0.85 (Injury) 0.93 (PDO)	$
E	Stop bars on Wilson Road approaches are worn or missing.	Negligible	Rare	A	Install new stop bars on Wilson Road approaches.		$

Existing Issues Photos

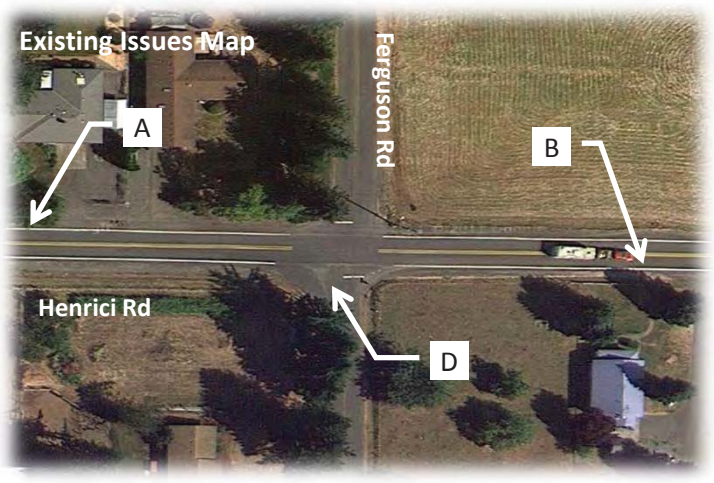
Vertical curve restricts intersection sight distance to the south

Street name signs are too small

Collision Diagram (2007-2011)



Location: S. Henrici Road at S. Ferguson Road, Clackamas County		
Milepoint: 1.99		
Roadway Characteristics:		
	Henrici Rd.	Ferguson Rd.
Posted Speed (mph)	40	45
ADT	2,270-3,645	680-700
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts intersection sight distance to the west and blocks SPEED 40 sign. The required intersection sight distance is 445 feet.	Medium	Infrequent	C	Trim vegetation in northwest corner of intersection.	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Vertical curve restricts intersection sight distance to the east. The required intersection sight distance is 445 feet.	Medium	Infrequent	C	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for westbound left turn lane. c) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
C	No advance intersection warning signs on Henrici Rd	Medium	Infrequent	C	Install advance intersection warning signs on Henrici Rd in both travel directions.	0.65 (Angle)	$
D	Stop bar on northbound approach is worn.	Low	Rare	A	Replace stop bar on northbound approach.		$

Existing Issues Photos

Vertical curve restricts intersection sight distance to the east

Vegetation restricts intersection sight distance to the west

Stop bar on northbound approach is worn

Collision Diagram (2007-2011)