REQUEST for PROPOSAL #938

PROFESSIONAL, TECHNICAL AND EXPERT SERVICES

Clark County Washington

RELEASE DATE: WEDNESDAY, SEPTEMBER 17, 2025
DUE DATE: WEDNESDAY, OCTOBER 29, 2025 by 11:00 am

Request for Proposal for:

TRAFFIC SAFETY MANAGEMENT PROGRAM & SYSTEMIC SAFETY IMPROVEMENT PROGRAM 2026 UPDATE

SUBMIT:
One (1) Original
Four (4) Complete Copies

of the Proposal to:

UPS / FedEx or Hand Delivery	**United States Postal Service**
Clark County ATTN: Office of Purchasing 1300 Franklin Street, 6th Floor, Suite 650 Vancouver WA 98660 564-397-2323	Clark County ATTN: Office of Purchasing PO Box 5000 Vancouver WA 98666-5000 564-397-2323

Office Hours: 8:00 am – 3:00 pm, Monday – Friday, except Legal Holidays.
No electronic submissions.

***Proposals must be delivered to the Purchasing office – No Exceptions**
***Proposals must be date and time stamped by Purchasing staff by 11:00 am on due date – No Exceptions**
****Proposal shall be sealed and clearly marked on the package cover with RFP #, Title & Company Name**

Refer Questions to Project Manager:

Dylan Jennings
Traffic Engineer / Public Works Transportation
Dylan.Jennings@clark.wa.gov
564-397-5993

ADMINISTRATIVE REQUIREMENTS - Contractors shall comply with all management and administrative requirements established by Washington Administrative Code (WAC), the Revised Code of the State of Washington (RCW), and any subsequent amendments or modifications, as applicable to providers licensed in the State of Washington.

ALL proposals submitted become the property of Clark County. It is understood and agreed that the prospective Proposer claims no proprietary rights to the ideas and written materials contained in or attached to the proposal submitted. Clark County has the right to reject or accept proprietary information.

AUTHORSHIP - Applicants must identify any assistance provided by agencies or individuals outside the proposers own organization in preparing the proposal. No contingent fees for such assistance will be allowed to be paid under any contract resulting from this RFP.

CANCELLATION OF AWARD - Clark County reserves the right to immediately cancel an award if the contractual agreement has not been entered into by both parties or if new state regulations or policy make it necessary to change the program purpose or content, discontinue such programs, or impose funding reductions. In those cases where negotiation of contract activities are necessary, Clark County reserves the right to limit the period of negotiation to sixty (60) days after which time funds may be unencumbered.

CONFIDENTIALLY - Proposer shall comply with all applicable state and federal laws governing the confidentiality of information.

CONFLICT OF INTEREST - All proposals submitted must contain a statement disclosing or denying any interest, financial or otherwise, that any employee or official of Clark County or the appropriate Advisory Board may have in the proposing agency or proposed project.

CONSORTIUM OF AGENCIES - Any consortium of companies or agencies submitting a proposal must certify that each company or agency of the consortium can meet the requirements set forth in the RFP.

COST OF PROPOSAL & AWARD - The contract award will not be final until Clark County and the prospective contractor have executed a contractual agreement. The contractual agreement consists of the following parts: (a) the basic provisions and general terms and conditions, (b) the special terms and conditions, (c) the project description and goals (Statement of Work), and (d) the budget and payment terms. Clark County is not responsible for any costs incurred prior to the effective date of the contract. Clark County reserves the right to make an award without further negotiation of the proposal submitted. Therefore, the proposal should be submitted in final form from a budgetary, technical, and programmatic standpoint.

DISPUTES - Clark County encourages the use of informal resolution to address complaints or disputes arising over any actions in implementing the provisions of this RFP. Written complaints should be addressed to Clark County – Purchasing, P.O. Box 5000, Vancouver, Washington 98666-5000.

DIVERSITY IN EMPLOYMENT AND CONTRACTING REQUIREMENTS - It is the policy of Clark County to require equal opportunity in employment and services subject to eligibility standards that may be required for a specific program. Clark County is an equal opportunity employer and is committed to providing equal opportunity in employment and in access to the provision of all county services. Clark County's Equal Employment Opportunity Plan is available at http://www.clark.wa.gov/hr/documents.html. This commitment applies regardless of race, color, religion, creed, sex, marital status, national origin, disability, age, veteran status, on-the-job injury, or sexual orientation. Employment decisions are made without consideration of these or any other factors that are prohibited by law. In compliance with department of Labor Regulations implementing Section 504 of the rehabilitation Act of 1973, as amended, no qualified handicapped individual shall be discriminated against in admission or access to any program or activity. The prospective contractor must agree to provide equal opportunity in the administration of the contract, and its subcontracts or other agreements.

MUNICIPAL RESEARCH and SERVICE CENTER - Clark County (WA) contracts with the Municipal Research and Service Center (MRSC) to maintain our Consultant, Small Works and Vendor rosters. To be eligible to participate in this Clark County public solicitation and the resulting contract, your business must be registered with the MRSC Rosters. Failure to register may result in your proposal being marked nonresponsive. Be sure to select Clark County in your application. If you have questions about the registration process, contact the MRSC Rosters at 206-436-3798 or https://mrscrosters.org/businesses/business-membership/

INDEPENDENT PRICE DETERMINATION - The prospective contractor guarantees that, in connection with this proposal, the prices and/or cost data have been arrived at independently, without consultation, communication, or agreement for the purpose of restricting competition. This does not preclude or impede the formation of a consortium of companies and/or agencies for purposes of engaging in jointly sponsored proposals.

INTERLOCAL AGREEMENT - Clark County has made this RFP subject to Washington State statute RCW 39.34. Therefore, the proposer may, at the proposers option, extend identical prices and services to other public agencies wishing to participate in this RFP. Each public agency wishing to utilize this RFP will issue a purchase order (or contract) binding only their agency. Each contract is between the proposer and the individual agency with **no** liability to Clark County.

LIMITATION - This RFP does not commit Clark County to award a contract, to pay any costs incurred in the preparation of a response to this RFP, or to procure or contract for services or supplies.

LATE PROPOSALS - A proposal received after the date and time indicated above will not be accepted. No exceptions will be made.

ORAL PRESENTATIONS - An oral presentation may be required of those prospective contractors whose proposals are under consideration. Prospective contractors may be informed that an oral presentation is desired and will be notified of the date, time and location the oral presentation is to be conducted.

OTHER AUDIT/MONITORING REQUIREMENTS - In addition, auditing or monitoring for the following purposes will be conducted at the discretion of Clark County: Fund accountability; Contract compliance; and Program performance.

PRICE WARRANT - The proposer shall warrant that the costs quoted for services in response to the RFP are not in excess of those which would be charged any other individual or entity for the same services performed by the prospective contractor, in a similar socioeconomic, geographical region.

PROTESTS - Must be submitted to the Purchasing Department.

PUBLIC SAFETY - May require limiting access to public work sites, public facilities, and public offices, sometimes without advance notice. The successful Proposer's employees and agents shall carry sufficient identification to show by whom they are employed and display it upon request to security personnel. County project managers have discretion to require the successful Proposer's employees and agents to be escorted to and from any public office, facility or work site if national or local security appears to require it.

ACCEPTANCE or REJECTION OF PROPOSALS - Clark County reserves the right to accept or reject any or all proposals received as a result of this RFP, to negotiate with any or all prospective contractors on modifications to proposals, to waive formalities, to postpone award, or to cancel in part or in its entirety this RFP if it is in the best interest of Clark County to do so.

SUBCONTRACTING - No activities or services included as a part of this proposal may be subcontracted to another organization, firm, or individual without the approval of Clark County. Such intent to subcontract shall be clearly identified in the proposal. It is understood that the contractor is held responsible for the satisfactory accomplishment of the service or activities included in a subcontract.

VERBAL PROPOSALS - Verbal proposals will not be considered in making the award of any contract as a result of this RFP.

WORKERS COMPENSATION INSURANCE – The contractor shall comply with R.C.W. Title 51- with minimum coverage limits of $500,000 for each accident, or provide evidence that State law does not require such coverage.

FOR ALTERNATIVE FORMATS
Clark County ADA Office: V: 564-397-2322
ADA@clark.wa.gov

Request for Proposals
Table of Contents

Request for Proposal #938
TSMP & SSIP 2026 Update

Part I Proposal Requirements

Section IA	General Information
1. Introduction	Clark County Public Works is soliciting proposals from qualified firms to assist with updating and improving two critical safety planning documents: the Systemic Safety Improvement Program (SSIP) and the Traffic Safety Management Program (TSMP). The County seeks innovative, actionable approaches to align these plans with current best practices, enable effective implementation of safety countermeasures, and support progress toward Washington State's Target Zero goals. This RFP invites the consultant community to propose methodologies and strategies that will not only update the technical content of these plans, but also improve the County's ability to prioritize, fund, and deliver safety projects. The successful consultant will provide a comprehensive, scalable framework to help the County transition from planning to implementation, while also identifying internal process improvements and resource needs. Clark County (WA) contracts with the Municipal Research and Service Center (MRSC) to maintain our Consultant, Small Works and Vendor Rosters. To be eligible to participate in this Clark County public solicitation and the resulting contract your business must be registered with the MRSC Rosters. Failure to register may result in your proposal being marked non-responsive. Be sure to select Clark County in your application. If you have questions about the registration process, contact the MRSC Rosters at 206-436-3798 or https://mrscrosters.org/businesses/business-membership/ If your company contact details ***are not*** on the Plan Holder List at https://clark.wa.gov/internal-services/request-proposal-1 Attachment B, Letter of Interest must be submitted to participate in this RFP. Proposers shall respond to all sections to be considered. Clark County has made this Request for Proposal subject to Washington State statute RCW 39.34 Interlocal Cooperation Act. The proposer may opt to extend identical services and prices to qualified public agencies. Each contract is between the proposer and individual agency binding only their agency, with no liability to Clark County.
2. Background	Clark County's Systemic Safety Improvement Program (SSIP) and Traffic Safety Management Program (TSMP) were developed to guide the County in identifying and addressing roadway safety concerns. While both documents contain valuable data and strategies, they have not been effectively integrated into County workflows or project development processes. Currently, the County maintains a list of high-risk locations and a library of proven countermeasures but lacks a coordinated framework to advance projects from concept to construction. Limited staffing capacity, lack of standardized implementation practices, and reactive grant pursuits have further limited progress. Additionally, recent staff turnover has resulted in knowledge gaps and inconsistent application of existing safety strategies. With fatal and serious injury crashes trending upward and limited progress toward Target Zero, the County recognizes the need for a more functional, streamlined, and actionable approach to roadway safety. This project is intended to update the SSIP and TSMP and provide a practical roadmap for integrating safety improvements into ongoing programs, enhancing grant readiness, and identifying resource needs to support implementation.

3. Scope of Project	The County is seeking a qualified consultant to lead the update and overhaul of its Systemic Safety Improvement Program (SSIP) and Traffic Safety Management Program (TSMP). The consultant's work should go beyond revising existing documents — the goal is to create a functional, sustainable, and actionable safety program that aligns with WSDOT's Highway Safety Improvement Program (HSIP), Target Zero, and the US DOT Safe Systems Approach principles and positions the County to secure and implement safety funding effectively. **Key Tasks:** **1. Review & Evaluation** o Conduct a detailed review of the existing SSIP and TSMP. o Interview County staff, including but not limited to staff in Transportation Planning, Transportation Programming, Traffic Engineering, Project Management, Engineering Design, Purchasing, Road Operations, Preservation, and Public Works Management, to identify organizational, procedural, and operational barriers to implementation of projects, processes, and countermeasures identified in the SSIP and TSMP. o Identify opportunities for process improvement to improve staff effectiveness. o Assess current prioritization scoring methodologies and tools, project lists, and systemic strategies for alignment with WSDOT's HSIP, Target Zero, and US DOT Safe Systems Approach best practices. **2. Program Updates** o Update the SSIP to reflect the most recent five years of crash data and current risk factors, with emphasis on identifying systemic crash patterns and selecting appropriate, proven countermeasures. The update should align with WSDOT's HSIP, Target Zero, and the US DOT Safe Systems Approach, and support the development of consistent strategies for incorporating systemic safety improvements into County programs and projects. o Update the TSMP to include a clear and defensible prioritization scoring methodology, using the most recent five years of crash data and incorporating additional relevant data sources as appropriate. The methodology should align with WSDOT's HSIP, Target Zero, and US DOT Safe Systems Approach. The Consultant should provide a transparent explanation of the methodology and an application of that methodology to produce a prioritized project list. The document will also move beyond high-level prioritization and into specific, implementable safety project concepts for the top fifteen prioritized projects. o Identify recommended policy and standard practice changes to allow for systemic safety countermeasures to be integrated into existing County programs (e.g., HMA overlays) to enable incremental systemic safety improvements. o Identify countermeasures in the existing and updated SSIP that are underutilized or not implemented. For each, assess barriers to implementation (e.g., equipment, staffing, standards, policy), and provide recommended changes to County practices or standards to enable their use. o Provide draft supporting documentation for recommended changes to policies or standard practices. This may include, but is not limited to, ordinances, staff reports, standard operating procedures, technical guidelines, management decision memos, training materials, or other administrative documents necessary to facilitate implementation.

	○ Attend management meetings, Clark County Council work sessions, and other relevant meetings in a support role to County staff to implement any agreed upon changes to practices, policies, and procedures. ○ Include an Executive Summary in the SSIP and TSMP not to exceed three (3) pages for each document for ease of reference to future staff reviewing and using these documents. **3. Implementation Strategy** ○ Develop a clear framework for project identification, funding, and implementation, including: ▪ A realistic phasing strategy (e.g., regional focus, annual goals). ▪ Recommendations for internal process improvements. ▪ Identification of staffing/resource needs required to implement prioritized projects and provide recommendations for addressing gaps. This may include identifying roles or expertise needed, estimating staff time commitments, recommending staff training, or outlining design grants for consultant-led project implementation. ▪ Guidelines for integrating safety into preservation and capital projects. **4. Grant Readiness** ○ Provide recommendations to improve the County's competitiveness for grant applications. ○ Develop tools or templates to help staff generate grant-ready safety projects from the updated documents. **5. Training and Documentation** ○ Work with County staff to determine and document expectations, responsibilities, and timelines for maintaining the TSMP and SSIP between departments, including but not limited to Transportation Planning, Transportation Programming, and Traffic Engineering. ○ Document processes and workflows to support internal capacity for future plan updates and project development. ○ Provide training to County staff on maintaining the TSMP and SSIP, including use of updated tools, prioritization methods, and reporting. **6. Target Zero Implementation Framework** ○ Assist in defining a standalone or integrated program focused on implementing Target Zero-aligned safety improvements using local or grant resources.
4. Project Funding	Funding is expected to come out of the County Road Fund. Federal funds will not be used.

5. Title VI Statement	**Title VI Statement** Clark County, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award. El Condado de Clark, de acuerdo con las disposiciones del Título VI de la Ley de Derechos Civiles de 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d a 2000d-4) y el Reglamento, por la presente notifica a todos los postores que se asegurará afirmativamente de que cualquier contrato celebrado de conformidad con este anuncio, las empresas comerciales desfavorecidas tendrán la oportunidad plena y justa de presentar ofertas en respuesta a esta invitación y no serán discriminadas por motivos de raza, color u origen nacional en consideración a un laudo. La políza del condado de Clark es garantizar que ninguna persona por motivos de raza, color, origen nacional o sexo según lo dispuesto en el Title VI of the Civil Rights Act de 1964, según enmendada, sea excluida por participar en, ser negado los beneficios de, o ser discriminado por cualquier programa o actividad patrocinada por el condado. Para preguntas relacionadas con el programa de Title VI de Obras Públicas del condado de Clark, o para servicios de interpretación o traducción para personas que no hablan inglés. O para que los materiales estén disponibles en un formato alternativo, comuníquese con el coordinador del Title VI de Obras Públicas del condado de Clark por correo electrónico a CCPW-TitleVI@clark.wa.gov o por teléfono a 564-397-4944. Las personas con problemas de audición / habla pueden llamar a Washington Relay Center al 711. For questions regarding Clark County Public Works' Title VI Program, or for interpretation or translation services for non-English speakers, or otherwise making materials available in an alternate format, contact Clark County Public Works' Title VI Coordinator via email at CCPW-TitleVI@clark.wa.gov or phone at 564-397-4944. Hearing/speech impaired may call the Washington Relay Center at 711. *Политика округа Кларк заключается в том, что никого нельзя отстранять от* участия, лишать льгот или подвергать дискриминации по признаку расовой принадлежности, цвета кожи и национального происхождения в рамках любой деятельности округа Кларк, как это предусмотрено разделом VI Закона о гражданских правах 1964 г. и сопутствующими законами. Эта политика распространяется на всю деятельность округа Кларк, в том числе на его подрядчиков и всех, кто действует от имени округа Кларк. Эта политика также распространяется на деятельность любого департамента или учреждения, которому округ Кларк предоставляет федеральную финансовую помощь. Федеральная финансовая помощь включает в себя гранты, обучение, использование оборудования, передачу избыточного имущества и другую помощь. Политика Округа Кларк состоит в том, чтобы гарантировать, что ни один человек не зависимо от расы, цвета кожи, национальности или пола - как это предусмотренно Разделом VI Закона о Гражданских Правах от 1964 года с поправками - не должен быть исключён из участия, или получить отказ в выгодах, или в иной форме быть ущемлён в любой программе или деятельности, спонсируемой Округом Кларк. По вопросам, связанным с Программой Раздела VI департамента Общественных работ Округа Кларк, или по вопросам перевода для людей, говорящих на ином языке кроме английского, или для получения материалов в альтернативном формате, обращайтесь к координатору Раздела VI департамента Общественных работ Округа Кларк по электронной почте CCPW-TitileVI@clark.wa.gov или по телефону 564.397.4944. Люди с нарушениями слуха или речи могут обратиться в Вашингтонский центр переключения по номеру 711.

<table>
<tr><td>6. Timeline for Selection</td><td>The following dates are the <u>intended</u> timeline:

<table><tr><td>Pre-submittal Meeting</td><td>October 1, 2025</td></tr><tr><td>Deadline for Questions and Answers</td><td>October 8, 2025</td></tr><tr><td>Final date for Addendum, if needed</td><td>October 17, 2025</td></tr><tr><td>Proposals Dues</td><td>October 29, 2025</td></tr><tr><td>Proposal Review/Evaluation Period</td><td>October 30 - November 14, 2025</td></tr><tr><td>Interviews</td><td>Week of November 17, 2025</td></tr><tr><td>Selection Committee Recommendation</td><td>November 21, 2025</td></tr><tr><td>Contract Negotiation/Execution</td><td>December 2025</td></tr><tr><td>Contract Intended to Begin</td><td>January 6, 2026</td></tr></table></td></tr>
<tr><td>7. Employment Verification</td><td>The Proposer, if awarded the Contract, shall register and enter into a Memorandum of Understanding (MOU) with the Department of Homeland Security E-Verify program before execution of the Contract. The Contractor shall ensure all Contractor employees and any sub-contractor(s) assigned to perform work under this Agreement are eligible to work in the United States. The Contractor shall provide verification of compliance upon County request. Failure by Contractor to comply with this subsection shall be considered a material breach.
(Sole Proprietors must submit a letter stating such.)</td></tr>
<tr><td>Section IB</td><td>Work Requirements</td></tr>
<tr><td>1. Required Services</td><td>Review and evaluation may include access to County network to identify organizational, procedural, and operational barriers. An IT representative will be on the RFP Review Committee and an IT Cyber Security Questionnaire is required.</td></tr>
<tr><td>2. County Performed Work</td><td>The County has not updated the SSIP or TSMP or their associated prioritization lists since the Final Report documents were created. However, the County has collected specific data to evaluate specific elements of each. If requested, the County will provide collected data for evaluation and implementation during the Consultant’s analysis. It is expected that many County staff across many departments and management levels will work with the Consultant throughout the project described in this RFP.</td></tr>
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<tr>
<td>3. Deliverables & Schedule</td>
<td>This is a suggested schedule and is subject to change:
<table>
<tr><th>Deliverable:</th><th>Expected Completion Date:</th></tr>
<tr><td>1: Research existing SSIP, TSMP, and practices/procedures/documentation.</td><td>April 2026</td></tr>
<tr><td>2: First Draft of Updates to SSIP and TSMP as well as first draft practices/procedures/documentation updates.</td><td>August 2026</td></tr>
<tr><td>3: Final Report explaining the reasoning and background of any changes to the methodologies described and used in the SSIP and TSMP. Updated SSIP and TSMP Final Report documents.</td><td>December 2026</td></tr>
<tr><td>4: Finalized package of recommended process updates/code changes/management decisions to improve implementation of SSIP and TSMP provided to management for consideration.</td><td>March 2027</td></tr>
<tr><td>5: Staff training on recommended process updates/code changes/management decisions complete. Assisting staff with proceeding with any changes complete.</td><td>July 2027</td></tr>
<tr><td>6: Documentation of how to update the SSIP and TSMP to produce updated prioritization lists for future staff complete.</td><td>July 2027</td></tr>
<tr><td>7: Staff training on how to update the SSIP and TSMP to produce updated prioritization lists using the created documentation complete with current staff.</td><td>September 2027</td></tr>
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<td>4. Place of Performance</td>
<td>Contract performance may take place remotely via Microsoft Teams, in-person in the County’s facility, in-person in the Proposer’s facility, in-person at a third-party location, or any combination thereof.</td>
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<td>5. Period of Performance</td>
<td>A contract awarded as a result of this RFP will be for two (2) years and is intended to begin on January 6, 2026 and end January 5, 2028.

No time extensions will be granted to ensure project completion in a reasonable timeframe.

The county also reserves the right to terminate the contract, with thirty (30) days written notice, at any time if the requirements of the contract are not being met satisfactorily, solely in the county’s judgment.</td>
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6. Prevailing Wage Applicable to all public work as defined in RCW 39.04.010(4) Public Works Definition	Pursuant to Washington State RCW 39.12 PREVAILING WAGES ON PUBLIC WORKS all work identified in this project as a public work requires the contractor to pay Washington State prevailing wages and file all affidavits of intent to pay with the WA State Dept of Labor & Industries. Contractors shall meet the requirements for Prevailing Wage and public works requirements, per RCW 39.04.350 BIDDER RESPONSIBILITY CRITERIA – SWORN STATMENT – SUPPLEMENTAL CRITERIA. For this project select the Clark County rates that apply on the proposal closing date from either of these sites: **http://www.wsdot.wa.gov/Design/ProjectDev/WageRates/default.htm** **http://www.lni.wa.gov/TradesLicensing/PrevWage/WageRates** Before payment is made by the Local Agency of any sums due under this contract, the Local Agency must receive from the Contractor and each Subcontractor a copy of "Statement of Intent to Pay Prevailing Wages" (Form L & I Number 700-29) approved by the Washington State Department of Labor and Industries. A fee of $45.00 per each "Statement of Intent to Pay Prevailing Wages" and "Affidavit of Wages Paid" is required to accompany each form submitted to this Department of Labor and Industries. The Contractor is responsible for payment of these fees and shall make all applications directly to the Department of Labor and Industries. These fees shall be incidental to all the proposed items of this contract.
7. Debarred/Suspended	Federally or Washington State debarred or suspended suppliers may not participate in this Request for Proposal. All proposers must fill out, sign and submit the “Certification Regarding Debarment, Suspension, and Other Responsibility Matters” form with their proposal to be eligible to participate.
8. Americans with Disabilities Act (ADA) Information	Clark County in accordance with Section 504 of the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA), commits to nondiscrimination on the basis of disability, in all of its programs and activities. This material can be made available in an alternate format by emailing ADA@clark.wa.gov or by calling 564-397-2322.
9. Public Disclosure	This procurement is subject to the Washington Public Records Act (the “Act”), chapter 42.56 RCW. Once in the County’s possession, all of the RFP Submittals shall be considered public records and available for public records inspection and copying, unless exempt under the Act. If a Respondent or Proposer considers any portion of an RFP Submittal to be protected under the law, whether in electronic or hard copy form, the Respondent or Proposer shall clearly identify each such portion with the word “PROPRIETARY”. The County will notify the Respondent or Proposer in writing of the request and allow the Respondent or Proposer ten (10) days to obtain a court order enjoining release of the record(s). If the Respondent or Proposer does not take such action within the ten (10) day period, the County will release the portions of the RFP Submittal deemed subject to disclosure. All Respondents and Proposers who provide RFP Submittals for this procurement accept the procedures described above and agree that the County shall not be responsible or liable in any way for any losses that the party may incur from the disclosure of records to a third party who requests them.

10. Insurance/Bond	The firm awarded the contract will be required to have insurance in effect as specified in the contract under Section XII Legal Relations. See: WSDOT Local Agency A&E Professional Services Negotiated Hourly Rate Consultant Agreement at: https://wsdot.wa.gov/sites/default/files/2021-10/LP_AEPS-NegotiatedHourlyRate.pdf
11. Plan Holders List	All proposers are required to be listed on the plan holders list. ✓ Prior to submission of proposal, confirm your organization is on the Plan Holders List below: To view the Plan Holders List, click on the link below or copy and paste into your browser. Clark County RFP site: https://clark.wa.gov/internal-services/purchasing-overview • If your organization is NOT listed, submit Attachment B - Letter of Interest to ensure your inclusion. • Proposals received by Clark County by proposers not included on the Plan Holders List may be considered non-responsive.

Request for Proposal #938
TSMP & SSIP 2026 Update

Part II Proposal Preparation and Submittal

Section IIA	Pre-Submittal Meeting / Clarification
1. Pre-Submittal Meeting	A pre-submittal meeting will be held on Wednesday, October 1, 2025 at 3:00 pm, via Microsoft Teams. Proposers shall email Dylan Jennings at Dylan.Jennings@clark.wa.gov to request the meeting invite no later than 4:00 pm on September 30, 2025.
2. Proposal Clarification	Questions and Requests for Clarification regarding this Request for Proposal must be directed in writing, via email, to the person listed on the cover page. The deadline for submitting such questions/clarifications is October 8, 2025 by 5:00pm PST). An addendum will be issued no later than October 17, 2025 to all recorded holders of the RFP if a substantive clarification is in order. The Questions & Answers/Clarifications are available for review at the link below. Each proposer is strongly encouraged to review this document prior to submitting their proposal. Clark County RFP site: **https://clark.wa.gov/internal-services/request-proposal-1**
Section IIB	**Proposal Submission**
1. Proposals Due	Sealed proposals must be received no later than the date, time and location specified on the cover of this document. **The outside of the envelope/package shall clearly identify:** **1. RFP Number and;** **2. TITLE and;** **3. Name and Address of the Proposer.** Responses received after submittal time will not be considered and will be returned to the Proposer - unopened. Proposals received with insufficient copies (as noted on the cover of this document) cannot be properly disseminated to the Review Committee and other reviewers for necessary action, therefore, may not be accepted.
2. Proposal	Proposals must be clear, succinct and not exceed twenty (20) pages, excluding resumes, coversheet and debarment form. Proposers who submit more than the pages indicated may not have the additional pages of the proposal read or considered For purposes of review and in the interest of the County, the County encourages the use of submittal materials (i.e. paper, dividers, binders, brochures, etc.) that contain post-consumer recycled content and are readily recyclable.

	The County discourages the use of materials that cannot be readily recycled such as PVC (vinyl) binders, spiral bindings, and plastic or glossy covers or dividers. Alternative bindings such as reusable/recyclable binding posts, reusable binder clips or binder rings, and recyclable cardboard/paperboard binders are examples of preferable submittal materials. Proposers are encouraged to print/copy on both sides of a single sheet of paper wherever applicable; if sheets are printed on both sides, it is considered to be two pages. Color is acceptable, but content should not be lost by black-and-white printing or copying. All submittals will be evaluated on the completeness and quality of the content. Only those Proposers providing complete information as required will be considered for evaluation. The ability to follow these instructions demonstrates attention to detail. Additional support documents, such as sales brochures, may be included with each copy unless otherwise specified.
Section IIC	**Proposal Content**
1. Cover Sheet	This form is to be used as your proposal Cover Sheet. See Cover Sheet - Attachment A
2. Project Team	Describe your organization and the team members who will be assigned to this project, including their roles, relevant qualifications, and past experiences with similar projects. Explain why qualifications or experiences align with the County's needs for this project. Do not include names or photos of team members.
3. Management Approach	Describe your overall approach to managing this project, including communication methods, project tracking tools, and strategies for maintaining scope, schedule, and budget. Provide an expected plan for efficiently gathering data and working with County staff to improve processes.
4. Respondent's Capabilities	**Relevant Plan Update Experience** Provide examples of similar planning efforts you have completed for jurisdictions of comparable size and scope, particularly updates to Transportation Safety Management Programs (TSMPs), Systemic Safety Improvement Programs (SSIPs), or similar safety-focused transportation planning documents. Describe the scope, methods, deliverables, and results for each example, noting any successful integration of safety priorities into standard maintenance or capital improvement programs. Explain how you kept the plan updates within budget. **Organizational Process Improvement & Implementation Experience** Provide examples of work where your team has helped jurisdictions improve their transportation safety programs, internal processes, and prioritization methods, especially cases where those improvements led to increased grant funding, more safety projects being implemented, or better integration of safety considerations into everyday projects. Include specific before-and-after impacts if available (e.g., new prioritization frameworks, updated standards, increased project delivery rates).

	References Please provide at least three (3) references with contact information for the specific work history examples explained above.
5. Project Approach and Understanding	Provide a detailed description of your understanding of the project's purpose, goals, and challenges. Explain how you will approach the updates to the TSMP and SSIP in a way that ensures technical accuracy, compliance with best practices, and strong alignment with grant funding opportunities. Discuss your strategies for coordination across multiple County divisions and stakeholders, especially in an environment where prior planning efforts may not have had strong direction or consistent follow-through. Identify potential challenges, such as limited internal resources or existing process gaps, and explain how your approach will overcome them to produce clear, actionable, and implementable programs.
6. Proposed Cost	This is a qualifications-based selection process for professional engineering/planning services. Do not submit cost with your proposal.

Part III Proposal Evaluation & Contract Award

<table>
<tr><th>Section IIIA</th><th>Proposal Review and Selection</th></tr>
<tr><td>1. Evaluation and Selection:</td><td>Proposals received in response to this RFP will be evaluated by a Review Committee. Depending on your funding requirements the Committee review results and recommendations may require presentation to an appropriate advisory board prior to the consent process with the Clark County Council.</td></tr>
<tr><td>2. Evaluation Criteria Scoring</td><td>Each proposal received in response to the RFP will be objectively evaluated and rated according to a specified point system.

This will be a Two-Tier evaluation for a total of two hundred (200) points.
Tier 1: A one hundred (100) point system will be used, weighted against the following criteria:

An initial list of up to five (5) qualified firms will be determined with the following point allocation to proceed to an interview stage:

<table>
<tr><td>Project Approach and Understanding</td><td>20</td></tr>
<tr><td>Relevant Program Update Experience (TSMP, SSIP, similar programs, outcomes)</td><td>20</td></tr>
<tr><td>Organizational Process Improvement & Implementation Experience</td><td>15</td></tr>
<tr><td>Qualifications of Key Personnel</td><td>15</td></tr>
<tr><td>Management Approach and Communication</td><td>10</td></tr>
<tr><td>References</td><td>10</td></tr>
<tr><td>Firm is local to Portland/Vancouver Metro Area</td><td>10</td></tr>
<tr><td>Total Points</td><td>100</td></tr>
</table>

Tier 2: A one hundred (100) point system will be used for the second round of scoring.
The interview will be scored based on clear and concise communication during the interview, and ability to succinctly and fully answer questions from Clark County staff. The presentation at the interview should cover the following topics, including visual examples of past work:

<table>
<tr><td>Project Approach and Understanding</td><td>10</td></tr>
<tr><td>Relevant Program Update Exper. (TSMP, SSIP, similar programs, outcomes)</td><td>10</td></tr>
<tr><td>Organizational Process Improvement & Implementation Experience</td><td>10</td></tr>
<tr><td>Qualifications of Key Personnel and Expected Team Organization</td><td>10</td></tr>
<tr><td>Management Approach and Communication</td><td>30</td></tr>
<tr><td>Anticipated Project Schedule</td><td>30</td></tr>
<tr><td>Total Points</td><td>100</td></tr>
</table>
</td></tr>
</table>

	The final selection of a consultant will be determined based on both the proposal and the interview.
Section IIIB	**Contract Award**
1. Consultant Selection	The County will determine the most qualified proposer based on the evaluation criteria listed using predetermined weights, the attributes of the Proposers and the overall responsiveness of the Proposal. If the County does not reach a favorable agreement with the top Proposer, the County shall terminate negotiations and begin negotiations with the next qualified Proposer. If the County is unable to reach agreeable terms with either Proposer, they may opt to void the RFP and determine next steps. Clark County reserves the right to accept or reject any or all proposals received, to negotiate with any or all prospective contractors on modifications to proposals, to waive formalities, to postpone award, or to cancel in part or in its entirety this RFP. Clark County reserves the right to award the contract based on the best interests of the County.
2. Contract Development	The proposal and all responses provided by the successful Proposer may become a part of the final contract. The form of contract shall be the County's Contract for Professional Services. The County's expectation is that the Consultant will prepare a draft contract scope of work and will collaborate closely with County staff, including the Project Manager, to refine deliverables, timelines, and milestones before final contract execution. This collaborative process should ensure the contract reflects the agreed-upon approach, performance expectations, and reporting requirements.
3. Award Review	The public may view Request for Proposal documents by submitting a public records request at www.clark.wa.gov .
4. Orientation/Kick-off Meeting	Following contract execution, the County will schedule a kick-off meeting with the Consultant team and key County stakeholders to: • Review project goals and timelines • Clarify communication protocols • Confirm deliverable formats and submission schedules • Identify immediate next steps and early action items The County expects the kick-off meeting to occur within two weeks of the contract award, unless otherwise agreed upon.

Request for Proposal #938
TSMP & SSIP 2026 Update

Attachment A: COVER SHEET

General Information:

Legal Name of Proposing Firm	
Street Address	
City | State | Zip Code	
Contact Person | Title	
Phone	
Program Location (if different than above)	
Email Address	
Tax Identification Number	

ADDENDUM:

Proposer shall acknowledge receipt of Addenda by checking the appropriate box(es).

None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐

NOTE: Failure to do so, shall render the proposer non-responsive and therefore be rejected.

I certify that to the best of my knowledge the information contained in this proposal is accurate and complete and that I have the legal authority to commit this agency to a contractual agreement. I realize the final funding for any service is based upon funding levels, and the approval of the Clark County Council and required approvals.

Authorized Signature of Proposing Firm _____ Date _____

Printed Name _____ Title _____

Request for Proposal #938
TSMP & SSIP 2026 Update

Attachment B: LETTER OF INTEREST

Legal Name of Proposing Firm	
Street Address	
City | State | Zip Code	
Contact Person | Title	
Phone	
Program Location (if different than above)	
Email Address	

- All proposers are required to be included on the plan holders list.
- If your organization is NOT listed, submit the 'Letter of Interest" to ensure your inclusion.

Email Letter of Interest to*: Koni.Odell@clark.wa.gov and Misty.Davis@clark.wa.gov*

Clark County web link: https://clark.wa.gov/internal-services/request-proposal-1

This document will only be used to add a proposer to the plan holders list. Submitting this document does not commit proposer to provide services to Clark County, nor is it required to be submitted with proposal.

Proposals may be considered non-responsive if the Proposer is not listed on the plan holders list.

Request for Proposal #938
TSMP & SSIP 2026 Update

Attachment C

Clark County, Washington

Certification Regarding
Debarment, Suspension and Other Responsibility Matters

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal, State or local department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to 5 years, or both.

_____
Company Name

_____
Typed Name & Title of Authorized Representative

_____ _____
Signature of Authorized Representative Date

☐ I am unable to certify to the above statements. My explanation is attached.

EXHIBIT A

Clark County
Systemic Safety Improvement Program

KITTELSON & ASSOCIATES

March 24, 2020

Clark County

Systemic Safety Improvement Program Final Report

Project Management Team:

Ejaz Khan, PE, Traffic Engineer

Courtney Furman, PE, Traffic Engineer

Consultant Team

Kittelson & Associates, Inc.

Matt Braughton, Senior Planner

Brian L. Ray, PE, Senior Principal Engineer

Alex Garbier, Engineering Associate

Kevin Yost, Transportation Analyst

Claire Casey, Transportation Analyst

TABLE OF CONTENTS

INTRODUCTION

Clark County is committed to reducing the crash frequency and severity of road users on County roads. As part of this commitment, the County completed a systemic safety analysis to augment County work identifying high crash locations. This report details work completed by Kittelson & Associates, Inc. (Kittelson) in coordination with Clark County staff to develop a Systemic Safety Improvement Program (SSIP). The SSIP provides a roadmap for the County to implement a proactive approach to improving safety on county roads. This program is intended to supplement the County's Transportation Safety Management Program (TSMP) which focuses on identifying safety locations based on historical safety performance. In contrast, the SSIP program identifies roadway and intersection characteristics associated with crash risk to allow the County to identify and address locations with identified crash risk characteristics. Together, the TSMP and SSIP provide the County with a comprehensive safety management process to address safety performance from multiple perspectives.

The report begins by describing crash patterns and roadway conditions to identify risk factors. Based on the risk factors identified, it presents processes for identifying where risk factors are present and how to prioritize corridors for treatment. It then provides a list of treatments that can be applied systemically to address the risks. The report ends with a series of model projects that serve as examples of how to apply treatments to priority corridors where risk factors are present.

Outline

The report is structured into four sections:

- ***Section 1: Crash and Roadway Characteristic Analysis*** – This section summarizes crashes on county roads reported over the past five years. Based on the analysis results, Kittelson identified crash and roadway and intersection characteristics associated with a high frequency of fatal and severe crashes to assist in prioritizing locations for proactive safety improvements.
- ***Section 2: Identify Priority Locations*** – The second section provides a framework for determining how to prioritize locations for systemic treatment applications. For each risk factor identified in Section 1, this section maps the locations exhibiting that roadway or intersection characteristic and provides guidance for prioritizing corridors.
- ***Section 3: Treatment Toolbox*** – The treatment toolbox identifies potential systemic countermeasures to address the established roadway risk factors. The toolbox also includes a section on speed management treatments to assist the County in mitigating increased crash frequency and severity risk associated with speeding on rural roads.
- ***Section 4: Model Projects*** – This section presents model projects for systemic and site-specific treatments for five corridors selected by Clark County from the priority locations identified in Section 2. The project examples provide a template for how systemic treatments can be applied to address risk factors on County roads while recognizing the need for site-specific treatments to address unique corridor elements.

Summary of Findings

Kittelson identified a set of systemic crash risk factors for roads in Clark County based on crash analyses. The identified crash risk factors include:

- Rural road curves and grades on high-speed roadways (45 mph and greater)
- Rural road fixed objects:
- Pedestrian crossings on multi-lane urban roadways
- Rural two-way stop-controlled intersections
- Urban signalized intersections

For each risk factor, the SSIP (1) develops a framework for identifying and prioritizing locations for treatments and (2) identifies a toolbox of low-cost safety treatments that address the risk factor. The treatment toolbox also includes a set of speed management treatments, as excessive speed is a primary or compounding factor for a large share of crashes in Clark County.

Using the identification and prioritization framework, the SSIP identified 20 potential systemic improvement locations. Using these prioritized locations as a starting put and based on input from Clark County staff seven locations were developed into model projects for potential safety treatments. The model projects use treatments from the safety treatment toolbox to demonstrate how systemic treatments can be applied in context. Table 1 lists the 20 potential locations as well as the locations developed as model projects highlighted in bold. This includes two signalized intersection corridors that were selected in collaboration with Clark County staff.

Table 1: Priority Locations Summary

Risk Factor	Preliminary Locations (Project Example Locations Bolded)
Rural Curves	**NE Risto Road between NE 207th Avenue and NE 227th Avenue** NE Lucia Falls Road between NE 172nd Avenue and NE Sunset Falls Road NE Ward Road between NE 119th Street and NE 172nd Avenue
Rural Grades	**Rawson Road between NE 271st Ave and NE 139th Street** NE W.H. Garner Road to NE Kelly Road, continuing to NE Yacolt Mountain Road NE Sunset Fall Road between NE Deer Road and NE Lucia Falls Road
Rural Fixed Objects	**NE 277th Avenue/NE 28th Street between NE 292nd Avenue and NE Blair Road** NE Lucia Falls between NE 172nd Avenue and NE Sunset Falls Road Washougal River Road between County Line and SE 17th Street
Rural Two-Way Stop-Controlled Intersection Corridors	**Intersections created by NE 82nd Street, NE 259th Street, NE 72nd Street, and NE Manley Road** NW 199th Street between 41st Avenue and NE 29th Street NE 182nd Street between NE Risto Road and NE 119th Street SE Blair Road between SE Washougal River Road and WA-500

Risk Factor	Preliminary Locations (Project Example Locations Bolded)
Pedestrian Corridor	**NE 78th Street between NE Hazel Dell Avenue and NE St Johns Road** NE 99th Street between NE Hazel Dell Avenue and NE 25th Street NE HWY 99 between Minnehaha Street and NE 104th Street
Signalized Intersections	NE 99th Street and NE HWY 99 NE 78th Street and NE HWY 99 NE St Johns Road and NE 78th Street NE Covington Road and NE 76th Street **NE 20th Avenue/ NE Highway 99 between NE 117th Street and NE 134th Street** **NE 78th Street between NE Saint Johns Road and NE 47th Avenue**

Source: Kittelson & Associates, Inc.

SECTION 1: CRASH AND ROADWAY CHARACTERISTIC ANALYSIS

During the first phase of the SSIP, Kittelson reviewed Clark County crash data and roadway features to determine potential systemic risk factors to mitigate fatal and severe crashes. This section summarizes the crash history and roadway features analysis results and identifies systemic risk factors. The findings from the analysis formed the basis for identifying priority systemic safety improvement locations in Section 2 as well as informing the systemic safety treatments in Section 3.

Overview of Data and Approach

Kittelson analyzed the crash and roadway data using five years of Washington State Department of Transportation (WSDOT) crash data (January 2013 to December 2017) for unincorporated Clark County and roadway features data from the County's GIS databases. The crash dataset included 4,906 reported crashes on unincorporated Clark County roads. The road network for unincorporated Clark County includes approximately 1,100 miles of roads that are split relatively equally between roads designated as rural and urban facilities. Table 2 describes the county's roadway network mileage and vehicle miles traveled (VMT) by location type (urban/rural) and functional classification.

Table 2: Roadways in Unincorporated Clark County by Location and Facility Type

Location and Facility Type	Roadway Miles	VMT
Total Rural	547	668,082
Local Access	275	103,168
Arterial or Collector	271	564,914
Total Urban	559	1,137,958
Local Access	416	179,312
Arterial or Collector	143	958,645

Source: Clark County Public Works, 2018.

Note: Kittelson estimated VMT by multiplying road segment average daily traffic (ADT) counts by roadway centerline miles.

Overall Crash Trends

Kittelson analyzed overall crash trends to develop a reference point when evaluating specific crash types to determine their relevance for systemic treatment. For all tables in this section, colors distinguish between smaller and larger numbers. A white to red pattern symbolizes low to high frequencies. A green to red pattern presents normalized data, such as the percent of fatal or severe injury crashes, or crashes per mile. In all cases, the coloration compares like-to-like numbers.

Table 3 summarizes total and fatal and severe injury crashes. The table categorizes the 4,906 crashes by rural or urban facility as well as local access or collector/arterial functional classifications. This table provides a baseline measure of crash frequency and fatal or severe crash frequencies for each category of roadway. Kittelson used these baseline measures to identify which crash factors, such as crashes that include a pedestrian, are associated with higher crash rates and/or crashes with a higher rate of fatalities or severe injuries.

Table 3: Total Reported Crash Trends by Location and Facility Type, 2013-2017

	Crashes			Crashes per Mile		Crashes per 1,000 VMT	
Location and Facility Type	Total	Fatal or Severe Injury Crash	Percent Fatal or Severe Injury	Total	Fatal or Severe Injury	Total	Fatal or Severe Injury
Total Rural	1,772	99	5.6%	3.2	0.2	2.7	0.15
Local Access	248	17	6.9%	0.9	0.1	2.4	0.16
Arterial or Collector	1,524	82	5.4%	5.6	0.3	2.7	0.15
Total Urban	3,134	106	3.4%	5.6	0.2	2.8	0.09
Local Access	575	22	3.8%	1.4	0.1	3.2	0.12
Arterial or Collector	2,559	84	3.3%	17.9	0.6	2.7	0.09

Data Source: WSDOT and Clark County Public Works, 2018.

In addition to providing countywide averages by location type and functional classification, Table 3 shows:

- More crashes occurred on urban roadways (63.8%) than on rural roadways (37.2%); however, rural crashes were 1.65 times more likely to result in a severe injury or fatality. Total crashes resulting in a fatality or severe injury were split nearly equally between rural (99) and urban roadways (106).

- Rural local access roads had the highest percentage of fatal or severe injury crashes (6.9%) among the roadway classifications in Table 3. Urban collectors and arterials had the highest percentage of total and fatal or severe injury crashes per mile (17.9 and 0.6, respectively).

Crash Types

Kittelson reviewed a range of crash characteristics, such as the presence of a curve, to identify crash characteristics associated with higher than average rates of crashes or high rates of fatal or severe injury crashes. Characteristics are not necessarily mutually exclusive – a crash occurring on a curve could also occur at a location at a grade. Kittelson considered local conditions as well as priority crash types identified in the

Washington Traffic Safety Commission Priority Crash Types list[1] to identify what characteristics to consider in the analysis.

The crash type analysis is divided into two components. The first separates crashes by the facility classification where the crash occurred. The second reexamines the data using posted speed limit on the road. Under each, Kittelson evaluated two sets of factors:

1. Vehicle movement and user factors; and,
2. Roadway features and conditions.

[1] WSDOT, Target Zero: Washington's Strategic Highway Safety Plan (2016), http://www.wsdot.wa.gov/sites/default/files/2017/04/26/TargetZeroWAStrategicHighwaySafetyPlan-2016.pdf

Crashes by Facility Classification

Vehicle Movement and User Factors

Table 4 summarizes crashes by vehicle movement and user factors. The table is presented in two parts, the top shows crash frequencies and bottom half shows crashes normalized by roadway miles.

Table 4: Total Reported Crashes by Vehicle Movement and User Factors, 2013-2017

Total Crashes

Location and Facility Type	Under the Influence	Fixed Object	At Angle	Opposite Direction	Pedestrian-Involved	Bicycle-Involved	Motorcycle-Involved	Large Truck	Total
Total Rural	256	1,011	204	110	8	6	57	27	1,772
Local Access	50	176	19	9	4	1	7	3	248
Arterial or Collector	206	835	185	101	4	5	50	24	1,524
Total Urban	347	633	735	396	79	62	92	45	3,134
Local Access	104	151	132	54	20	17	19	6	575
Arterial or Collector	243	482	603	342	59	45	73	39	2,559

Crashes per Mile of Road Group

Location and Facility Type	Under the Influence	Fixed Object	At Angle	Opposite Direction	Pedestrian-Involved	Bicycle-Involved	Motorcycle-Involved	Large Truck	Total
Total Rural	0.5	1.8	0.4	0.2	0.0	0.0	0.1	0.0	3.2
Local Access	0.2	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.9
Arterial or Collector	0.8	3.1	0.7	0.4	0.0	0.0	0.2	0.1	5.6
Total Urban	0.6	1.1	1.3	0.7	0.1	0.1	0.2	0.1	5.6
Local Access	0.2	0.4	0.3	0.1	0.0	0.0	0.0	0.0	1.4
Arterial or Collector	1.7	3.4	4.2	2.4	0.4	0.3	0.5	0.3	6.1

Data Source: WSDOT and Clark County Public Works, 2018.

Rural Roads

- More than 50 percent of crashes were **fixed object crashes** where a vehicle left the travel lane and hit a fixed object.
- **Driving under the influence** was noted in 13.5% of all rural crashes.

Urban Road

- **At angle** and **opposite direction multi-vehicle** crashes were a greater proportion of urban crashes (24% and 13% of urban crashes, respectively) relative to rural roads. These crashes were primarily on arterial and collector roadways (79.3% of urban crashes).
- Most **pedestrian-involved** crashes were reported on urban roads (90.8%) compared to rural roads, with over two-thirds (67.8%) occurring on arterial and collector roadways.

Table 5 replicates Table 4 looking only at fatal or severe injury crashes. The table identifies which road type and crash type combinations saw a larger concentration of fatal or severe injury crashes. The second part of the table normalizes the figures by total crashes. This identifies crash categories that are overrepresented for fatal

or severe injury crashes, such as pedestrian- or motorcycle-involved crashes. The percentages are not presented if the total number of crashes for a particular combination of roadway type and crash types is less than 20 crashes. This helps avoid misleading results where a small number of total crashes could result in non-representative percentages caused by the small sample size.

Table 5: Reported Fatal or Severe Injury Crashes by Vehicle Movement and User Factors, 2013-2017

Crashes Resulting in a Fatality or Severe Injury

Location and Facility Type	Under the Influence	Fixed Object	At Angle	Opposite Direction	Pedestrian-Involved	Bicycle-Involved	Motorcycle-Involved	Large Truck	Total
Total Rural	27	51	11	12	2	0	19	0	99
Local Access	7	11	1	0	1	0	2	0	17
Arterial or Collector	20	40	10	12	1	0	17	0	82
Total Urban	28	20	22	23	19	3	21	0	106
Local Access	9	6	3	6	5	0	7	0	22
Arterial or Collector	19	14	19	17	14	3	14	0	84

Percent of Crashes Resulting in a Fatality or Severe Injury

Location and Facility Type	Under the Influence	Fixed Object	At Angle	Opposite Direction	Pedestrian-Involved	Bicycle-Involved	Motorcycle-Involved	Large Truck	Total
Total Rural	11%	5%	5%	11%			33%	0%	6%
Local Access	14%	6%	5%						7%
Arterial or Collector	10%	5%	5%	12%			34%	0%	5%
Total Urban	8%	3%	3%	6%	24%	5%	23%	0%	3%
Local Access	9%	4%	2%	11%	25%	0%	37%		4%
Arterial or Collector	8%	3%	3%	5%	24%	7%	19%	0%	3%

Source: WSDOT and Clark County Public Works, 2018.

Urban Road

- Crashes involving **pedestrians** were three times more likely to result in fatal or severe injury crashes than other crash types.

General

- **Motorcycle** crashes were exhibited relatively evenly between urban and rural locations. Motorcycle crashes also had the second-highest percentage of fatal or severe injury crashes (23%) in urban areas and the highest (33%) in rural areas.
- **Driving under the influence** was associated with two times the average percentage of fatal and severe injury crashes in urban and rural areas.

Roadway Features

Table 6 categorizes crashes by roadway features and Table 7 presents the same data for only fatal and severe injury crashes. For the "at grade" roadway feature, the description reflects crashes where the police report noted a positive or negative grade associated with the crashes. Throughout the report, Kittelson uses "grade" in reference to roadways that have an incline. The report does not use "grade" to describe roads with a grade of zero.

Table 6: Total Reported Crashes by Roadway Features, 2013-2017

Total Crashes

Location and Facility Type	At Curve	At Grade	Intersection -Related	Driveway-Related	Dark (No Streetlights)	Rain	Total
Total Rural	666	590	401	101	642	367	1,772
Local Access	124	121	40	4	114	53	248
Arterial or Collector	542	469	361	97	528	314	1,524
Total Urban	316	467	1,529	305	329	568	3,134
Local Access	75	82	256	55	54	94	575
Arterial or Collector	241	385	1,273	250	275	474	2,559

Crashes per Mile of Road Group

Location and Facility Type	At Curve	At Grade	Intersection -Related	Driveway-Related	Dark (No Streetlights)	Rain	Total
Total Rural	1.2	1.1	0.7	0.2	1.2	0.7	3.2
Local Access	0.5	0.4	0.1	0.0	0.4	0.2	0.9
Arterial or Collector	2.0	1.7	1.3	0.4	1.9	1.2	5.6
Total Urban	0.6	0.8	2.7	0.5	0.6	1.0	5.6
Local Access	0.2	0.2	0.6	0.1	0.1	0.2	1.4
Arterial or Collector	1.7	2.7	8.9	1.7	1.9	3.3	17.9

Data Source: WSDOT and Clark County Public Works, 2018.

Rural

- The top two roadway features associated with rural crashes were crashes **at curves** (37.6%) and in the **dark with no streetlights** (36.2%).
- Rural crashes **at a grade** also represented one-third (33.3%) of rural crashes.
- Most rural crashes occur on **arterial or collector roadways** (86%).

Urban

- **Intersection-related** crashes were the predominant roadway features associated with urban crashes (40.6%). Most of these crashes occur on arterial or collector roadways (83.3%).

Table 7: Reported Fatal or Severe Injury Crashes by Roadway Features, 2013-2017

Crashes Resulting in a Fatality or Severe Injury

Location and Facility Type	At Curve	At Grade	Related to Intersection	Related to Driveway	Dark (No Streetlights)	Rain	Total
Total Rural	41	44	21	7	38	14	99
Local Access	4	12	3	0	11	1	17
Arterial or Collector	37	32	18	7	27	13	82
Total Urban	18	14	40	10	27	24	106
Local Access	4	1	7	3	6	4	22
Arterial or Collector	14	13	33	7	21	20	84

Percent of Crashes Resulting in a Fatality or Severe Injury

Location and Facility Type	At Curve	At Grade	Related to Intersection	Related to Driveway	Dark (No Streetlights)	Rain	Total
Total Rural	6%	7%	5%	7%	6%	4%	6%
Local Access	3%	10%	8%		10%	2%	7%
Arterial or Collector	7%	7%	5%	7%	5%	4%	5%
Total Urban	6%	3%	3%	3%	8%	4%	3%
Local Access	5%	1%	3%	5%	11%	4%	4%
Arterial or Collector	6%	3%	3%	3%	8%	4%	3%

Data Source: WSDOT and Clark County Public Works, 2018.

Rural Roads

- Over one-third (35.6%) of rural crashes were associated with **curves** and just under one-third of crashes were associated with **grade** (30.8%)
- Crashes on **rural local access roads associated with grade** were more likely to result in fatality or severe injuries (9.9%) than other crashes occurring on rural roads (5.5%).

Urban

- 50 percent of crashes and 40 percent of crashes resulting in fatality or severe injuries were **intersection-related**.
- Crashes on **urban arterials and collectors at curves** were a relatively low number of total crashes; however, these crashes were more likely to result in a fatality or severe injuries.

General

- 10.1% of crashes in the **dark with no streetlights** on local access roads (urban and rural) are fatal and severe injury crashes compared to 4.7% of reported crashes on local access roadways.

Posted Speed Limit

Analyzing posted speed limit differentiates roads by speed profile. In particular, the goal was to identify specific cases where a crash pattern identified in the analysis of crashes by facility type can be refined and associated with posted speed. The speed limit used in the analysis was based on the value recorded in the officer-reported crash report. As a result, the crash data was not normalized by number of miles of roadways.

Vehicle Movement and User Factors

Table 8 summarizes total reported crashes by vehicle movement, user factors, and posted speed limit.

Table 8: Total Reported Crashes by Vehicle Movement and User Factors, 2013-2017

Speed Limit	Under the Influence	Fixed Object	At Angle	Opposite Direction	Pedestrian-Involved	Bicycle-Involved	Motorcycle-Involved	Large Truck	Total
Total Rural	256	1,011	204	110	8	6	57	27	1,772
30 and Under	12	51	5	4	1	0	1	0	79
35 - 40	38	147	39	17	1	0	7	5	250
45 and Greater	206	813	160	89	6	6	49	22	1,443
Total Urban	347	633	735	396	79	62	92	45	3,134
30 and Under	81	123	127	32	15	20	8	4	472
35 - 40	171	287	385	266	39	29	44	26	1698
45 and Greater	95	223	223	98	25	13	40	15	964

Data Source: WSDOT and Clark County Public Works, 2018.

Rural

- The three most frequent rural crash types are **fixed object**, **under the influence**, and **at angle** crashes.
- Over three-quarter of these top three crash types occur on the **highest-speed roadways** (45 – 60 mph).

Urban

- The three most frequent crash types are **at angle**, **fixed object**, and **opposite direction**, with **driving under the influence** crashes a close fourth.
- Crashes for the top four crash types occur most frequently at **posted speed limits of 35 and 40 mph** roadways followed by higher speed roadways (45 – 60 mph).

Table 9 summarizes vehicle movement and user factors by speed limit for fatal and severe injury crashes.

Table 9: Reported Fatal or Severe Injury Crashes by Vehicle Movement and User Factors

Crashes Resulting in a Fatality or Severe Injury

Speed Limit	Under the Influence	Fixed Object	At Angle	Opposite Direction	Pedestrian-Involved	Bicycle-Involved	Motorcycle-Involved	Large Truck	Total
Total Rural	27	51	11	12	2	0	19	0	99
30 and Under	0	2	0	1	0	0	0	0	3
35 - 40	2	5	1	1	0	0	0	0	8
45 and Greater	25	44	10	10	2	0	19	0	88
Total Urban	28	20	22	23	19	3	21	0	106
30 and Under	4	3	2	1	3	0	3	0	10
35 - 40	12	6	10	16	7	2	10	0	49
45 and Greater	12	11	10	6	9	1	8	0	47

Percent of Crashes Resulting in a Fatality or Severe Injury

Speed Limit	Under Influence	Fixed Object	At Angle	Opposite Direction	Pedestrian-Involved	Bicycle-Involved	Motorcycle-Involved	Large Truck	Total
Total Rural	11%	5%	5%	11%			33%	0%	6%
30 and Under		4%							4%
35 - 40	5%	3%	3%						3%
45 and Greater	12%	5%	6%	11%			39%	0%	6%
Total Urban	8%	3%	3%	6%	24%	5%	23%	0%	3%
30 and Under	5%	2%	2%	3%					2%
35 - 40	7%	2%	3%	6%	18%	7%	23%	0%	3%
45 and Greater	13%	5%	4%	6%	36%		20%		5%

Data Source: WSDOT and Clark County Public Works, 2018.

Rural

- The three most frequent crash types for fatal and severe injury crashes are **fixed object** (51.5%), **under the influence** (27.3%), and **motorcycle-involved crashes** (19.2%).
- Fatal and severe injury crashes were strongly associated with the **highest posted speeds** (88.9% of reported fatal and severe injury crashes)

Urban

- Fatal and severe injury crashes were more **evenly distributed** among six categories (in descending order of crashes): under the influence, opposite direction, at angle, motorcycle-involved, fixed object, and pedestrian-involved.
- These crash types were associated with posted speeds of **35 mph and higher**.
- Motorcycle-involved and pedestrian-involved crashes represented 37.8% of fatal and severe injury crashes while representing only 5.5% of total reported crashes.

Roadway Features

For roadway features, the share of crashes at each speed limit category generally reflects the distribution of speed limits on county roads. For example, speed limits on the rural county roads are generally higher than on urban county roads. As a result, more crashes are reported on rural roads with speed limits of 45 to 60 mph than on urban roadways. Kittelson was not able to normalize the crash frequency by lane or centerline miles because speed limit data for the roadway network was incomplete. As a result, the analysis by speed limit is primarily used to identify roadway features that exhibit a higher crash risk as speeds increase. For example, crashes that occurred on urban roadways with curves were five times more likely to result in a fatal or severe injury crash on roadways with speed limits of 45 to 60 mph than on roads with speed limits of 15 to 30 mph.

Table 10 presents reported crashes by roadway features.

Table 10: Total Reported Crashes by Roadway Features, 2013-2017

Speed Limit	At Curve	At Grade	Intersection-Related	Driveway-Related	Dark (No Streetlights)	Rain	Total
Total Rural	666	590	401	101	642	367	1,772
30 and Under	57	35	11	4	33	25	79
35 – 40	115	98	64	11	104	44	250
45 and Greater	494	457	326	86	505	298	1,443
Total Urban	316	467	1,529	305	329	568	3,134
30 and Under	64	77	224	33	48	77	472
35 - 40	149	253	901	161	162	325	1,698
45 and Greater	103	137	404	111	119	166	964

Data Source: WSDOT and Clark County Public Works, 2018.

Rural Roads

- Crash characteristics were strongly associated with **higher-speed roadways**. This matches expectations given the generally higher posted speeds in rural areas.

Urban Roads

- Over 50 percent of intersection-related crashes occurred on roadways with **posted speeds of 35 or 40 mph**. This is generally in line with the share of urban roadway miles that have a speed limit of 35 to 40 mph.

Table 11 presents the same roadway features by posted speed for fatal and severe injury crashes.

Table 11: Reported Fatal or Severe Injury Crashes by Roadway Features, 2013-2017

Crashes Resulting in a Fatality or Severe Injury

Speed Limit	At Curve	At Grade	Intersection-Related	Driveway-Related	Dark (No Streetlights)	Rain	Total
Total Rural	41	44	21	7	38	14	99
30 and Under	3	3	0	0	1	2	3
34 – 40	4	5	1	0	4	1	8
45 and Greater	34	36	20	7	33	11	88
Total Urban	18	14	40	10	27	24	106
30 and Under	1	0	2	1	4	3	10
35 - 40	7	6	25	3	12	10	49
45 and Greater	10	8	13	6	11	11	47

Percent of Crashes Resulting in a Fatality or Severe Injury

Speed Limit	At Curve	At Grade	Intersection-Related	Driveway-Related	Dark (No Streetlights)	Rain	Total
Total Rural	6%	7%	5%	7%	6%	4%	6%
30 and Under	5%	9%			3%	8%	4%
35 - 40	3%	5%	2%		4%	2%	3%
45 and Greater	7%	8%	6%	8%	7%	4%	6%
Total Urban	6%	3%	3%	3%	8%	4%	3%
30 and Under	2%	0%	1%	3%	8%	4%	2%
35 - 40	5%	2%	3%	2%	7%	3%	3%
45 and Greater	10%	6%	3%	5%	9%	7%	5%

Data Source: WSDOT and Clark County Public Works, 2018.

Rural Roads

- Crashes occurring **on curves**, **at grades**, or under **dark conditions with no streetlights** are overrepresented for fatal and severe injury crashes.
- There is a high frequency of fatal or severe injury crashes at **rural intersections in the highest speed category** (45 – 60 mph). This correlation was not apparent when analyzing crashes without considering the speed limit (see Table 7).

Urban Roads

- There is a low frequency of severe injuries across various posted speeds for crashes associated with intersection movements on urban roads. **Intersection-related** crashes produced a relatively large number of total crashes resulting in fatal or severe injuries attributed to the high number of total intersection-related crashes.

- Crashes at **high speed curves** show an increased frequency of fatal or severe injury crashes relative (9.7%) relative to the rate for overall crashes on urban roads (3.4%).

Systemic Crash Risk Factors

Initial List of Risk Factors

Kittelson identified an initial set of systemic crash risk factors by identifying what crash types and roadway features were associated with a higher frequency of total and fatal or severe injury crashes in the County. The risk factors initially included driving under the influence and motorcycle-involved crashes. However, since both factors lend themselves better to education and enforcement approaches to safety management, Kittelson dropped them from consideration for systemic engineering treatments. The seven risk factors identified in the systemic analysis are shown below by location type (rural/urban).

Rural Factors

- Fixed Object Crashes
- Curves, grade, and locations where both factors are present
- Intersections

Urban Factors

- At Angle and Opposite Direction Crashes
- Intersections
- Curves on High Speed and Arterials
- Pedestrian Crashes

Refining Risk Factors

The initial risk factors provided a starting point from which Kittelson refined factors to identify the specific risks associated with each factor and possible overlap between risk factors. Kittelson reviewed the following five questions to help understand systemic crash profiles in the county to better understand the risk factors.

Question 1: For crashes at curves and/or at a grade in rural areas, are crashes, or fatal and severe injury crashes, clustered on roads with narrower lanes or narrower shoulders?

Table 12 compares rural roadways by functional class and lane width for the three crash conditions (at curve, at grade, and both).

Table 12: Total Reported Crashes on Rural Roads at Curves and/or at Grades by Lane Width, 2013-2017

Rural Class	Lane Width	Percent Roadway Miles	At Curve	Percent Fatal and Severe Injury	At Grade	Percent Fatal and Severe Injury	At Both	Percent Fatal and Severe Injury
Local Access	**Total**	63%	124	3%	121	10%	80	5%
	Less than 8	**3%**	3		2		2	
	8 - 9.9	**13%**	41	5%	43	9%	32	3%
	10 - 11.9	**13%**	64	2%	63	11%	35	3%
	12 - 13.9	**5%**	13		12		10	
	14+	**29%**	3		1		1	
Arterial or Collector	**Total**	37%	542	7%	469	7%	261	9%
	Less than 8	**0%**	0		0		0	
	8 - 9.9	**4%**	30	10%	36	8%	21	14%
	10 - 11.9	**24%**	467	7%	383	7%	213	8%
	12 - 13.9	**6%**	23	0%	22	0%	8	
	14+	**3%**	22	14%	28	11%	19	

Data Source: WSDOT and Clark County Public Works, 2018.

Note: Lane width may be incorrectly described for arterial and collector roads recorded with lanes over 14 feet. The county is reviewing the roads to confirm conditions.

Findings

- Crashes at curves were more likely to result in a fatality or severe injury on arterials and collectors (7% of reported) compared to local access roads (3%)
- Crashes where grade was cited were more likely to result in a fatal or severe injury crash (10%) on local roadways
- 60 percent of the rural road crashes occurring at a curve or grade occurred at locations including a curve and grade.
- Fatal and severe injury crashes were 1.5 times more likely for arterial and collector roadways with narrow lanes (8 – 9.9 feet) and on a curve and grade (14% of fatal and severe injury crashes).
- Fatal and severe injury crashes were over-represented on arterial and collectors with wide lanes (14 feet or greater). This finding should be considered with caution due to the small sample of locations and potential miscoding of lane widths.

Table 13 summarizes shoulder width by roadway miles for the county roadway network.

Table 13: Roadway Miles by Shoulder Width

Rural Class	Width of Shoulders (ft)	Roadway Miles
Local Access	**Less than 2**	273.2
	2 - 3.9	0.5
	4 - 5.9	1.4
	8+	0.1
	Left and Right Differ	0.1
Arterial or Collector	**Less than 2**	255.1
	2 - 3.9	0.6
	4 - 5.9	1.9
	6 - 7.9	5.7
	8+	6.0
	Left and Right Differ	2.2

Data Source: Clark County Public Works, 2018.

Over 95 percent of road miles are built with shoulders narrower than two feet. As a result, Kittelson could not establish statistically significant associations for differences in shoulder width.

Question 2: Are there specific fixed objects associated with a higher frequency of fatal or severe injury crashes?

Table 14 summarizes fixed object crashes by the object type hit.

Table 14: Rural Fixed Object Crashes by Object Hit

Object	Total Crashes	Fatal or Severe Injury Crashes	Percent Fatal or Severe Injury Crashes
Roadway Ditch	247	10	4%
Utility Pole	132	4	3%
Tree or Stump (Stationary)	122	16	13%
Fence	107	2	2%
Earth Bank or Ledge	100	6	6%
Over Embankment (No Guardrail Present)	69	4	6%
Culvert/Ditch	41	1	2%
Mailbox	40	0	0%
Guardrail	37	3	8%
Metal Signpost	27	0	0%
Utility Box	22	0	0%
Wood Signpost	15	1	
Other Objects (All Other Categories)	51	4	8%
Total	1,011	51	5%

Data Source: WSDOT, 2018.

- The percentage of fatal or severe injuries (5%) was comparable to the overall percentage for crashes on rural roads (6%).

- Tree and stump crashes resulted in 2.6 times as many fatal or severe injury crashes (13%) compared to total fixed object crashes (5%).
- Earth Bank or Ledge (6%), Over Embankment (6%), and Guardrail (8%) crashes also represented higher than average (5%) fatal and severe injury crashes for fixed object crashes.
- Fatal and severe injury crashes were reviewed involving guardrails since the finding ran counter to expectations and the relatively small size of the sample. The review found additional contributing factors for all three crashes (driving under the influence, avoiding an animal in the road, and driving at 70 mph) that help explain the severity of the crashes.

Table 15 presents the speed limit and functional classification characteristics of rural fixed object crashes where the vehicle hit a tree or stump.

Table 15: Crash Characteristics on Rural Roads where a Vehicle Hit Tree or Stump

Speed Limit (mph)	Class	Total	Fatal or Severe Injury Crashes
15 - 34	**Rural**	6	0
	Local Access	4	0
	Arterial or Collector	2	0
35 - 44	**Rural**	16	4
	Local Access	5	1
	Arterial or Collector	11	3
45 and Greater	**Rural**	100	12
	Local Access	23	4
	Arterial or Collector	77	8
Grand Total		122	16

Source: WSDOT and Clark County Public Works, 2018.

- Fatal and severe injury tree or stump-related crashes occur primarily on arterial and collector roadways (68.8%) and the county's highest-speed roadways (75%)

Question 3: Relative to the total number of intersections in Clark County, are crashes or crashes resulting in a fatal or severe injury more likely to occur at specific intersection types? Does this vary for rural or urban facilities?

Table 16 presents crashes by location and intersection type.

Table 16: Total Reported Crashes by Intersection Type

Location and Intersection Type		Count of Intersection Type	Crashes		Normalized	
			Total	Fatal or Severe Injury Crashes	Percent Fatal or Severe Injury	Crashes per Intersection
Rural	**All**	498	329	20	6%	0.7
	All-Way Stop	18	42	2	5%	2.3
	Signal	5	52	2	4%	10.4
	Sweeping Curve	40	16	2		
	Two-Way Stop	343	215	14	7%	0.6
	Uncontrolled	83	4	0		
	Yield	9	0	0		
Urban	**All**	3078	1254	29	2%	0.4
	All-Way Stop	40	42	0	0%	1.1
	Signal	90	689	17	2%	7.7
	Sweeping Curve	15	6	0		
	Two-Way Stop	1129	448	12	3%	0.4
	Uncontrolled	1762	62	0	0%	0.0
	Yield	42	7	0		

Data Source: WSDOT and Clark County Public Works, 2018.

- Signalized intersections had the highest concentration of crashes, by crashes per intersection on rural and urban roadways.
- Crashes at rural intersections (6%) were three times as likely to result in a fatal or severe injury crash than urban intersections (2%).
- Almost 75 percent of crashes resulting in fatal or severe injury crashes on rural roads were at two-way stop-controlled intersections. Two-way stop control intersections are the predominant control type (68.9% of all intersections) on rural county roads.

Question 4: Are crashes at curves on high speed urban arterials concentrated or dispersed?

As noted above, 10 percent of crashes on curves on urban roads with speed limits of 45 mph or greater resulted in a fatal or severe injury crash.

For crashes with these characteristics, Kittelson found the crashes were distributed on 61 different roads, with fewer than 10 roads experiencing more than two crashes located on curves. The road with the highest number of crashes during the period was NE Padden Parkway, which had 13 crashes involving curves (over the five-year crash data period).

Question 5: What are the conditions on roads where pedestrian crashes occur in urban areas? Are there sidewalks present in locations where pedestrian crashes are occurring?

Table 17 summarizes characteristics associated with pedestrian-involved crashes.

Table 17: Summary of Pedestrian-Involved Crashes on Urban Roadways

	Crashes		Normalized	
Location Conditions	**Total**	**Fatal or Severe Injury Crashes**	**Percent Fatal or Severe Injury Crashes**	**Crashes per Mile**
Sidewalks Present	63	16	25%	0.21
No Sidewalks	16	3		
At Intersection	34	5	15%	NA
Not at Intersection	45	14	31%	NA
Two Lane	32	7	22%	0.06
Four Lane	38	12	32%	1.47

Data Source: WSDOT and Clark County Public Works, 2018.

Note: Pedestrian-involved crashes on urban roads are present in each pair of conditions

- Non-intersection-related crashes were twice as likely to result in a fatal or severe injury than crashes at intersections.
- A similar number of crashes occurred on two and four lane urban roads. However, there is approximately 20 times as many roadway miles of urban two-lane roads as four-lane roadways. Fatal or severe injury crashes were 1.7 times as likely to occur on a four-lane roadway before controlling for roadway miles.
- The highest proportion of pedestrian-involved crashes occurred at locations where sidewalks are present, which suggests pedestrians were likely struck crossing the roadway at these locations. Pedestrian facilities may also be associated with increased pedestrian activity increasing the potential for conflicts.

Refined Systemic Risk Factors

Based on the crash analysis, Kittelson identified the following systemic crash risk factors for the priority location identification, countermeasure selection, and initial project development:

- Rural road curves and grades on high-speed roadways (45 mph or greater)
    - Narrow (less than 10 feet) on curves or at grades
- Rural road fixed objects:
    - Trees, stumps, posts, and poles
    - Embankments or ledges
- Pedestrian crossings on multi-lane urban roadways
- Rural two-way stop-controlled intersections
- Urban signalized intersections

SECTION 2: IDENTIFY PRIORITY LOCATIONS

After developing and refining the systemic risk factors, Kittelson identified methods to locate where the systemic risk factors are present on Clark County roadways. This guidance will help prioritize locations and assist in implementation of safety treatments across the County. This section describes the methods developed and identifies opportunity sites for potential implementation of systemic safety treatments.

For each risk factor, there is a corresponding methodology for identifying locations where the risk factor is present along with potential prioritization approaches. For some risk factors, locations were more difficult to identify based on available data. For example, what constitutes a "significant" curve or "significant" grade for systemic treatment. For other risk factors, identification was straightforward, but prioritizing among them for treatment implementation was more difficult. All data used in this section is from Clark County's GIS databases, unless otherwise noted.

Rural Roads with Curves and Grade

Rural roads with curves and grades were identified as risk factors using characteristics available in the crash dataset. However, the dataset only identifies the police-reported characteristics at the point of the crash and the definition of a curve or what counts as a substantive grade may vary based on the reporting officer. Kittelson used additional publicly-available data to supplement available Clark County datasets, as curves and grade are not currently integrated into the County's Road Log dataset.

Identifying Rural Curves and Grades

The methodology developed to identify rural curves and grades is described in the steps below.

1. *Segment and Evaluate Network*: Kittelson segmented the road network into 200-foot segments to identify specific curve and grade locations.
    - *Curves*: The sinuosity and grade of each segment was calculated to estimate the curve of a segment relative to a straight line. The higher the sinuosity, the less a segment represents a straight line. Kittelson used ET Geowizards' Polyline Characteristic tool to calculate sinuosity.
    - *Grades*: Digital elevation model (DEM) data was obtained for Clark County from the University of Washington[2]. The dataset estimates elevation on a 10-meter grid. End points were created for each 200-feet segment and the elevation data was joined to each end point from the DEM dataset. The point dataset was then joined back to the 200-foot segment and a net grade estimate was calculated by taking the absolute value of the difference in elevation between the two endpoints and dividing by the segment length[3].

[2] The DEM data can be downloaded from the University of Washington at the following link: http://gis.ess.washington.edu/data/raster/tenmeter/byquad/vancouver/index.html

[3] *Note*: Shorter segments will more precisely identify the steepest grade on the road network and reduce the probability of missing a crest or sag in the middle of the segment. However, the raster data is imprecise over shorter distances which may have a greater impact on error in the estimate of grade. This is particularly an issue in areas where the road is next to a steep

2. *Determine Significant Curves*: Segments were identified as having "significant" curves and grades based on the 80th percentile sinuosity[4] and grade.
3. *Aggregating to Longer Segments*: Kittelson created a set of longer segments of 1,600 feet and spatially joined the shorter curve and grade segments to the longer segments. The longer segments were then analyzed to identify which 1,600-foot segment contained concentrations of significant curve and grade segments. This approach identified corridors where curves and changes in grades are concentrated for systemic treatment.

Prioritizing Curves and Grades

The method above identified concentrations of curves and steeper grade by using percentile to identify the "most" curved segments or segments with the greatest change in grade. However, the ultimate goal was to identify the type of curves or grades associated with higher crash rates rather than the sharpest roads or steepest changes in grade. As a result, Kittelson conducted a second round of identification for additional refinement to address limitations in the initial analysis and help prioritize corridors for treatment. The steps for the primary and secondary prioritization are described below.

Primary Prioritization

1. *Isolating Crash Groups*: Kittelson identified rural roadway crashes where a curve or grade was cited in the crash report. Then, the crashes were separated into three groups based on roadway conditions cited in the crash report: (1) curve and grade, (2) curve and no grade, and (3) grade and no curve. In reviewing these groups, Kittelson found that:
    - *Grade Refinements:* Of the segments identified in method 1, 29 percent contained a grade-related crash and 49 percent were within 800 feet of a grade-related crash. Reviewing the crashes, Kittelson found local access roads could be deprioritized. After removing local access roads, the rural curved segments identified were significantly more likely to contain (49%) or be within 800 feet of a grade relate crash (71%). Rawson Road was identified as an exception to this refinement given its association with grade-related crashes and local access designation.
    - *Curve Refinement*: Just 20 percent of rural curve-related crashes were located on local facilities. As a result, Kittelson removed local roads from priority consideration. Curve-related crashes appear to be concentrated on collectors with multiple "S"-turns in areas in the north and east of the county where roads connect between higher and lower elevations. There appear to be fewer crashes on segments with fewer sharper curves, such as those in the area southwest of Battle Ground.

Figure 1 and Figure 2 show the results of the identification using the prioritization refinements. The crash associated with the risk factor are shown for comparison.

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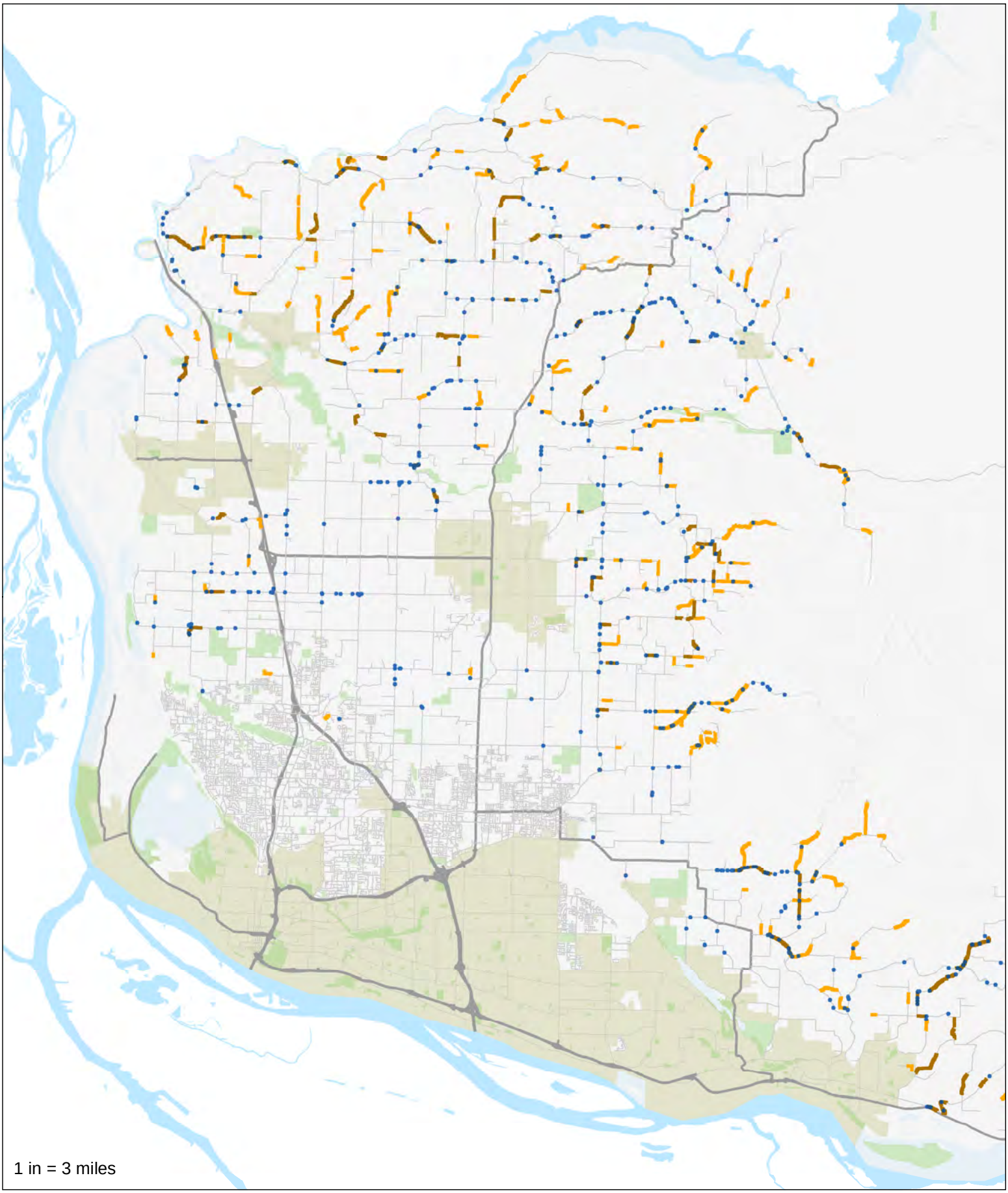
incline or decline. These conflicts were considered in selecting 200 feet as the segment length, though further exploration of the data against field data could refine a more appropriate segment distance.

[4] This approach could be refined using field testing to ground truth the "significant" curves determination or otherwise develop a greater understanding of the relationship between on-the-ground curves and GIS-based sinuosity measurements.



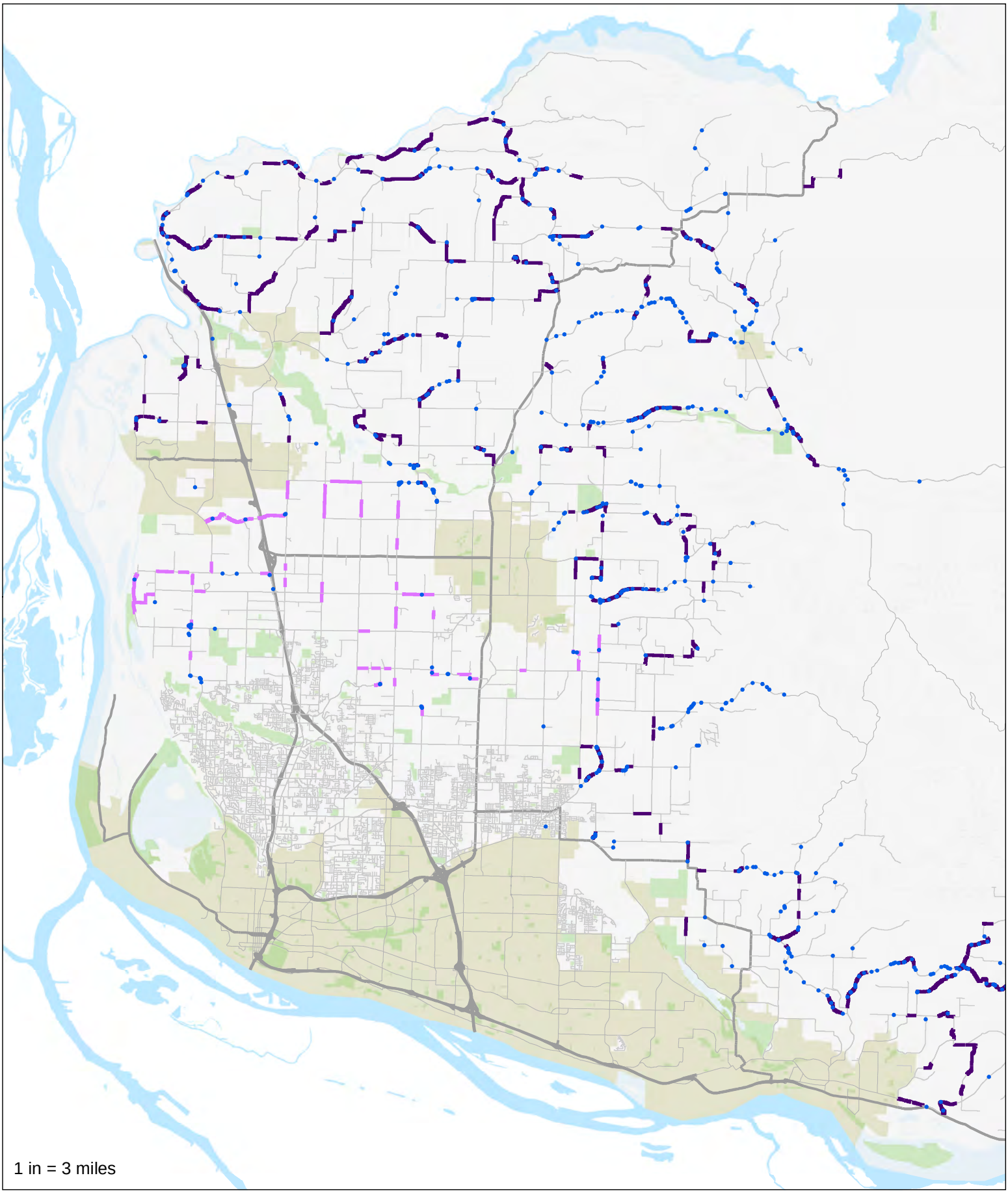
Slope Related Crashes

Rural Local Access

Rural Collectors

Figure 1: Grade Segments on Rural Roadways 2013 - 2017

Data Source: WSDOT and Clark County Public Works



• Curve Related

General Conditions

Flatter Areas with Sharper Curves

Changing Grade with Gradual Turns

Figure 2: Curved Segments on Rural Roadways 2013 - 2017

Data Source: WSDOT and Clark County Public Works

Secondary Prioritization

The following secondary criteria for prioritization were identified to further refine the locations for systemic improvement:

1. *Connect Segments into Corridors*: Identify locations where priority locations can be connected to create continuous corridors. This will allow applications of treatments continuously, providing a consistent experience for drivers.
2. *Prioritize Road Segments that include Curves and Grade*: Treatments should be prioritized at locations where both risk factors are present. Sixty percent of the rural road crashes occurring at a curve or a grade occurred at locations that included a curve and a grade.

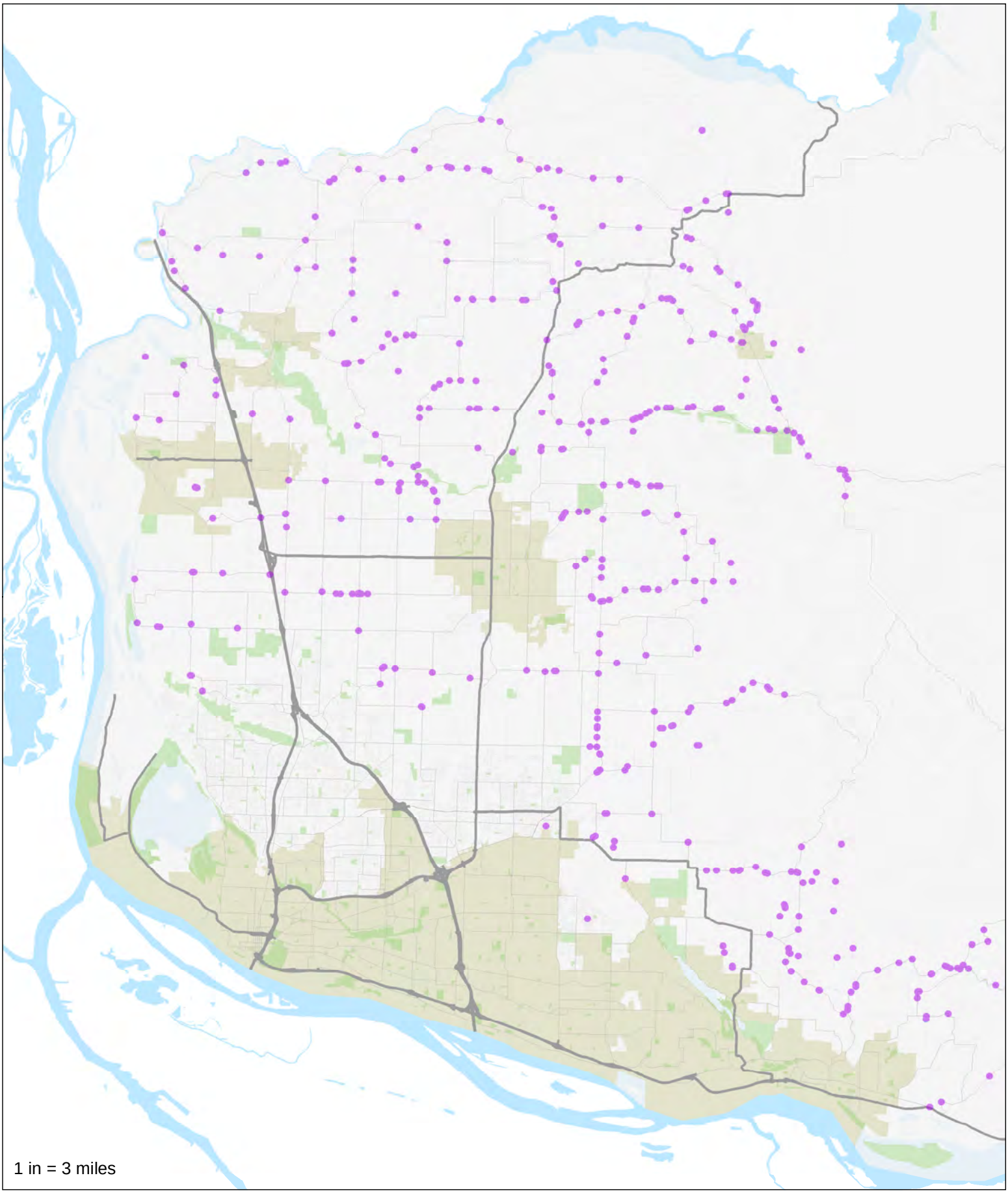
Rural Road Fixed Objects

More than 50 percent of crashes on rural roadways were fixed object crashes where a vehicle left the roadway and hit a fixed object. The county has a high percentage of roads where trees or other objects are adjacent to the roadway. This makes it difficult to isolate locations for implementing systemic safety treatments based solely on the presence of the risk factor (i.e., fixed objects off the road). As a result, the goal of the identification and prioritization processes for this risk factor is to identify additional roadway features on roads where rural fixed object crash risk may be concentrated.

Identifying Locations with Higher Risk for Fixed Object Crashes

The methodology developed to identify rural roads with an elevated risk for fixed object crashes is described in the steps below.

1. *Map Crashes where Risk Factor Present:* Kittelson started the analysis by segmenting the road network at intersections to create a map of continuous segments. The number of hit-object crashes involving trees and stumps, posts and poles, and embankments or ledges on each segment were then counted (crashes are shown in Figure 3).
2. *Reviewing Conditions at Highest Crash Concentration:* For each segment, Kittelson calculated the frequency of crashes given the segment length. The results were sorted to find the segments exceeding half a mile with the highest crashes per mile. Figure 4 shows the result of this analysis, highlighting the segments with more than 2.5 crashes per mile.
3. *Road Type*: Kittelson then reviewed the characteristics of the roadways identified in Step 2 to identify what unifying roadway features exist. The analysis showed about half the segments were rural major collectors, with the remaining spread across rural local access, rural minor collector, and rural minor arterial. The roadways identified generally lacked wide shoulders which is a consistent characteristic in the rural parts of the county
4. *Conditions at Locations*: The analysis generally identified two categories of segments: longer corridors with higher crash frequencies spread over multiple miles, and shorter segments on the approach to more urbanized areas in the county. Based on review of the identified locations, Kittelson also found the segments tended to include:
    - "S"-turns on higher-speed roads with trees close to the roadway; and,
    - Sharper turns on approaches to intersections.



Fixed Object Risk Factor Crashes

Figure 3: Risk Factor Fixed Object Crashes on Rural Roadways 2013 - 2017

Data Source: WSDOT and Clark County Public Works

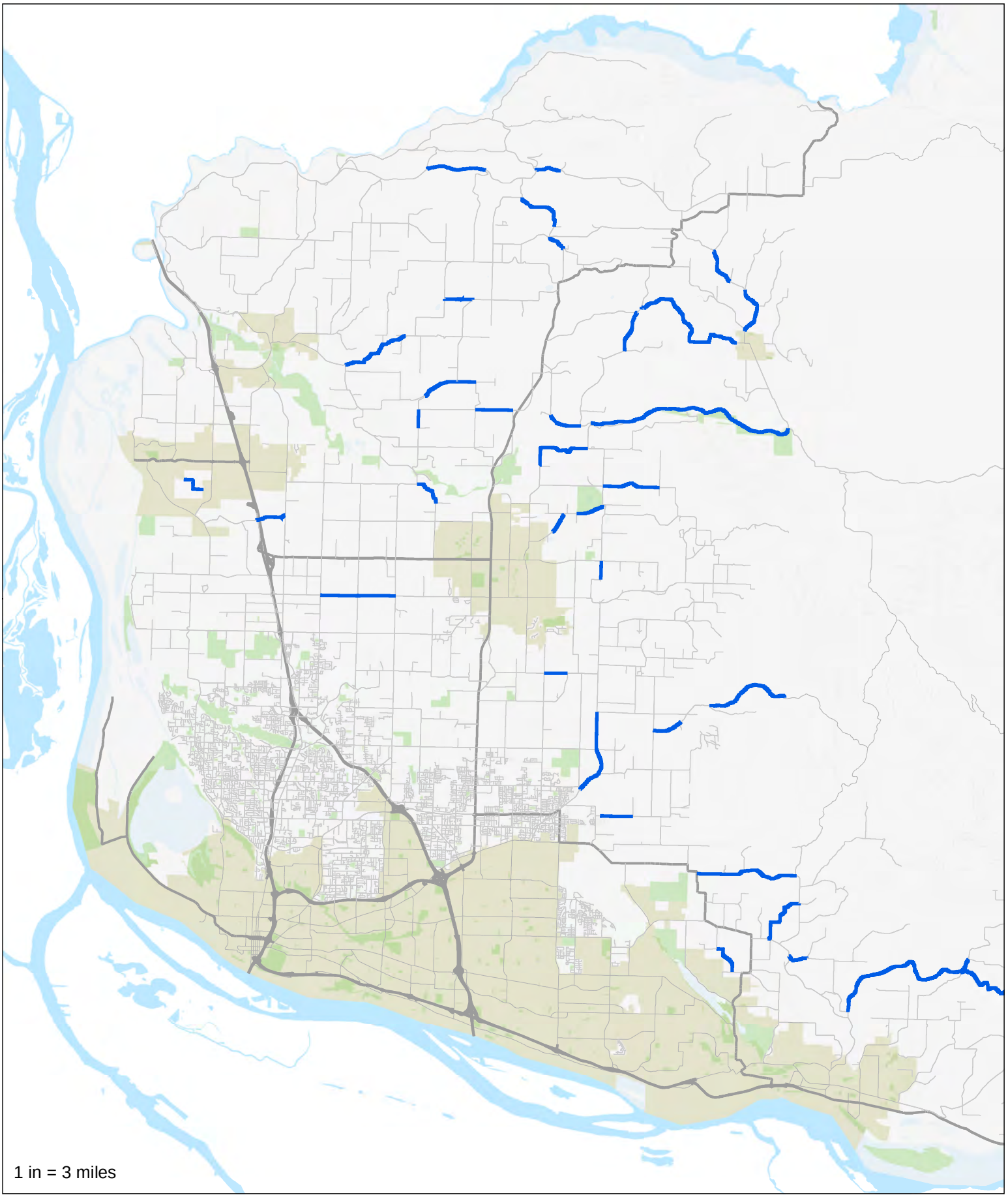


Figure 4: Corridors with Fixed Object Crashes on Rural Roadways 2013 - 2017

More than 2.5 Fixed Obj. Crashes per Mile

Data Source: WSDOT and Clark County Public Works

Prioritizing Roads

Kittelson developed two approaches to help prioritize specific roadways for systemic treatment by identifying locations with the most potential for improvement.

1. *Prioritize Segments where Severe Injuries were Recorded*: Considering crash history and severity is helpful for prioritizing segments.
2. *Connect Segments into Corridors:* Identify locations where priority locations can be connected to create continuous corridors. This will allow applications of treatments continuously, providing a consistent experience for drivers.

Figure 5 shows the results of applying the prioritization methodology to the segments in the prior figure.

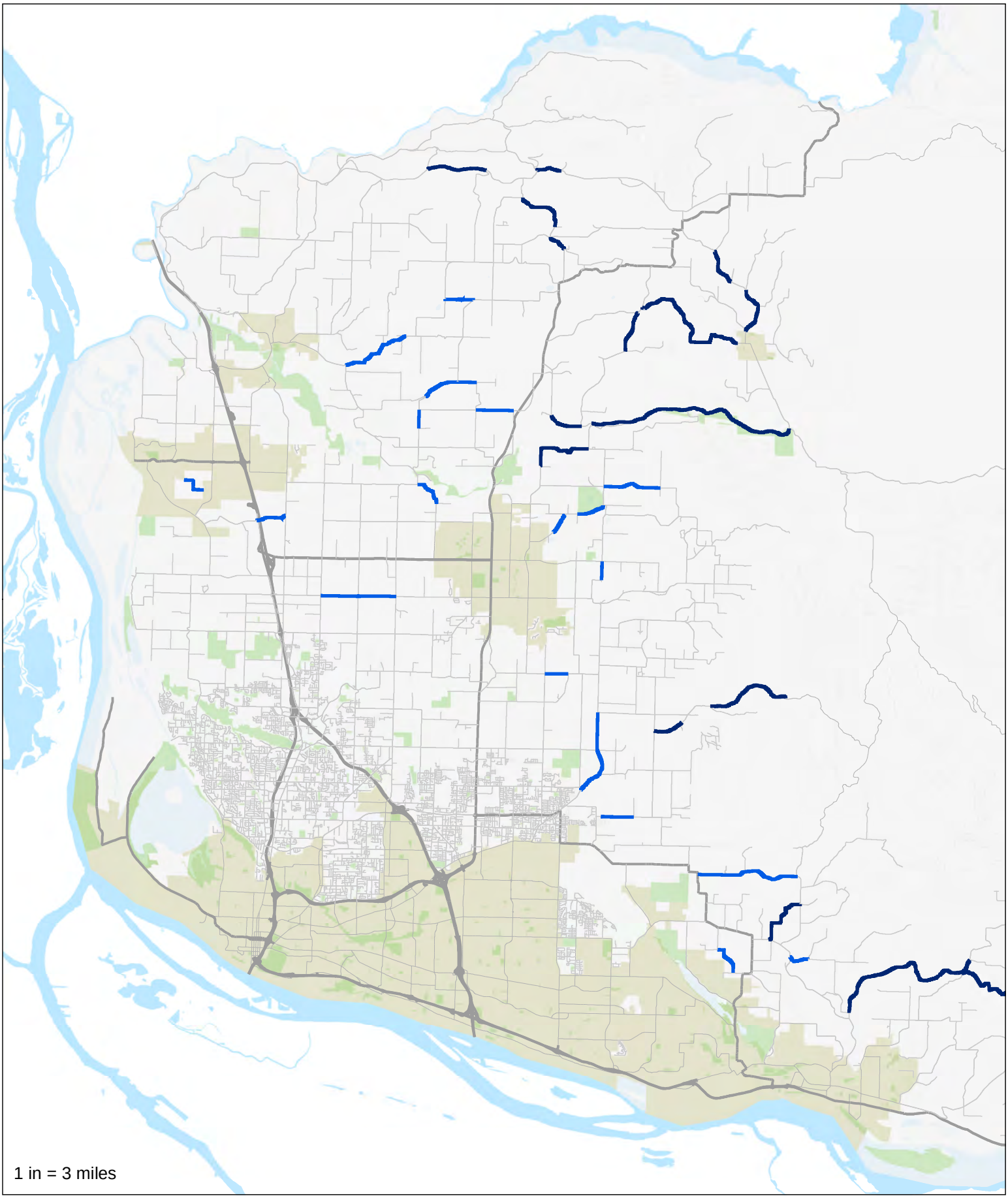


Figure 5: Prioritizing Corridors for Fixed Object Crashes on Rural Roadways 2013 - 2017

Corridors with Severe/Fatal Crashes

Corridors without Severe/Fatal Crash

Data Source: WSDOT and Clark County Public Works

Pedestrian Crossings on Multi-lane Urban Roadways

Pedestrian crossings on multi-lane urban roadways are a risk factor. Pedestrian-involved crashes were three times more likely to result in a fatal or severe injury crash than any other characteristic observed outside of motorcycle-involved crashes. Pedestrian-involved crashes were also more concentrated geographically than other crash types, with half occurring on a major multi-lane urban roadway. This concentration allows for greater targeting of systemic treatments given the reduced roadway miles under consideration.

Identifying Urban Multi-Lane Roadways

The methodology developed to identify urban multi-lane roadways is described in the steps below.

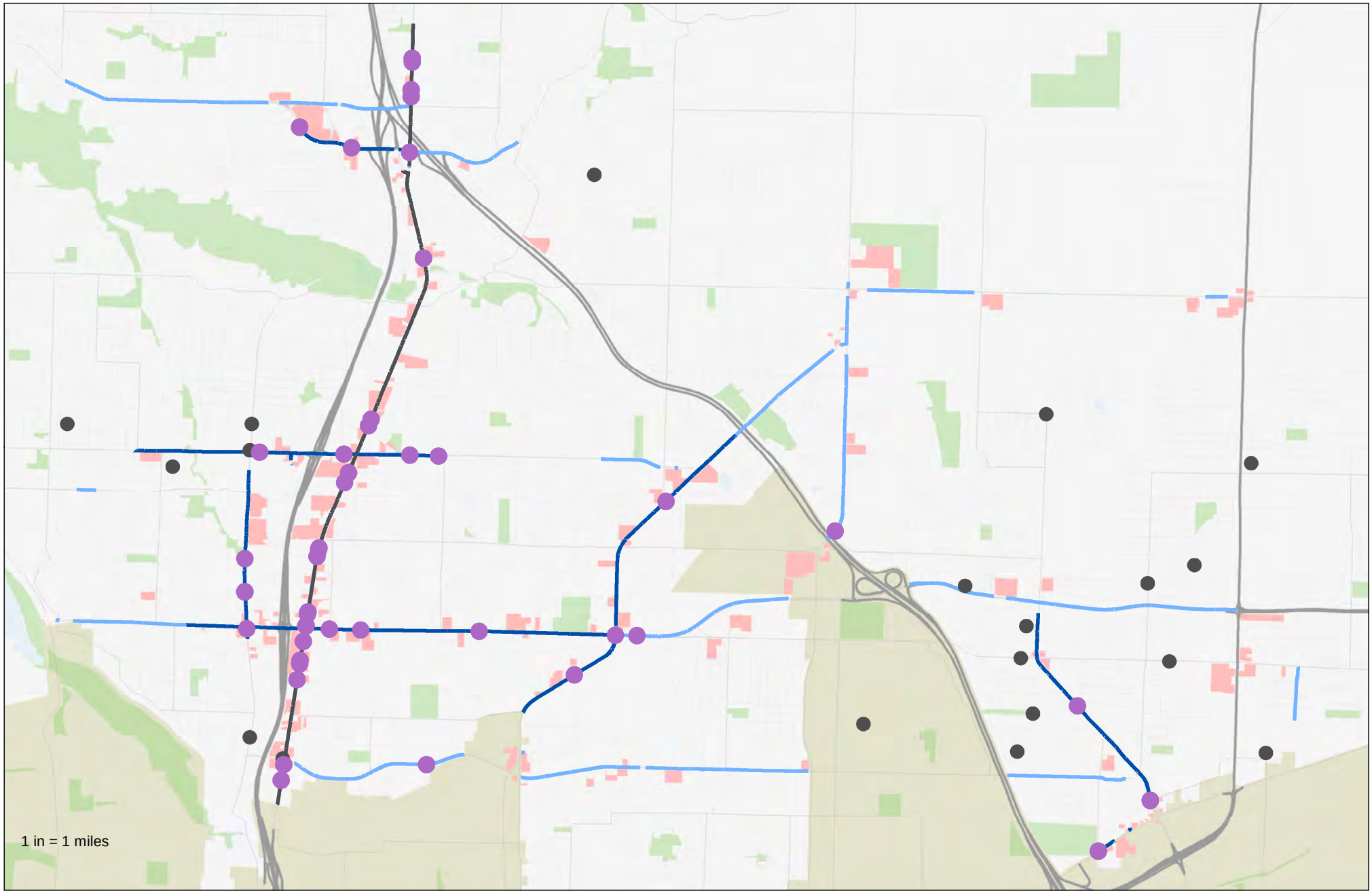
Map Roadways: Pedestrian-involved crashes in the county can be organized into two general groups: (1) pedestrian crashes on multi-lane urban roadways and, (2) crashes dispersed across the rest of the urban roadway network. Between the two groups, crashes on multi-lane urban roadways were more spatially concentrated.

Prioritizing Locations

Kittelson developed the following approaches for prioritization to assist in targeting systemic treatments for pedestrian-involved crashes on multi-lane urban roadways.

Primary Prioritization

1. *Shared Characteristics*: Crashes were mapped over the multi-lane road network to conduct an initial evaluation of the locations of reported crashes. The crash locations shared two primary characteristics:
    - a concentration of commercial businesses; and,
    - long distances between designated pedestrian crossings
2. *Finding Priority Segments*: Figure 6 identifies the location of pedestrian-involved crashes and multi-lane urban roadways. Kittelson identified segments from the map for prioritization based on the presence of commercial corridors using county parcel data and crash frequency.



Pedestrian Crashes

- OFF Multi-Lane Urban Road
- ON Multi-Lane Urban Road
- Tax Lot with Commercial Use

Multi-Lane Urban Roads

- Priority Locations
- Hwy 99 Priority Locations
- Other Multi-Lane Urban Roadways

Figure 6: Pedestrian Crashes on Urban Roadways and Priority Corridors 2013 - 2017

Data Source: WSDOT and Clark County Public Works

Secondary Prioritization

The following considerations may be used to further refine priority locations.

1. *Consider Potential for Additional Protected Crossings:* Distances between pedestrian crossings were not applicable as a prioritizing factor as crossings are relatively infrequent across the county's multi-lane roadways. However, the frequency of protected crossings for pedestrians on these roadways could be used to prioritize among a smaller set of locations where site-specific considerations can be considered.
2. *Other Locations with Pedestrians*: Locations with a clear pedestrian demand that are not commercial should also be incorporated into project prioritization and development to document locations such as schools and parks are also considered for systemic improvements.

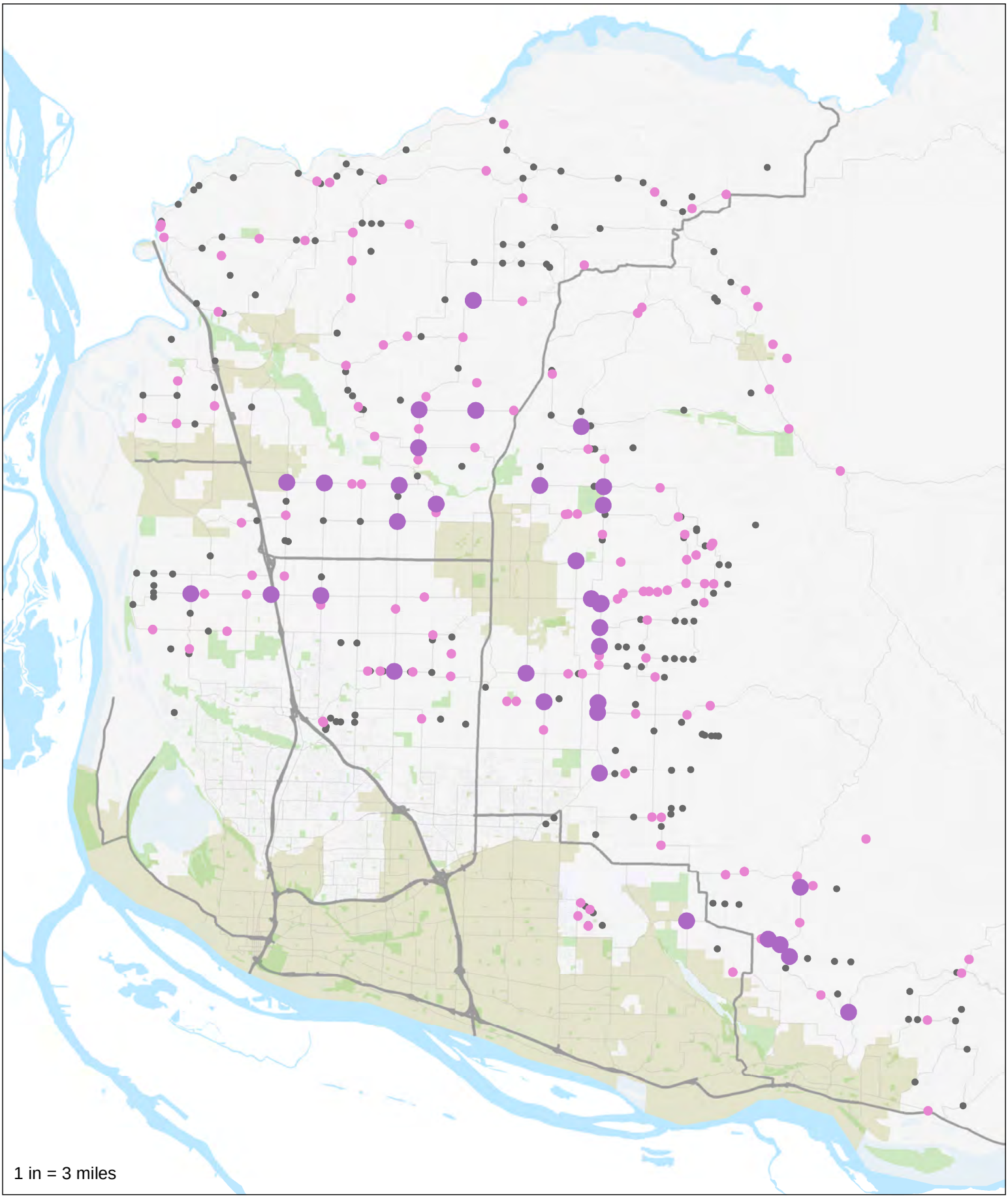
Rural Two-Way Stop-Controlled Intersections

Severe and fatal crashes on rural roads are disproportionately concentrated at two-way stop-controlled intersections. However, while these locations are easily identified, they are also the most frequent form of traffic control at rural intersections – with 343 two-way stop-controlled intersections on rural county roads. This means prioritizing locations is critical to effectively targeting resources.

Identifying Stop-Controlled Intersections

The methodology developed to identify stop-controlled intersections is described in the steps below.

Map Locations: Figure 7 shows the location of two-way stop-controlled intersections, grouped by the number of crashes reported within 250 feet of the intersection between 2013 and 2017.



Crashes within 250 ft of TWSC Intersection

- 4 or more Crashes
- Between 1 and 3 Crashes
- No Crashes Reported

Figure 7: Intersection Crashes at TWSC Intersections on Rural Roadways, 2013 - 2017

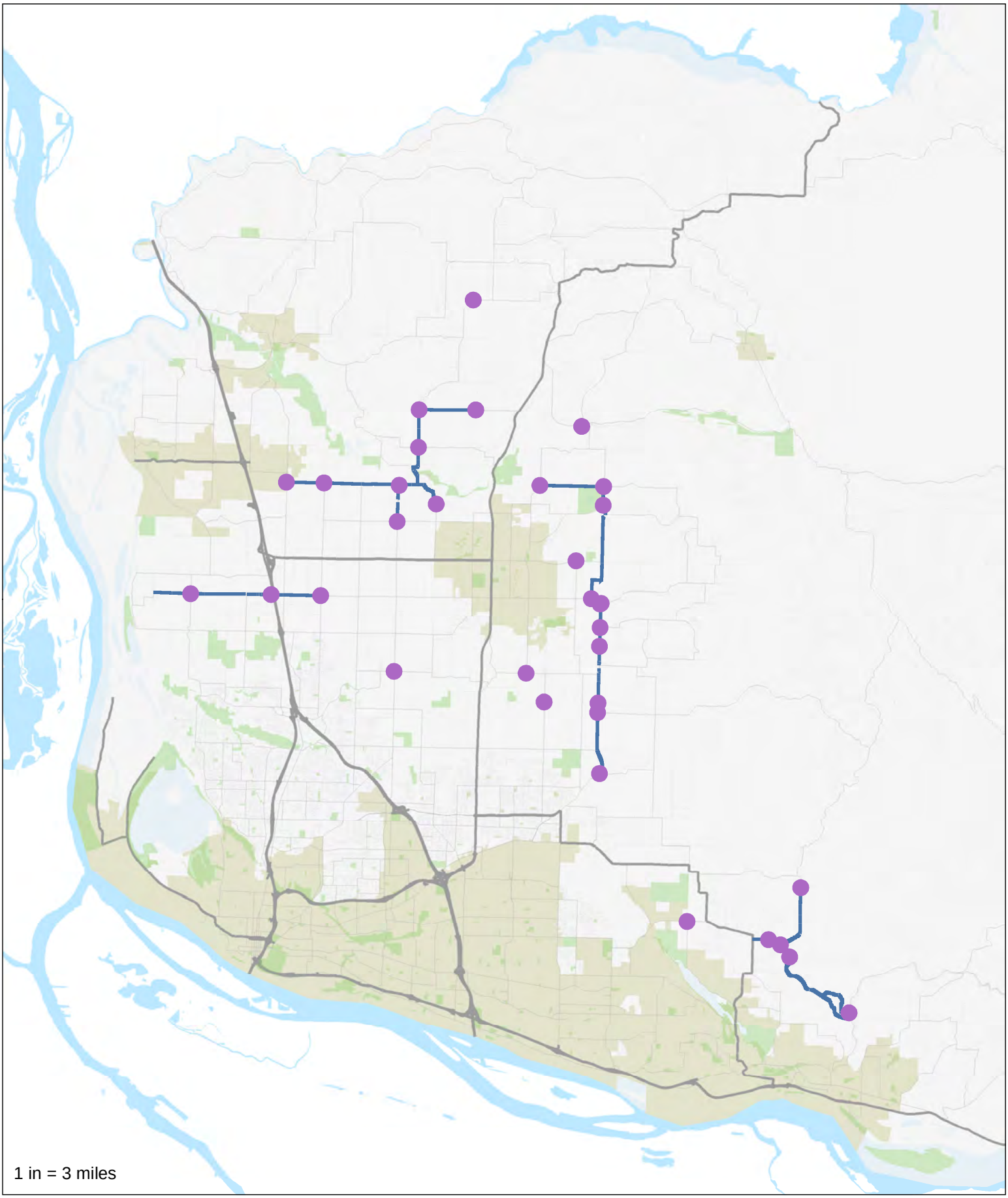
Data Source: WSDOT and Clark County Public Works

Prioritizing Locations

Kittelson evaluated the following prioritization approaches to help narrow the number of locations for consideration and identify which locations should be considered as priorities for systemic improvements,

Primary Prioritization

1. *Identify Locations with Higher Crash Frequencies*: Kittelson identified the location of two-way stop-controlled intersection with the most crashes during the study period. Intersections with multiple reported crashes were concentrated around and between the incorporated cities in the county.
2. *Identify Characteristics of High Crash Locations:* The intersections with more crashes were generally located along a major collector or minor arterial roadway. A review of aerials of the locations established the intersections tended to include:
    - limited sight lines at the intersection because of a curve on the uncontrolled road; and/or,
    - a long straight approach on a stop-controlled approach that may leave drivers less prepared for the upcoming stop.
2. *Identifying Priority Corridors:* The intersections that meet the defined characteristics are found on several corridors that border the City of Battle Ground. Kittelson recommends prioritizing treatments systemically along these corridors. The corridors and the higher crash intersections are identified in Figure 8.



Crashes within 250 ft of TWSC Intersection

Locations with 4 or more Crashes

Priority Corridors

Figure 8: Priority Corridors for Two-Way Stop-Controlled Rural Intersections 2013 - 2017

Data Source: WSDOT and Clark County Public Works

Urban Signalized Intersections

Urban signalized intersections exhibited the highest frequency of crashes per intersection among rural and urban intersections types. Traffic signals are generally installed to manage higher volumes of traffic, so the elevated frequency is likely caused by increased exposure. Crashes at urbanized intersections had a relatively lower frequency of fatal or severe injury crashes; however, because of the large number of total crashes, these locations still represent a substantive number (17) of total fatal and severe crashes during the study period.

Identify Signalized Intersections

The methodology developed to identify signalized intersections is described in the steps below.

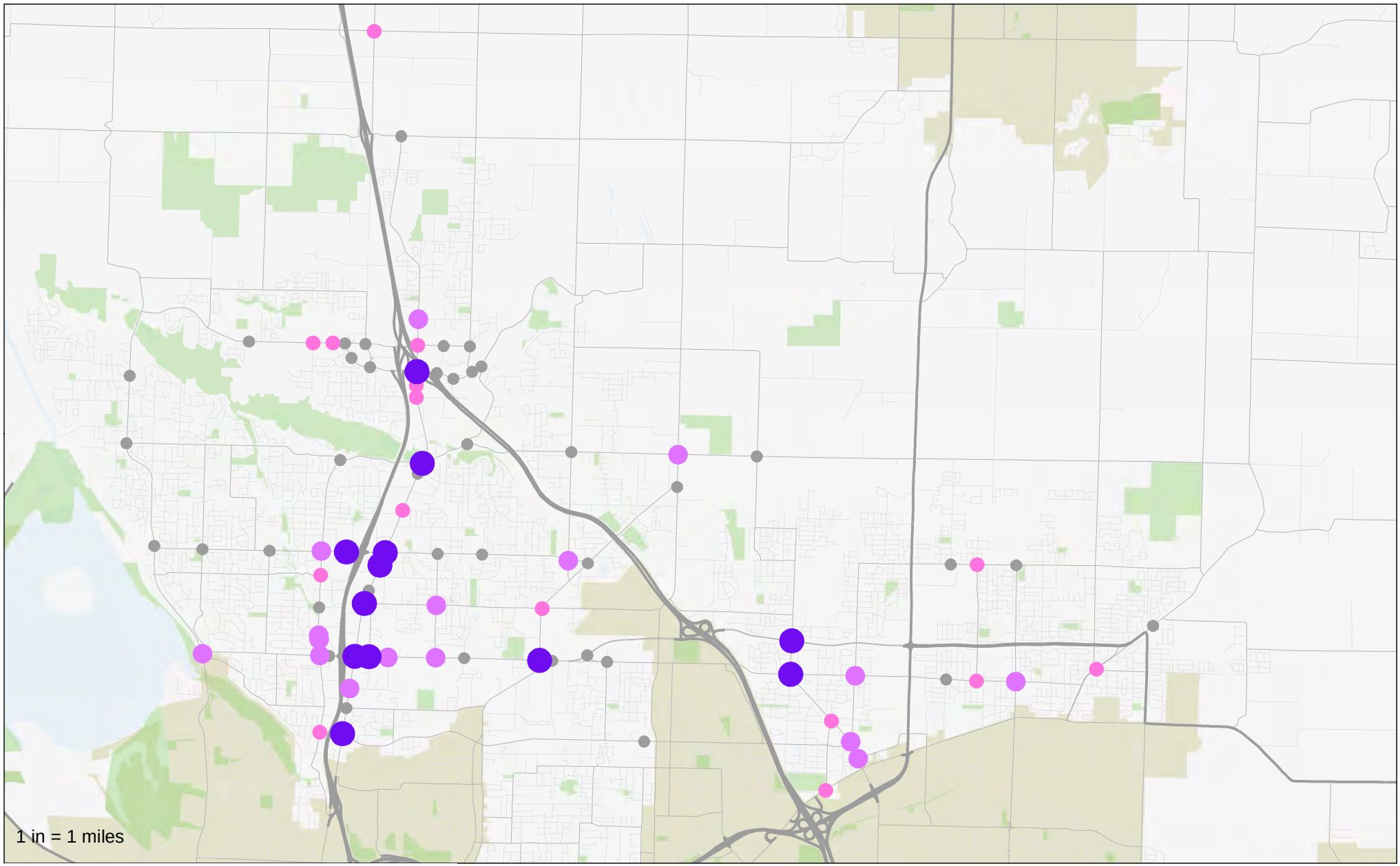
Map Locations: There are 90 signalized intersections in the urban county road network. They are largely concentrated in the southwest corner of the county adjacent to the City of Vancouver.

Prioritize Locations

Kittelson evaluated the following prioritization approaches to help narrow the number of locations for consideration to identify which locations should be considered as priorities for systemic improvements,

Primary Prioritization:

1. *Identify Locations with Higher Crash Frequencies*: Figure 9 shows the location of urban signalized intersections, grouped by the number of crashes reported within 250 feet of the intersection between 2013 and 2017.



Crashes within 250 ft of Signalized Intersection

- 24 - 54 Crashes
- 14 - 23 Crashes
- 8 - 13 Crashes
- 7 or fewer Crashes

Figure 9: Crashes at Signalized Intersections on Urban Roadways 2013 - 2017

Data Source: WSDOT and Clark County Public Works

2. *Identify Characteristics of High Crash Locations:* Table 18 shows the intersections with the highest crash frequencies over the five-year period. The locations with the highest frequency of crashes were signals with four approaches and relatively higher than average traffic volumes on more than two legs.

Identify Locations: Secondary Prioritization

In addition to the prioritization factors above, the following consideration may be used to refine priority locations:

1. *Consider overlap with Pedestrian Priority Locations*: Treatments should also be prioritized at signalized intersections that meet multiple risk factors such as those associated with the pedestrian crossings of multi-lane arterials. There is significant overlap between the locations identified for prioritization for these two risk factors.

Figure 10 identifies potential signalized intersections to prioritize based on their characteristics (four approaches and higher traffic volumes) and crash frequencies.

Table 18: Top Ten Urban Signalized Intersections by Crash Frequency, 2013 – 2017

Intersection	Total Crashes	Annual Crash Frequency
NE 78th St – NE Saint Johns Rd	54	10.8
NE 78th St – NE Highway 99	41	8.2
NE Padden Parkway – NE 94th Av	41	8.2
NE 94th Av – NE 76th St	34	6.8
NE 7th Av – NE 99th St	33	6.6
NE 63Rd St – NE Highway 99	31	6.2
NE 117th St – NE Highway 99	30	6.0
NE 20th Av – NE 134th St	30	6.0
NE 88th St – NE Highway 99	27	5.4
NE 96th Wy – NE Highway 99	27	5.4

Data Source: Clark County Public Works, 2018.

Secondary Prioritization

In addition to the prioritization factors above, the following consideration may be used to further refine priority locations.

1. *Consider overlap with Pedestrian Priority Locations:* Treatments should also be prioritized at signalized intersections that meet multiple risk factors such as those associated with the pedestrian crossings of multi-lane arterials. There is significant overlap between the locations identified for prioritization for these two risk factors.

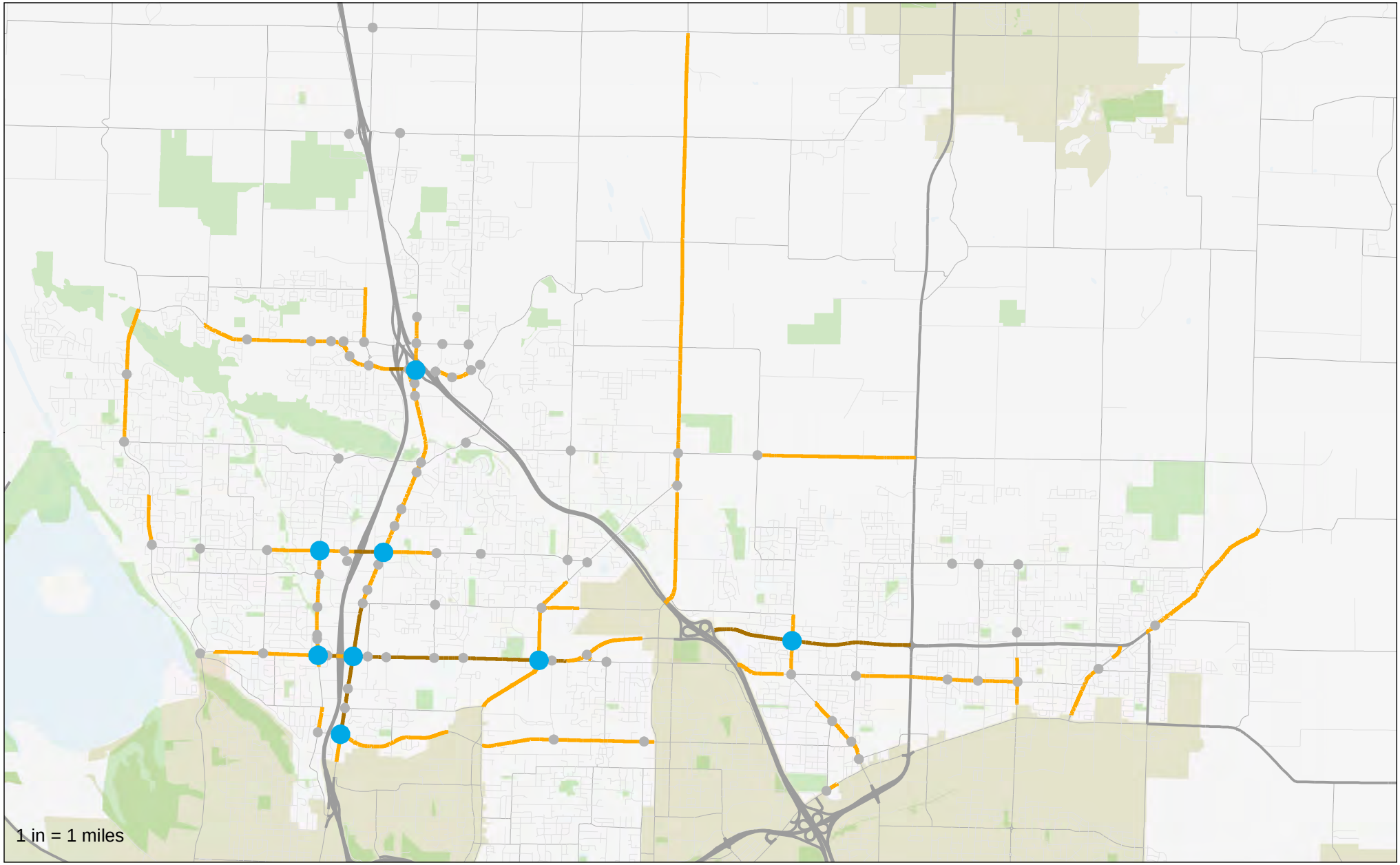


Figure 10: Priority Signalized Intersections on Urban Roadways

Data Source: WSDOT and Clark County Public Works

Prioritized Systemic Treatment Locations

Based on the methodologies presented above, Kittelson identified several locations that would be appropriate for systemic safety project development. From this list, Clark County selected five locations from the list for Kittelson developed into model project. This work is included in Section 4. The long list of 20 initially prioritized corridors is provided below.

Rural Road Curves

- NE Lucia Falls Road between NE 172nd Avenue and NE Sunset Falls Road
- NE Ward Road between NE 119th Street and NE 172nd Avenue
- NE Risto Road between NE 207th Avenue and NE 227th Avenue

Rural Road Grade

- NE W.H. Garner Road to NE Kelly Road, continuing to NE Yacolt Mountain Road
- NE Sunset Fall Road between NE Deer Road and NE Lucia Falls Road
- Rawson Road between NE 271st Ave and NE 139th Street

Rural Road Fixed Objects

- NE Lucia Falls between NE 172nd Avenue and NE Sunset Falls Road
- Washougal River Road between County Line and SE 17th Street
- Connection between NE 27th Avenue at NE Blair Road and NE 39th Street at NE 292nd Avenue

Rural Road Two-Way Stop-Controlled Intersection Corridors

- NW 199th Street between 41st Avenue and NE 29th Street
- Intersections created by NE 82nd Street, NE 259th Street, NE 72nd Street, and NE Manley Road
- NE 182nd Street between NE Risto Road and NE 119th Street
- SE Blair Road between SE Washougal River Road and WA-500

Signalized Intersections

- NE 99th Street and NE Highway 99
- NE 78th Street and NE Highway 99
- NE St Johns Road and NE 78th Street
- NE Covington Road and NE 76th Street

Pedestrian Corridor

- NE 99th Street between NE Hazel Dell Avenue and NE 25th Street
- NE 78th Street between NE Hazel Dell Avenue and NE St Johns Road
- NE Highway 99 between Minnehaha Street and NE 104th Street

Systemic Corridors for Model Projects

Based on an evaluation of the crash history, roadway characteristics, and County knowledge, the following seven corridors were jointly identified from the 20 initial locations and additional feedback from County staff.

- NE Risto Road between NE 207th Avenue and NE 227th Avenue (Rural Road Curves)
- NE Rawson Road between NE 271st Ave and NE 139th Street (Rural Road Grade)
- NE 277th Avenue/NE 28th Street between NE 292nd Avenue and NE Blair Road (Rural Roads Fixed Object Crashes)
- NE 78th Street between NE Hazel Dell Avenue and NE 47th Avenue (Pedestrian Crossings on Multi-lane Urban Roadways)
- NE 82nd Avenue between NE 259th Street and NE 299th Street (Rural Two-way Stop-controlled Intersection Corridors)
- NE 20th Avenue/ NE Highway 99 between NE 117th Street and NE 134th Street (Urban Signalized Intersection Corridors)
- NE 78th Street between NE Saint Johns Road and NE 47th Avenue (Urban Signalized Intersection Corridors)

The model project for the identified corridors are described in Section 4.

SECTION 3: COUNTERMEASURE TREATMENTS

Using the systemic risk factors identified in the sections above, Kittelson developed a toolbox of systemic treatments that could be applied at sites exhibiting a systemic risk factor across unincorporated Clark County. The systemic treatment toolbox focused on identifying lower-cost and widely applicable treatments that could be integrated into the County's project development processes. In addition to the systemic treatments, Kittelson identified speed management as a vital component of addressing crash risk across the county. Kittelson developed a second toolbox of speed management treatments applicable on rural two-lane roads to help the County address locations with high frequencies of speed-related crashes.

Systemic Treatment Toolbox

The systemic treatment toolbox organizes treatments by systemic risk factor. The systemic treatments are summarized in Table 19. Each treatment is described below, including how the treatment addresses the risk factor, what types of crashes are addressed, the treatment's crash reduction factor (CRF), as well as estimates of the treatment's design life and estimated cost. Planning-level cost estimates and expected design life represent a typical installation of the treatment and may vary based on site conditions.

Table 19: Proposed Systemic Safety Tools for Clark County

Type	Countermeasure Name	CRF
Rural Road Curves	Install Centerline Rumble Strips	20%
	Increase Pavement Friction[1]	24%
	Widen Paved Shoulder (0-4 feet)	31%
	Install Chevron Signs on Horizontal Curves	4%
	Install Dynamic Feedback Sign on Curves	25%
Fixed Object and Run-off Road	Install Continuous Milled-in Shoulder Rumble Strips	79%
	Increase Pavement Friction	24%
	Remove, Relocate, or Protect Fixed Objects Adjacent to Road	38%
	Install Wider Edge-lines (From 4 to 6 inches)	37%
Pedestrian Crossings on Multi-lane Urban Roadways	Pedestrian Refuge Island	32%
	Parking Restriction on Approach to Crosswalk	30%
	Rectangular Rapid Flashing Beacon	47%
	Pedestrian Hybrid Beacon	57%
Rural Two-way Stop-Controlled Intersections	FHWA Basic Set of Sign and Marking Improvements for Unsignalized Intersections	40%
	Provide "Stop Ahead" Pavement Markings	56%
	Transverse Rumble Strips on Stop-controlled Approaches	25%
Urban Signalized Intersections	FHWA Basic Set of Signal and Sign Improvements for Signalized Intersections	30%
	Increase All-red Clearance Interval	20%
	Convert Left turn Permissive to Protected Phasing	16%
	Leading Pedestrian Interval (4 lane principal arterial)	59%

Source: Developed by Kittelson & Associates, Inc., CRF sources are cited in the body of the section.

[1]Description of treatment is provided in the Fixed Object and Run-off Road Section.

Rural Road Curves

Kittelson identified the following countermeasures as potential treatments for addressing risk associated with rural curves in Clark County. They focus on treatments to help drivers remain in their travel lane through turns.

Install Centerline Rumble Strips

Description: Centerline rumble strips provide auditory and tactile feedback to motorists when they have begun to cross over the centerline of the roadway.

Potential Crash Reduction: 20%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: Centerline rumble strips can reduce head-on and other crossover crash types on horizontal curves of undivided roadway segments by alerting drivers that they are crossing over the centerline into the opposing direction of traffic when navigating a curve.	**Design Life:** 10 Years	**Cost:** $10 per linear foot

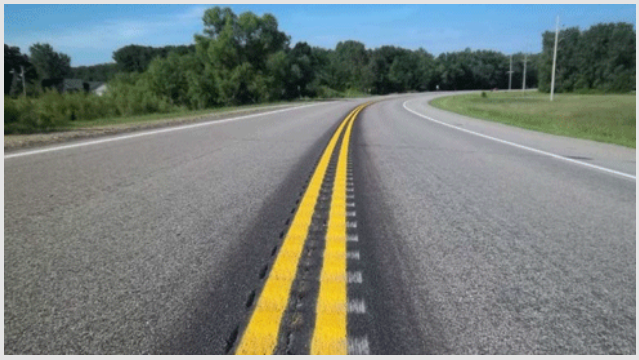


Photo Source: Federal Highway Administration (FHWA)

** Persaud, B. N., Retting, R. A., and Lyon, C., "Crash Reduction Following Installation of Centerline Rumble Strips on Rural Two-Lane Roads." Arlington, Va., Insurance Institute for Highway Safety, (2003)*

Widen Paved Shoulder (0 to 4 feet)

Description: Widens the paved shoulder adjacent to travel lanes.

Potential Crash Reduction: 31%*	**Crash Types Addressed:** Fixed object, Head on, Run off road, Sideswipe	**Crash Severity Addressed:** Fatal
Reason for Application: Paved shoulders provide increased safety when navigating horizontal curves by providing a paved recovery area for motorists who have left the travel lane to maintain control and correct the vehicle path. Widening the outside shoulder of a curve provides the greatest benefit on roads where existing space is limited.	**Design Life:** 20 years	**Cost:** $60 per linear square foot (costs vary with terrain)

Photo Source: FHWA

** Park, J., M. Abdel-Aty, and C. Lee. "Exploration and comparison of crash modification factors for multiple treatments on rural multilane roadways". Accident Analysis and Prevention, Vol. 70, (2014) pp. 167-177.*

Install Chevron Signs on Horizontal Curves

Description: Chevron signs along horizontal curves provide a visual que to alert and guide motorists through an approaching curve

Potential Crash Reduction: 4%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: Chevron signs alert drivers to reduce speeds and prepare to enter a curve. Chevron placement also helps guide drivers through the curve by providing a visual cue to the approaching curve's radius.	**Design Life:** 10 Years	**Cost:** $500 per sign

Photo Source: FHWA

** Srinivasan, R., Baek, J., Carter, D., Persaud, B., Lyon, C., Eccles, K., Gross, F., Lefler, N., "Safety Evaluation of Improved Curve Delineation." Report No. FHWA-HRT-09-045, Federal Highway Administration, Washington, D.C., (2009)*

Install Dynamic Feedback Sign on Curve

Description: Dynamic speed warning signs alert drivers of their speed into the approach of a curve when their speed is above the curve design speed.

Potential Crash Reduction: 25%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: Speeding on horizontal curves is a primary factor of curve-related crashes. Dynamic speed warning signs can reduce curve-related crashes by providing visual feedback to the driver that speeds should be reduced when approaching a curve.	**Design Life:** 10 Years	**Cost:** $7,500 per sign

Photo Source: Center for Transportation Research and Education, Iowa State University

** Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.*

Fixed Object and Run-Off Road Treatments

Kittelson identified the following countermeasures as potential treatments for addressing fixed object and run-off road crashes in Clark County. The treatments selected help to emphasize the road edge and increase the recovery area available to drivers.

Install Continuous Milled-in Shoulder Rumble Strips

Description: Rumble strips are milled into paved shoulders that produce auditory and tactile feedback when driven over.

Potential Crash Reduction: 79%*	**Crash Types Addressed:** Run off Road, Single Vehicle	**Crash Severity Addressed:** All
Reason for Application: Rumble strips can help reduce run-off road crashes along rural two-lane highways by alerting drowsy or distracted drivers when they are leaving the roadway. The treatment was recommended for Clark County because run-off road crashes are the most common crash type on rural county roads.	**Design Life:** 10 Years	**Cost:** $10 per linear foot

Photo Source: Fauquier Times

** Perrillo, K., "The Effectiveness and Use of Continuous Shoulder Rumble Strips." Albany, N.Y., Federal Highway Administration, (1998)*

Increase Pavement Friction

Description: High friction surface treatments are the application of aggregate to the pavement to increase or maintain the pavement friction at a site.

Potential Crash Reduction: 24%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: Increasing or maintaining appropriate pavement friction through a curve can reduce the potential for motorists to lose control of their vehicle or skid when navigating a curve. Increased pavement friction has been shown to reduce crash frequency during wet conditions and in locations with high friction demand due to vehicle speeds or roadway geometrics.	**Design Life:** 10 Years	**Cost:** $1,000 per square foot

Photo Source: FHWA

** Merritt, D., C. Lyon, and B. Persaud. "Evaluation of Pavement Safety Performance". Report No. FHWA-HRT-14-065, Federal Highway Administration, February 2015*

Remove, Relocate, or Protect Fixed Objects Adjacent to Road

Description: Remove or relocate fixed objects adjacent to the roadway to increase the unpaved shoulder clear zone.

Potential Crash Reduction: 38%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: Clearing or moving fixed-objects away from the roadway can reduce fixed-object crashes by providing a clear zone that gives drivers more space and time to correct their path should they leave the road.	**Design Life:** 10 Years	**Cost:** $10 per linear foot

Photo Source: Florida Vegetation Management Association

** Hovey, P. W. and Chowdhury, M., "Development of Crash Reduction Factors." 14801(0), Ohio Department of Transportation, (2005)*

Install Wider Edge-lines (From 4 to 6 inches)

Description: Restripe edgelines to increase their width to improve visibility for drivers.

Potential Crash Reduction: 37%*	**Crash Types Addressed:** Single-vehicle	**Crash Severity Addressed:** Fatal and Injury Crashes
Reason for Application: Wider edgelines more clearly define the edge of the roadway. This increased visibility of the edge of roadway can reduce the incidence of vehicles leaving the roadway.	**Design Life:** 10 Years	**Cost:** $10 per linear foot

Photo Source: Texas A&M Transportation Institute

** Park, E.S., P.J. Carlson, R.J. Porter, and C.K. Anderson. "Safety effects of wider edge lines on rural, two-lane highways". Accident Analysis and Prevention Vol. 48, (2012)*

Pedestrian Crossings on Multi-lane Urban Roadways

Kittelson identified the following countermeasures as potential treatments for addressing risk associated with pedestrian crossing on multi-lane urban roadways in Clark County. The treatments were selected to reduce the risk for pedestrians crossing arterials and other high-volume multi-lane roads.

Refuge Islands

Description: Refuge islands provide a raised island for pedestrians to safely wait in the roadway between opposing lanes of traffic.

Potential Crash Reduction: 32%*	**Crash Types Addressed:** Vehicle/Pedestrian	**Crash Severity Addressed:** All
Reason for Application: Adding a refuge island provides a safe location for pedestrians to wait as they cross a multi-lane roadway. The refuge island reduces exposure to vehicles and allows pedestrians to cross a roadway in two stages. Refuge islands can be installed uncontrolled intersections, midblock locations, or even at wide signalized intersections.	**Design Life:** 20 Years	**Cost:** $20 per square foot

Photo Source: Michael Frederick, City of St. Petersburg, FL

** Zegeer et al. NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. NCHRP, Transportation Research Board, Washington, DC, 2017.*

Parking Restriction on Approach to Crosswalk

Description: Restricting parking on an approach to the crosswalk ("daylighting") provides improved sight triangles for motorists and pedestrians approaching the crosswalk.

Potential Crash Reduction: 30%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: Removing parking on the approach to a crosswalk improves sightlines for motorists and pedestrians – giving each more time to identify and react to potential crossing conflicts.	**Design Life:** NA	**Cost:** $500 for signing

Photo Source: FHWA, Pedestrian Safety Guide and Countermeasure Selection System

** Gan, A., J. Shen, and A. Rodriguez. "Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement Projects." Final report. Florida Department of Transportation, Tallahassee, FL, 2005.*

Rectangular Rapid Flashing Beacons (RRFBs)

Description: RRFBs are a pedestrian-activated beacon that uses an irregular flash pattern to increase driver yielding compliance at uncontrolled crossing locations.

Potential Crash Reduction: 47%*	**Crash Types Addressed:** Vehicle/Pedestrian	**Crash Severity Addressed:** All
Reason for Application: When activated, RRFBs create a visual indication to drivers using a flash pattern similar to emergency flashes. They are an effective tool for increasing motorist yielding compliance at uncontrolled locations.	**Design Life:** 20 Years	**Cost:** $10,000 - $15,000

Photo Source: FHWA, Pedestrian Safety Guide and Countermeasure Selection System

** Zegeer et al. NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. NCHRP, Transportation Research Board, Washington, DC, 2017.*

Pedestrian Hybrid Beacon (PHBs)

Description: PHBs provide crossing pedestrians with an actuated protected crossing phase across a roadway. PHBs are placed overhead with signal heads facing both directions on the major street. When activated, the signal switches to a flashing red phase allowing motorists to stop and proceed when the crossing is clear.

Potential Crash Reduction: 57%*	**Crash Types Addressed:** Vehicle/Pedestrian	**Crash Severity Addressed:** All
Reason for Application: PHBs allow pedestrians to cross the street safely by stopping motor vehicle traffic. Combined with signage and markings, PHBs can reduce pedestrian-related crashes at mid-block crossings by alerting vehicles of the upcoming crossing. This treatment is particularly effective for crossings of high-volume or high-speed roadways, especially at midblock crossing locations.	**Design Life:** 20 Years	**Cost:** $80,000

Photo Source: Michigan Complete Streets Coalition

** Zegeer et al. "Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments". Transportation Research Record No. 2636, Transportation Research Board of the National Academies of Science, Washington, D.C. (2017).*

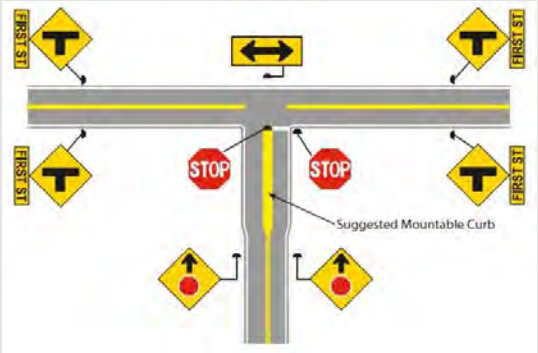
Rural Two-Way Stop-Controlled Intersections

Kittelson identified the following countermeasures as potential treatments for addressing risk associated with two-way stop-controlled intersections in Clark County. The treatments selected reduce risk by improving communication on that approach to stop-controlled legs.

FHWA Basic Sign and Marking Improvements for Unsignalized Intersections

Description: It is a package of treatments to improve safety at unsignalized intersections. The improvements include doubled (left and right) oversize warning signs, doubled STOP signs, a raised splitter island on the stop approach (if feasible), street name signs, stop bars, removing any limitations to sight distance, and double warning arrow at the stem of T-Intersections.

Potential Crash Reduction: 40%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: This set of enhancements combines multiple treatments to make the approach of two-way stop-controlled intersections more visible to the driver and increase awareness and visibility of potential conflicts. These treatments can help slow approaching vehicles and increase stop compliance on the controlled approaches.	**Design Life:** 10 Years	**Cost:** $5,000 to 8,000 per intersection



Graphic Source: FHWA

** FHWA, "Low-Cost Safety Enhancements for Stop-Controlled and Signalized Intersections," (2014)*

Provide "Stop Ahead" Pavement Markings

Description: "Stop Ahead" markings provide advance warning of an approaching stop control.

Potential Crash Reduction: 56%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: "Stop Ahead" markings alert drivers to approaching stop controls and can help reduce vehicle speeds into the controlled intersection approach and increase stop compliance to reduce potential conflicts.	**Design Life:** 10 Years	**Cost:** $2,500 per approach

Photo Source: FHWA

** NCHRP Report 500, "Volume 6: A guide for Addressing Run-Off-Road Collisions," (2003)*

Transverse Rumble Strips on Controlled Approaches		
Description: Transverse rumble strips are milled-in or raised auditory and tactile cues to help warn drivers of an approaching stop sign or other transition in the roadway requiring reduced speed.		
Potential Crash Reduction: 25%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** Fatal and Injury Crashes
Reason for Application: Transverse rumble strips attract the attention of a driver along high-speed rural corridors and alert them to a possible change of conditions, such as an upcoming stop control or curve.	**Design Life:** 10 Years	**Cost:** $2,000 - $3,000 per intersection

Photo Source: FHWA

***** *Srinivasan, R., Baek, J., and Council, F., "Safety Evaluation of Transverse Rumble Strips on Approaches to Stop-Controlled Intersections in Rural Areas." Presented at the 89th Annual Meeting of the Transportation Research Board, Washington, D.C., (2010)*

Urban Signalized Intersections

Kittelson identified the following countermeasures as potential treatments for addressing risk associated with urban signalized intersections in Clark County. The treatments include countermeasures to reduce risk for motor-vehicles and pedestrians at signalized intersections.

FHWA Basic Set of Signal and Sign Improvements for Signalized Intersections		
Description: It is a package of treatments to improve safety at signalized intersections. The improvements include installing back plates on all signal heads, adding reflective tape to increase visibility, 12-inch LED signal lenses, adding at least one signal head per approach lane, adjusting signal clearance timing, and eliminating flashing operation during night conditions.		
Potential Crash Reduction: 30%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: These changes make traffic signals more visible to motorists approaching intersections, helping motorists identify potential conflicts and reduce the risk of conflicts at the intersection.	**Design Life:** 10 Years	**Cost:** $5,000 - $30,000 per intersection

Photo Source: FHWA

** Rice, E. (2009). Low-Cost Safety Enhancements for Stop-Controlled and Signalized Intersections (No. FHWA-SA-09-020).*

Increase All-red Clearance Interval

Description: Increasing the all-red signal phase provides additional clearance time for vehicles who have entered an intersection prior to opposing movements receiving a green indication.

Potential Crash Reduction: 20%*	**Crash Types Addressed:** All	**Crash Severity Addressed:** All
Reason for Application: Increasing all-red clearance intervals provides more time for vehicles to move through the intersection before the start of the next green movement. This can reduce the frequency of crashes related to late-entering vehicles or motorists running a red light. The treatment is more effective at location where the existing red-clearance time is relatively short (2 seconds or less).	**Design Life:** 20 years	**Cost:** $3,000 per intersection

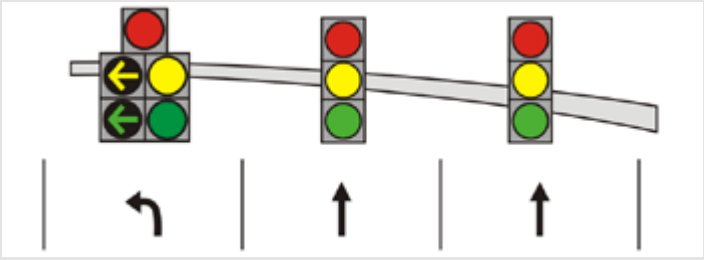
Photo Source: FHWA

** Srinivasan, R. et al., "NCHRP Report 705: Evaluation of Safety Strategies at Signalized Intersections.", Washington, D.C., Transportation Research Board, National Research Council, (2011)*

Convert Left-turn Permissive to Protected Phasing

Description: Converts signalized intersections that have permissive left-turn phasing to protected phasing

Potential Crash Reduction: 16%*	**Crash Types Addressed:** Left-turn	**Crash Severity Addressed:** Fatal and Injury Crashes
Reason for Application: Permissive left-turn movements are among the highest risk at signalized intersections due to the potential conflicts with crossing vehicular and pedestrian traffic. Protected left-turn phasing can reduce left-turn collisions by creating an exclusive movement for left-turning motorist.	**Design Life:** 20 Years	**Cost:** $25,000 per intersection (assumes existing left turn lane)



Graphic Source: FHWA

** Bonneson, J. A., National Research Council (U.S.)., American Association of State Highway and Transportation Officials., & National Cooperative Highway Research Program. (2010). Highway safety manual. Washington, D.C: American Association of State Highway and Transportation Officials.*

Leading Pedestrian Interval (LPI) at Traffic Signal

Description: LPIs start the pedestrian WALK phase 3-7 seconds before vehicles are given the green phase to give pedestrians a "head start" on the crossing movement and increase their visibility to conflicting vehicles movements.

Potential Crash Reduction: 59%*	**Crash Types Addressed:** Vehicle/Pedestrian	**Crash Severity Addressed:** All
Reason for Application: LPIs increase driver awareness of potential pedestrian conflicts by allowing pedestrians to begin crossing ahead of vehicles movements. This "head start" can reduce conflicts with motorists making right and left turns.	**Design Life:** 20 Years	**Cost:** $1,000 - $2,000

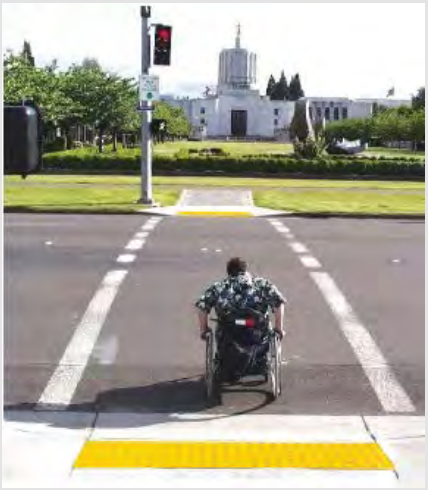


Photo Source: FHWA

** Fayish, A.C. and F. Gross, "Safety Effectiveness of Leading Pedestrian Intervals Evaluated by a Before–After Study with Comparison Groups." Transportation Research Record: Journal of the Transportation Research Board, No. 2198, Transportation Research Board of the National Academies, Washington, D.C., 2010, pp. 15–22. DOI: 10.3141/2198-03*

Speed Management Toolbox

Excessive speed was a common contributing factor for crashes on rural roads in the county. In particular, excessive speed can exacerbate risks present at rural two-way stop-controlled intersections. As a result, Kittelson developed a secondary set of treatments for managing speeds on rural roads, either by reducing the frequency of unsafe speeds by motorists and/or by clearly indicating to drivers when speeds need to be reduced in preparation for a change in roadway conditions, such as a stop-controlled intersection or curve. Kittelson prioritized treatments for potential applications on high crash risk rural roadways in Clark County, with a focus on low-cost treatments that may be implemented in a systemic manner.

The types of treatments and other strategies appropriate for rural roadways and intersections are organized into the following four categories:

- pavement markings;
- physical roadway improvements;
- signage; and
- other strategies.

For each treatment, a description is provided as well as guidance on typical application.

Pavement Markings

This section describes speed management treatments that use pavement to provide visual cues and messaging.

Transverse Lane Marking

Description: Transverse lane markings are horizontal markings placed on the roadway. There are many types of transverse lane markings including optical bars and chevron marking.

Application Guidance:

Transverse markings are especially useful for transition zones but can be used in locations where there is an approaching change in roadway character such as an intersection or curve. Markings may be spaced increasingly closer on the approach to an intersection to give the appearance that the driver is speeding up and provide more awareness of speed. This may cause the driver to decrease their speed on their approach to the intersection or other roadway transition. Optical speed bars are an additional type of transverse marking. MUTCD Section 3B.22 provides guidance on placement of optical speed bars.

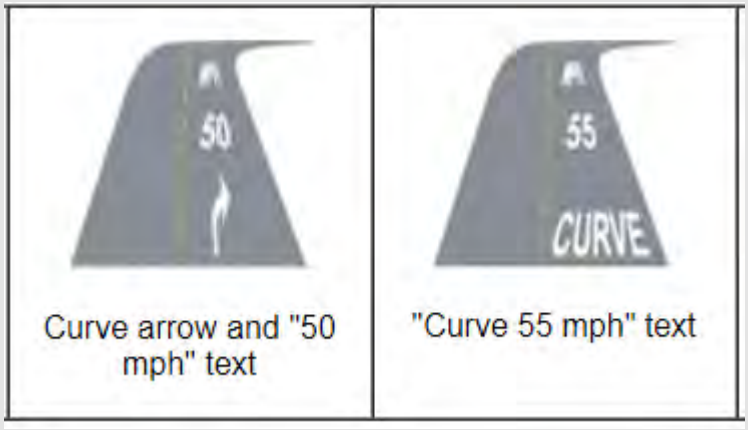
Photo Source: FHWA

Speed Advisory Markings in Lane ("Slow", "Curve", or "Speed Limit XX")

Description: Advisory markings provide information before curves and other advisory zones. Markings may include the speed limit or a warning of an approaching curve.

Application Guidance:

NCHRP Report 600: Human Factors Guidelines for Road Systems contains guidelines for effective markings. The report found that usage of speed advisory markings may lower speeds by up to 4 MPH and showed an 11% reduction in vehicles exceeding the speed limit. Speed advisory markings can supplement other signage such as curve advisory signs. MUTCD Section 3B.20 provides design and placement criteria for pavement advisory markings.



Graphic Source: FHWA.

Colored Pavement Advisory Markings

Description: The addition of color to advisory pavement markings may make the markings more visible to the driver.

Application Guidance:

Colored pavement markings are typically used in transition zones but may be appropriate for rural roadways in general or where there is a change in roadway character, such as an approaching curve. Studies have study found that colored pavement markings reduced mean speeds between 2.3 and 7.4 MPH.

Photo Source: Iowa State University, *Speed Management Toolbox for Rural Communities*

Shoulder Widening to Narrow Travel Lanes

Description: Shoulders in rural areas can be widened to install striping that visually narrows the roadway. The example figure shows an example of shoulders with transverse striping. Shoulders can be colored to further define the roadway edge and further the appearance of lane narrowing.

Application Guidance:

This treatment is most applicable in areas where there is the right-of-way available to widen the shoulder. Narrowing lanes can reduce excessive speeding, but lanes that are too narrow for larger vehicles may increase crashes.

Photo Source: Iowa State University, *Speed Management Toolbox for Rural Communities*

Wider Edge-lines

Description: Edge-lines are a visual pavement marking that guide drivers when navigating a roadway. Wider edge-lines further delineate the roadway path, make the roadway appear narrower, and can increase driver perception of speed.

Application Guidance:

Edge-lines can be placed along roadways with curves or long straight segments. Although the specific effect of wider edge-lines on speed is not available, studies have shown that widening edge-lines has reduced crashes on rural roadway segments. Wide edge-lines can only be installed on roadways where there is sufficient right-of-way. See the countermeasure treatment toolbox for more information on wider edge-lines.

Photo Source: The Texas Transportation Institute

Physical Roadway Improvements

This section describes speed management treatments that alter the physical roadway. The treatments range from relatively low-cost treatments, like vertical centerline posts to expensive construction projects, such as installing a roundabout.

Splitter Islands at Intersections

Description: Splitter islands are a treatment for stop-controlled intersections that provides deflection on the approach to an intersection.

Application Guidance:
When applied properly, splitter islands have been shown to be effective at decreasing traffic speed and crashes at intersections. Splitter islands can be combined with doubled-up stop signs for increased visibility. NCHRP Report 279 covers splitter island design and placement.

Photo Source: FHWA

Horizontal Deflections

Description: Horizontal deflections are a type of physical roadway or curb enhancement to narrow or otherwise break up a roadway's straight design character. A horizontal deflection requires the motorist to turn slightly in order to stay on the roadway path.

Application Guidance:
Horizontal deflections can provide a visual endpoint for the roadway along curves. Lateral shifts, chicanes, and roundabouts are examples of horizontal deflections. Horizontal deflections are more common in populated areas and can be integrated as a part of other roadway infrastructure such as medians, pedestrian islands, or curb extensions. Center islands are an additional type of horizontal defection that provides separation from traffic and can reduce the risk of a head-on collision occurring.

Photo Source: City and County of San Francisco

Vertical Centerline Posts

Description: Vertical centerline posts are a type of vertical treatment that delineates the centerline. This treatment is also known as a longitudinal channelizer.

Application Guidance:
Vertical delineators give the impression of a lane narrowing. Delineators may be between 18-36 inches tall and spaced 32 inches apart. Posts should only be applied where there is enough room in the roadway to accommodate larger vehicles. This treatment can help reduce speed along long straight roadways. Centerline vertical delineators placed on rural roads have been shown to reduce average speed by as much as 3 MPH. Delineators also have the benefit of separating oncoming traffic and potentially reducing the risk of head-on collisions.

Photo Source: Iowa State University, *Speed Management Toolbox for Rural Communities*

Sinusoidal Transverse Rumble Strips

Description: Rumble strips provide an auditory warning to drivers of an approaching change in roadway character. Sinusoidal rumble strips are a type of rumble strip that has a sine wave milled into the pavement. This design reduces the amount exterior noise of the rumble strips and vibration while still providing interior noise and rumble.

Application Guidance:
Sinusoidal rumble strips can be applied in the same way that transverse rumble strips are installed. The grooves of transverse rumble strips are installed perpendicular to the roadway travel lane. Transverse rumble strips are most effective at locations before an intersection, transition zone, or other change in roadway character. The sinusoidal design allows the speed management benefits of transverse rumble strips without the noise. The South Dakota Department of Transportation has installed transverse sinusoidal rumble strips throughout the state.

Photo Source: Caltrans

Intersection Realignment

Description: There are several intersections in Clark County where roadways intersect at acute angles. Realigning the intersection to meet at a right angle can improve safety and decrease speed in the approach to the intersection by making the intersection more visible.

Application Guidance:

In an intersection realignment, the straight-through movement should become the top of the 'T' and approaches should be as perpendicular as possible, given site conditions. Intersection realignment also improves sight distance for drivers approaching the intersection.

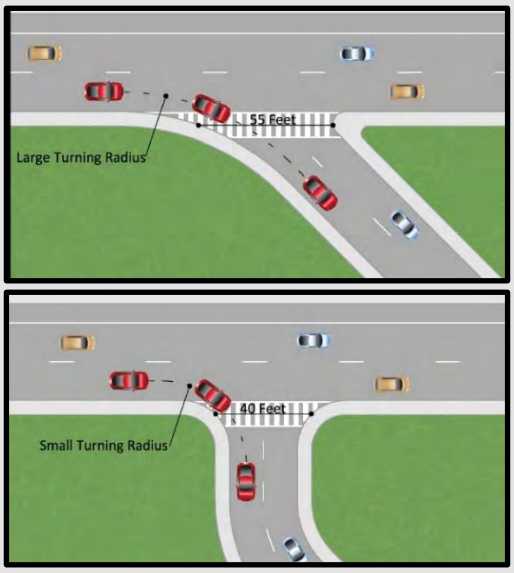


Photo Source: FHWA, Pedestrian Safety Guide and Countermeasure Selection System

Roundabouts

Description: Roundabouts are circular intersections where vehicles travel counterclockwise around a center island without signals or stop signs. Roundabouts can provide horizontal deflection and a visual endpoint to the roadway that requires a lower vehicle speed into the intersection approach.

Application Guidance:

Roundabouts can be designed so that drivers must approach the intersection at speeds as low as 15-25 MPH. The decrease in approach speed can lower the severity of crashes when compared to stop-controlled intersections. Roundabouts can be used in place of a two-way and all-way stop controlled intersection, and potentially traffic signals depending on volume. Replacing a rural two-way stop-controlled intersection with a roundabout has been shown to reduce injury crashes as much as 87%.

Photo Source: Kittelson & Associates, Inc.

Speed Tables

Description: Speed tables are flat-top mounds that cover the full width of the roadway. Speed tables are similar in design to speed humps with an elongated top that covers the wheelbase of a passenger car.

Application Guidance:
Speed tables can target speeds as high 45 MPH. Speed tables are most effective in transition zones or community-focused streets. Consideration should be given to accommodate trucks or other larger vehicles.

Photo Source: FHWA

Signage

This section describes treatments that manage speed through improved communications with drivers. The treatments are generally targeted at locations, such as prior to a curve, where changing roadway conditions reduce the appropriate roadway speed.

Dynamic Speed Displays and Vehicle-Actuated Signs / Speed Trailers

Description: Dynamic speed feedback signs display the speed of approaching vehicles. Dynamic signs can display other information or signage that is triggered by an approaching vehicle.

Application Guidance:
Installing dynamic speed feedback signs on rural roadways may reduce 85th percentile speeds by 2 – 7 MPH. Typical applications include the paring of a dynamic speed feedback sign with a speed limit sign or curve advisory sign.

Photo Source: FHWA

Enhanced Signing

Description: A number of enhanced signing techniques can be applied to rural roadways, including oversized and fluorescent signage. Other techniques include placing retroflected strips on existing signage, such as chevrons or curve advisory signs.

Application Guidance:
Fluorescent or retroreflective sheeting on signage makes signage more visible, especially in low-light conditions. Retroreflective strips on signage may lead to a reduction in vehicles exceeding the speed limit and a reduction in overall mean speed.

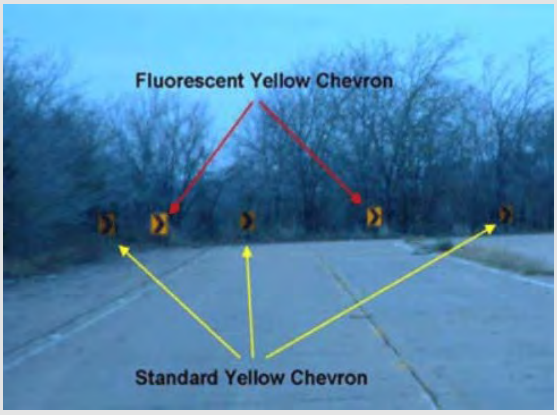


Photo Source: Texas Transportation Institute

Curve Warning Sign with Flashing Beacon

Description: Flashing beacons supplement curve warning signs at the approach to a horizontal curve by attracting driver attention to the curve.

Application Guidance:
The 2009 MUTCD contains guidance on curve warning signs and the use of flashing beacons. Studies of speed-activated beacons have shown an average speed reduction of 1 – 8 MPH. Beacons can also be placed overhead the roadway to improve visibility.

Photo Source: Michigan Department of Transportation

LEDs in Pavement Markings or Signs

Description: LEDs can be embedded in delineators or any warning or regulatory sign. MUTCD Section 2A.08 contains guidance on the installation of signage with embedded LEDs.

Application Guidance:
LEDs can draw driver attention and improve comprehension of signage on curves. This treatment has also been applied LEDs experimentally by placing LEDs in the roadway serving the function of roadway advisory pavement markings. LEDs may also be embedded in speed limit signs. LEDs on speed limit signs have been shown to reduce the number of vehicles that were traveling significantly over the speed limit.

Photo Source: Marc Hutchins and Nick Hutchins

Other Strategies

This section describes other speed management treatments, including treatments that are appropriate for managing speeds as roads enter more urban locations.

Community Gateway Signage

Description: Gateways are a type of sign or other visual cue that indicates that the motorist is entering a community or more urbanized area.

Application Guidance:
Gateways may be placed overhead and completely span roadway or may simply be placed to the right of the road. Gateways are most effective when placed at transition zones into urban areas. Gateways have shown effectiveness at reducing speed in studies performed outside of the United States.

Photo Source: Iowa State University, *Speed Management Toolbox for Rural Communities*

Transition Zones

Description: A transition speed zone is the area of the roadway between a higher-speed and lower-speed location, often between a rural and urban area.

Application Guidance:

Transition zones can allow drivers to safely slow down over a period of time. Some states require the use of transition zones for rural roadways. The length of the zone should be set to provide sufficient distance for motorists to gradually reduce their speed[1].

Graphic Source: FHWA

[1] For more information, see FHWA's Speed Management ePrimer on determining the appropriate distance for transition zones: https://safety.fhwa.dot.gov/speedmgt/ref_mats/ePrimer_modules/module4.cfm.

Enforcement

Description: Enforcement encompasses actions taken by legal authorities to validate that drivers are complying with the posted speed limit and other traffic laws.

Application Guidance:

Enforcement is a strategy to reduce speeding in rural areas. Enforcement is intended to generally deter speeding and deter at specific locations. Enforcement can be achieved though automatic methods (LiDAR or RADAR systems), vehicle pacing, or by parking an enforcement vehicle along a roadway. Enforcement should be concentrated at locations where speeding has been identified as an issue.

Photo Source: FHWA

Education Campaign

Description: Education campaigns are an important part of an overall approach to speed management. The National Highway Traffic Safety Administration (NHSTA) has developed tools for education outreach on speed management.

Application Guidance:

The NHSTA "Stop Speeding Before It Stops You" campaign has been tested across the United States and has developed banner ads, infographics, posters, television, and radio ads that educate on speed prevention.

Graphic Source: Ad Council

SECTION 4: MODEL PROJECTS

Kittelson developed initial model projects for seven locations based on the initial longer list of 20 priority systemic treatment corridors, County staff input, and additional site reviews. The locations were selected from the risk factor priority locations identified in *Section 2*. The model projects identify appropriate treatments from the systemic treatment toolbox as well as treatments identified for the site-specific conditions of each corridor. These model projects provide Clark County with a framework for considering how to apply to the systemic treatments across the county roadway system going forward. The locations for each project scope corridor are shown in Figure 11.

- NE Risto Road between NE 207th Avenue and NE 227th Avenue (Rural Road Curves)
- NE Rawson Road between NE 271st Ave and NE 139th Street (Rural Road Grade)
- NE 277th Avenue/NE 28th Street between NE 292nd Avenue and NE Blair Road (Rural Roads Fixed Object Crashes)
- NE 78th Street between NE Hazel Dell Avenue and NE 47th Avenue (Pedestrian Crossings on Multi-lane Urban Roadways)
- NE 82nd Avenue between NE 259th Street and NE 299th Street (Rural Two-way Stop-controlled Intersection Corridors)
- NE 20th Avenue/ NE Highway 99 between NE 117th Street and NE 134th Street (Urban Signalized Intersection Corridors)
- NE 78th Street between NE Saint Johns Road and NE 47th Avenue (Urban Signalized Intersection Corridors)

For each location, the document includes a description of the location, why it was identified, and a brief crash history of the location. Note that while crash history is reported for each corridor and was considered in the application of treatments, the systemic risk factors identified as part of the SSIP were the primary driver for site selection and treatment application. It then describes the treatments selected and presents a high-level graphic showing the locations for the treatments.

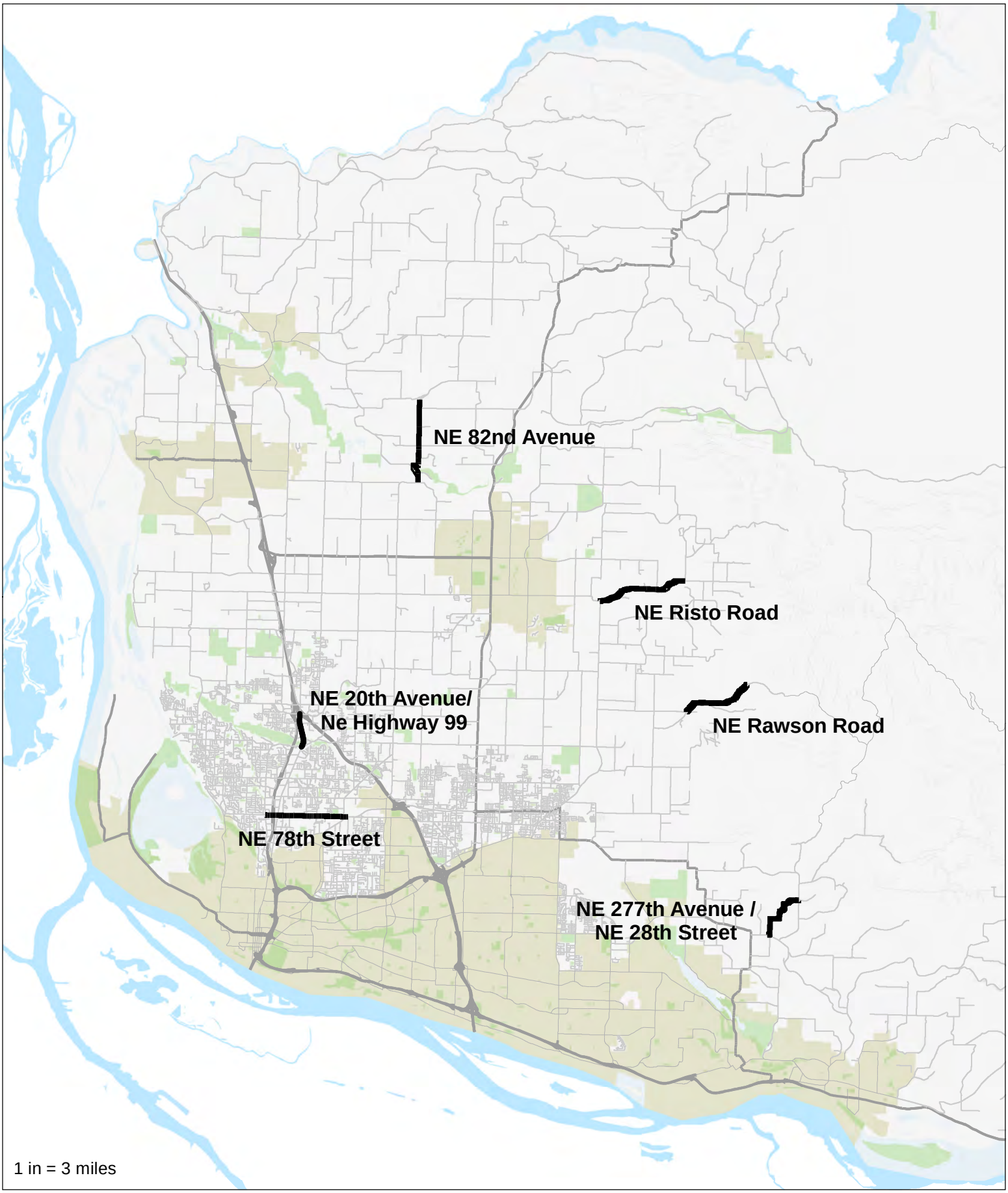


Figure 11: Location of Corridors Selected for Project Development

Legend

Project Corridors

Data Source: WSDOT and Clark County Public Works

NE Risto Road (Rural Road Curves)

Corridor Description

NE Risto Road was identified through the Rural Road Curves priority location analysis. The segment extends from NE 182nd Avenue to NE 227th Street and is approximately 2.5 miles long. It is indicative of many corridors in the more rural parts of Clark County in that it includes transitions between relatively flat and straight segments and more curved segments with denser vegetation and substantive grades.

Crash History

During the study period, there were 25 crashes along the corridor. The crashes include:

- 11 injury crashes including 1 severe injury (under wet conditions)
- 56% of the crashes occurred at night
- 21 single vehicle crashes (18 were fixed object crashes)

Corridor Treatments

Kittelson selected the following treatments for NE Risto Road with a focus on communicating the transitions between flat and straight segments to curve segments with inclines. The proposed locations for the treatments are shown in Figure 12. The treatments include:

- High friction surface treatments
- Wider edgelines
- Chevrons and delineation/reflective markers on horizontal curves
- Improving sightlines around intersections at the intersection with NE 212th Avenue
- Adding turn advisory signs

High Friction Surface Treatment

Wider Edgelines

Chevrons on Horizontal Curves

Delineation/Reflective Markers on Curves

Improve Sightlines

Turn Warning Sign

Figure 12:
Rural Road Curves
NE Risto Road

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NE Rawson Road (Rural Road Grades)

Corridor Description

NE Rawson Road was identified through the Rural Road Grades priority location analysis. The segment extends from NE 151st Street to NE 139th Street and is approximately 1.6 miles long. It is similar to the NE Risto Road project corridor in that it consists of a straighter segment between two segments with curves. Relative to Risto Road, it is less flat with a continuous change in elevation through the corridor and denser vegetation adjacent to the road throughout the corridor.

Crash History

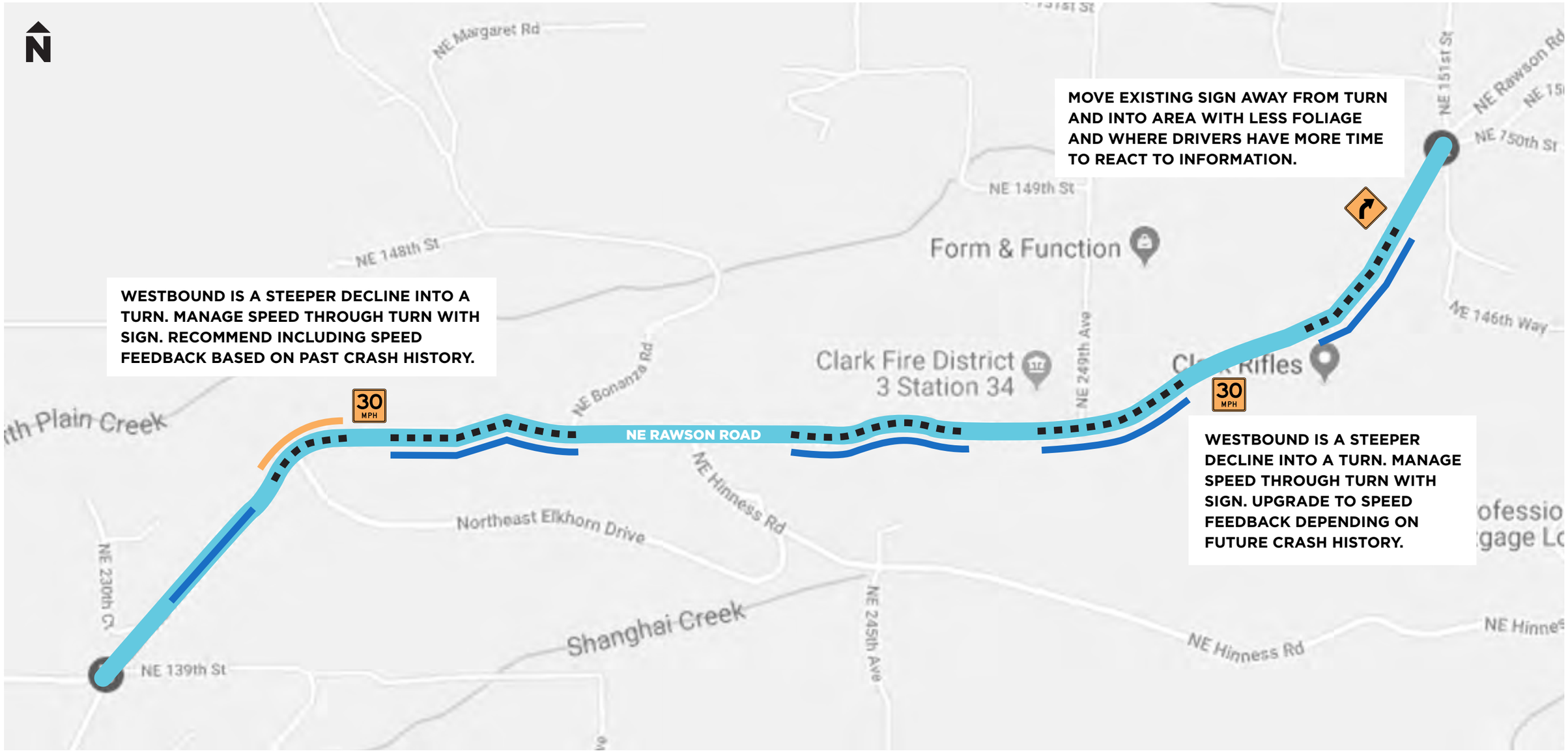
During the study period, there were 12 crashes. These crashes include:

- 7 injury crashes (no severe injury crashes)
- 8 night crashes
- 8 fixed object crashes
- 2 head-on collisions

Corridor Treatments

Kittelson selected the following treatments for NE Rawson Road to focus on communicating the transitions between flat and straight segments, and curve segments. To manage speed, the treatments include speed warning signs to alert drivers to the appropriate advisory speed as well as high friction surface treatments on curves to help prevent the loss of control. The proposed location for the treatments is shown in Figure 12. The treatments include:

- High friction surface treatments
- Chevrons and delineation/reflective markers on horizontal curves
- Turn advisory sign and speed warning signs



High Friction Surface Treatment

Chevrons on Horizontal Curves

Delineation/Reflective Markers on Curves

30 MPH Speed Warning Sign

Turn Warning Sign

Figure 13:
Rural Road Grades
NE Rawson Road

KITTELSON & ASSOCIATES

NE 277th Avenue/NE 28th Street (Rural Roads Fixed Object Crashes)

Corridor Description

NE 277th Avenue/NE 28th Street was identified through the Rural Roads Fixed Object Crashes priority location analysis. The segment extends from NE 292nd Avenue to NE Blair Road and is approximately 1.5 miles long. Relative to the first two corridors, this roadway width on the segment is thinner, with a total width of around 20 feet on much of the corridor. The corridor is wooded on the norther portion of the segment with tightly curving roads. The southern portion of the corridor consists of straight segments connected by 90-degree turns.

Crash History

During the study periods, there were 10 crashes.

- 1 fatal crash (snow/slush was present on the road and the driver was under the influence)
- 6 injury crashes (no severe injury crashes)
- 5 night crashes
- 6 single-vehicle, fixed-object crashes
- 3 multi-vehicle crashes with one vehicle entering traffic

Corridor Treatments

Kittelson selected the following treatments for the corridor to visually specify the edge of the roadway. On the northern half of the corridor, the proposed treatments provide visual cues through the tightest curves on the segment. Further south, the treatments specify vehicle movements where driveways are present along the apex of 90-degree curves. The proposed location for the treatments is shown in Figure 14. For the south end of the corridor, Kittelson outlined potential restriping for the intersection of NE 277th Avenue and NE 19th Street to reinforce the presence of an intersection and clarify movements through the intersection. The treatments are shown in Figure 15.

Along the corridor, the treatments include:

- High friction surface treatment
- Adding edgelines
- Chevrons and delineation/reflective markers on horizontal curves
- Stop bars
- Turn and speed warning signs

Figure 14: Rural Road Fixed Object Crashes
NE 277th Ave/NE 28th St

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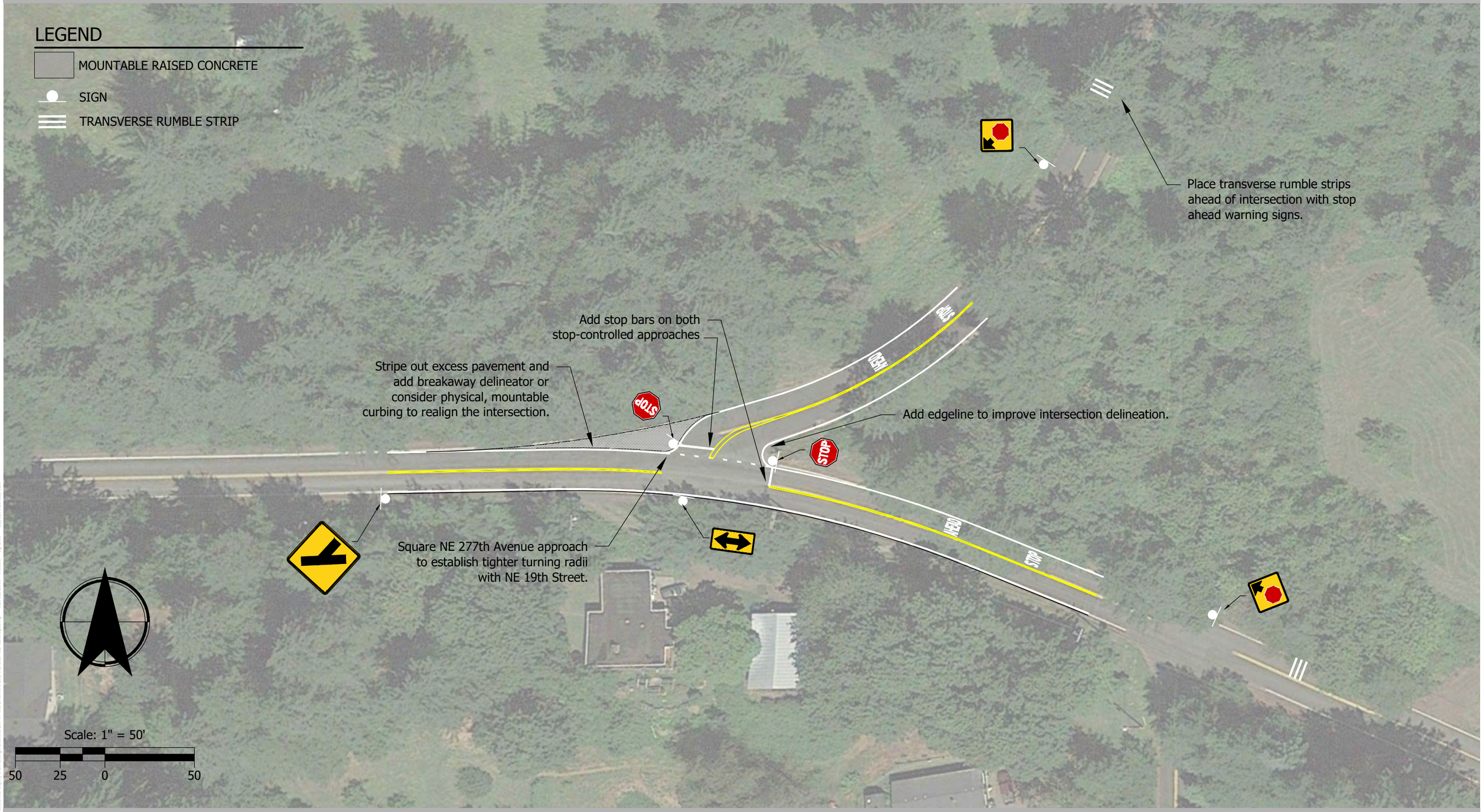

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Figure 15: NE 19th Street & NE 277th Avenue

Clark County

NE 78th Street (Pedestrian Crossings on Multi-lane Urban Roadways)

Corridor Description

NE 78th Street was identified through the Pedestrian Crossings on Multi-Lane Urban Roadways priority location analysis. The segment extends from NE Hazel Dell Avenue to NE 47th Avenue. It is a little over two miles long. The corridor has a high density of commercial businesses on the west side of the corridor and includes intersections with NE Highway 99, I-5 on- and off-ramps, and NE Hazel Drive. The center and east side of the corridor has less dense commercial land uses and large currently undeveloped parcels. NE 78th Street is generally five or more lanes wide with pedestrian crossings located at signalized intersections.

Crash History

During the study period, there were nine vehicle-pedestrian crashes on the corridor. These crashes include:

- 8 injury crashes including 3 severe injury crashes
- 4 right-turning vehicle crashes
- 1 left-turning vehicle crashes
- 6 crashes were during daylight and 3 crashes occurred at night with lights present

Corridor Treatments

Kittelson selected the following treatments to mitigate crossing risk to pedestrians along the corridor. Note that some of the treatments on the eastern portion of the corridor are contingent on future development. The location of the treatments are shown in Figure 16 and Figure 17. The second figure displays treatments in greater detail around the I-5 on- and off-ramps. The treatments include:

- Adding pedestrian countdown signals at signalized intersections
- Adding crosswalks on stop-controlled leg of T-intersection
- Adding a pedestrian hybrid beacon
- Re-establishing the road edge to reduce crossing distances
- Adding yield signs and shark teeth before uncontrolled crosswalks
- Adding stop bars at controlled crosswalk locations

SIDEWALK ENDS AT ENTRANCE TO PARK WITHOUT CONNECTION INTO PARK

- **ADD YIELD SIGNS BEFORE AND AFTER CROSSWALK ON-RAMPS**
- **ADD STOP BARS AT ALL OFF-RAMPS (ALL ARE SIGNAL- CONTROLLED)**
- **USE CURB BARRIER TO SET ROAD EDGE WHERE PAVEMENT IS STRIPED OUT AT THE PORK-CHOPS EAST OF THE INTERSTATE**

ADD PEDESTRIAN CROSSING WITH REFUGE AND PUSH BUTTON ON MEDIAN ON WEST SIDE OF INTERSECTION WITH NE 5TH AVENUE

ADD PHB ON EAST SIDE OF INTERSECTION

RECOMMEND PLANNING TO ADD PHB AT PARK AND ACROSS FROM SHOPPING CENTER AS DEVELOPMENT OCCURS.

SIDEWALKS EXIST THROUGHOUT THE CORRIDOR

- Add Pedestrian Countdown Signals
- Add Crosswalks on Stop-Controlled Leg of T-Intersection
- Combination of Treatments
- Add Pedestrian Hybrid Beacon (PHB) Crossing Treatment (lighted version shows contingent locations)

Figure 16: Pedestrian Crossings on Multi-lane Urban Roadways
NE 78th Street

KITTELSON & ASSOCIATES

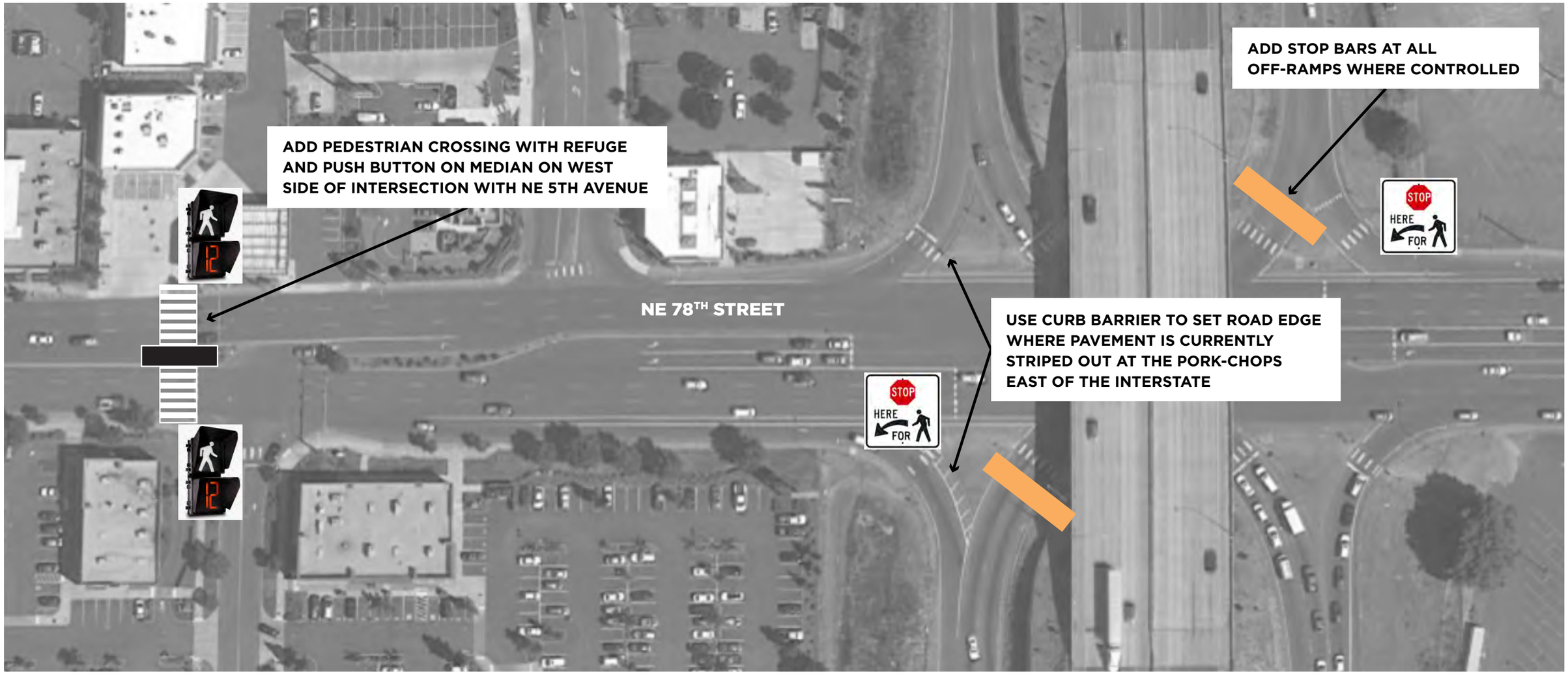

Figure 17:
Pedestrian Treatments
On-/Off-Ramps at I-5 Interchange
NE 78th Street

KITTELSON & ASSOCIATES

NE 82nd Avenue (Rural Two-way Stop-controlled Intersection Corridors)

Corridor Description

NE 82nd Avenue was identified through the rural two-way stop-controlled intersection priority location analysis. The segment extends over two miles long from NE 299th Street to NE 259th Street and includes six two-way stop-controlled intersections. The segment was identified for developing a project scope to show how intersection treatments could be applied systemically along a corridor to create consistent conditions for drivers.

Crash History

There were 42 reported crashes along the corridor, and 30 crashes within 250 feet of an intersection during the study period. These crashes include:

- 1 fatal crash
- 19 injury crashes including 2 severe injury crashes
- 10 angle, entering-vehicle crashes
- 5 opposite direction, left-turning crashes
- 18 fixed object crashes

Corridor Treatments

Kittelson identified two categories of stop-controlled intersections along the corridor. To the north, the stop-controlled approaches are perpendicular to the corridor. To the south, there are two intersections with less-standard geometry. Kittelson selected treatments that clarify movements and increase visibility at these intersections. Treatments for the whole corridor are shown on Figure 18. Figure 19 and Figure 20 show specific treatments for two intersections at the south end of the corridor: NE 82nd Avenue and NE 259th Street, and NE Daybreak Road & Hyatt Road, respectively. The treatments proposed include:

- High friction surface treatments
- Adding stop bars
- Transverse rumble strips in advance of controlled approaches
- Restriping on intersections to square intersection approaches
- Delineation/reflective markers on curves
- Improving intersection sightlines
- Splitter islands on stop approaches with secondary stop signs to increase intersection visibility
- Reflective stripes on signposts

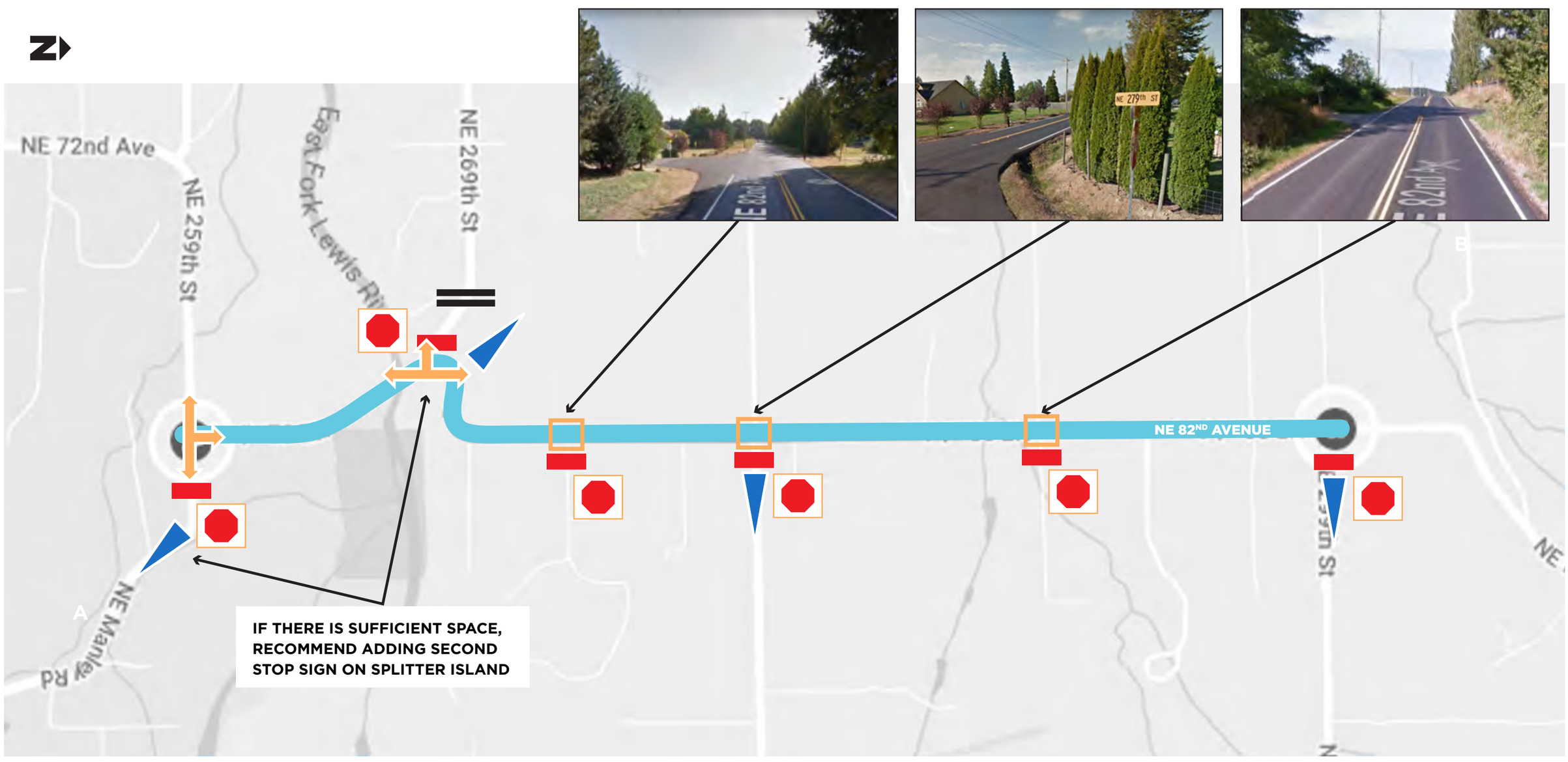

Figure 18: Rural Two-Way Stop-Controlled Intersection Corridors

NE 82nd Avenue

KITTELSON & ASSOCIATES

LEGEND

- MOUNTABLE RAISED CONCRETE
- SIGN
- TRANSVERSE RUMBLE STRIP

Restripe edgelines.

Monitor site during growing season to ensure sight lines through the curve for left-turning vehicles onto NE 259th Street.

Square the westbound approach to the apex of the curve to reinforce intersection visibility.

Add splitter island with second stop sign in the splitter island.

Stripe out excess pavement and add breakaway delineator or consider physical, mountable curbing to realign the intersection.

Add chevrons on south side of NE 259th Street.

Install oversize turn warning sign.

Scale: 1" = 50'

50 25 0 50

KITTELSON & ASSOCIATES

Figure 19: NE 82nd Avenue and NE 259th Street

Clark County

LEGEND

- MOUNTABLE RAISED CONCRETE
- SIGN
- TRANSVERSE RUMBLE STRIP

Place transverse rumble strips further in advance of intersection with existing stop ahead warning sign.

Add edgeline around turn and dashed striping to indicate intersection presence.

Add stop bar. Maintain six-foot shoulder between the stop bar and travel lane.

Add signs reaffirming lack of through movement.

Realign approach to square the intersection approach to the intersecting roadway.

This will reduce conflict areas for vehicles traveling between NE Daybreak Road and NE Daybreak Road.

Consider adding breakaway delineators or physical, mountable curbing to align the intersection.

Extend edgeline to define west intersection approach.

NE Daybreak Road

STOP

STOP

Scale: 1" = 50'

50 25 0 50

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Figure 20: NE Daybreak Road and Hyatt Road
Clark County

NE 20th Avenue/Ne Highway 99 (Urban Signalized Intersections)

Corridor Description

NE 20th Avenue/ NE Highway 99 was identified through the Urban Signalized Intersection priority location analysis and County staff input. The segment extends from NE 117th Street to NE 134th Street and is approximately 0.9 miles long. The segment contains four signalized intersections and has four through lanes (two in each direction) with left-turn auxiliary lanes at intersections. Interstate 5 and Interstate 205 have on- and off-ramps on NE 134th Street on either side of the NE 20th Avenue & NE 134th Street intersection, the northern-most intersection of the corridor. There are commercial land uses surrounding the northern and southern parts of the corridor. The middle section of the corridor transitions into a rural context as it crosses Salmon Creek.

Crash History

There were 113 reported crashes along the corridor during the study period, of which, 100 occurred within 250 feet of an intersection. These crashes include:

- 41 injury crashes
    - 1 severe injury
- 24 night crashes
- 8 single-vehicle crashes
    - 8 fixed object
- 5 vulnerable road user crashes
    - 3 vehicle – bicyclist
    - 2 vehicle – pedestrian
- 105 multi-vehicle crashes
    - 30 with one vehicle entering at an angle
    - 28 rear-end crashes
    - 18 with vehicles colliding from opposite directions (including 16 left-turning-related crashes)
    - 12 sideswipe crashes
- 44 crashes with a contributing circumstance listed as either “Disregard Stop and Go Light” (20 crashes) or “Inattention” (24 crashes)

Corridor Treatments

Kittelson selected the following corridor treatments to reinforce the presence and visibility of the signalized intersections, to clarify intersection movements, and delineate and reinforce pedestrian crossings and intersection footprints. Figure 21 through Figure 24 show specific treatments for each signalized intersection along the corridor, ordered from north to south. The proposed treatments include:

- Adding retroreflective backplates on all approaches
- Installing or relocating advance “Signal Ahead” warning signs, as needed
- Adding intersection left-turn tracking striping
- Restriping crosswalks
- Adding protected or protected-permissive left-turn phases
- Installing ADA-compliant directional curb ramps

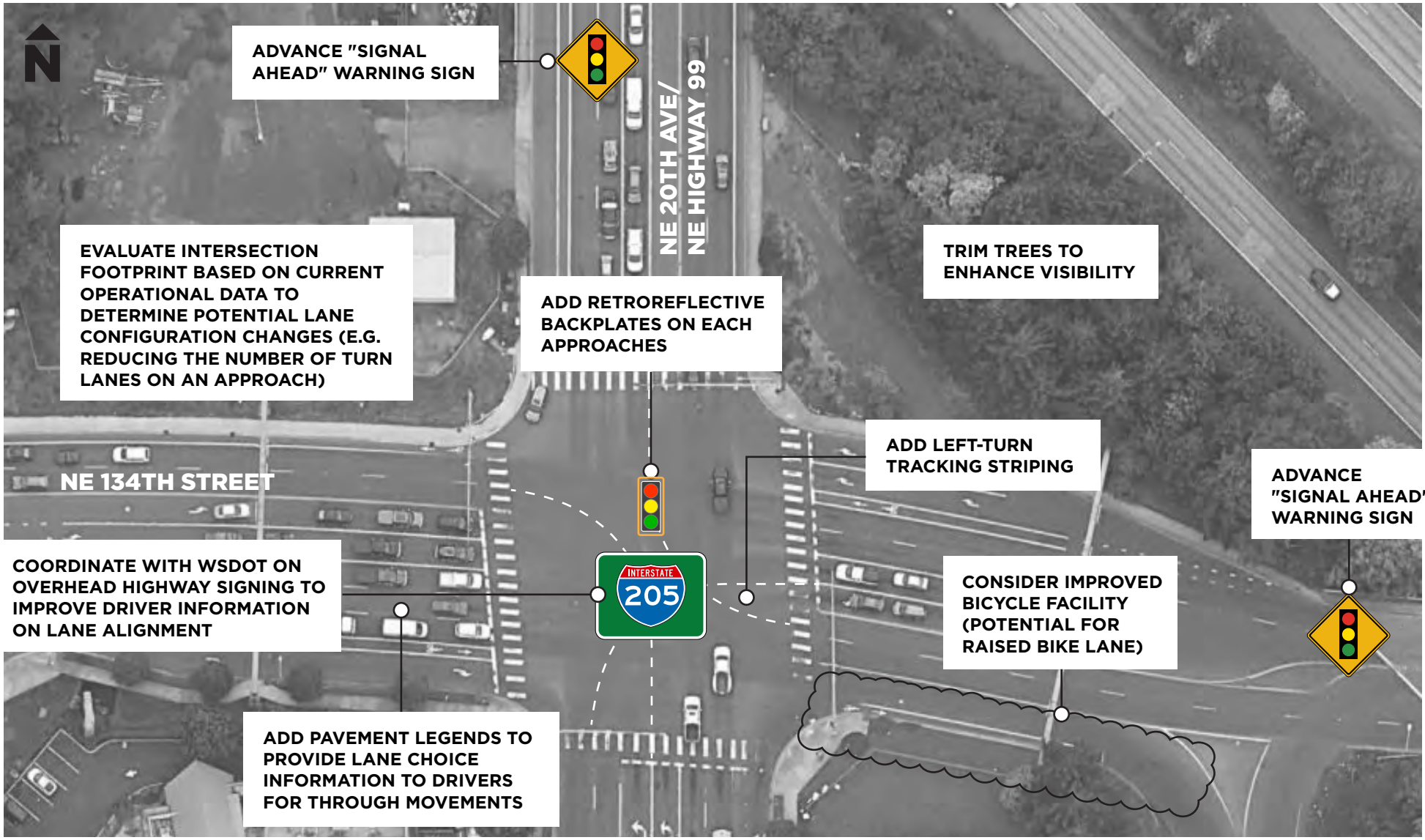

FIGURE 21: **NE 20th Avenue/NE Highway 99 and NE 134th Street**
NE 20th Avenue/NE Highway 99 Corridor

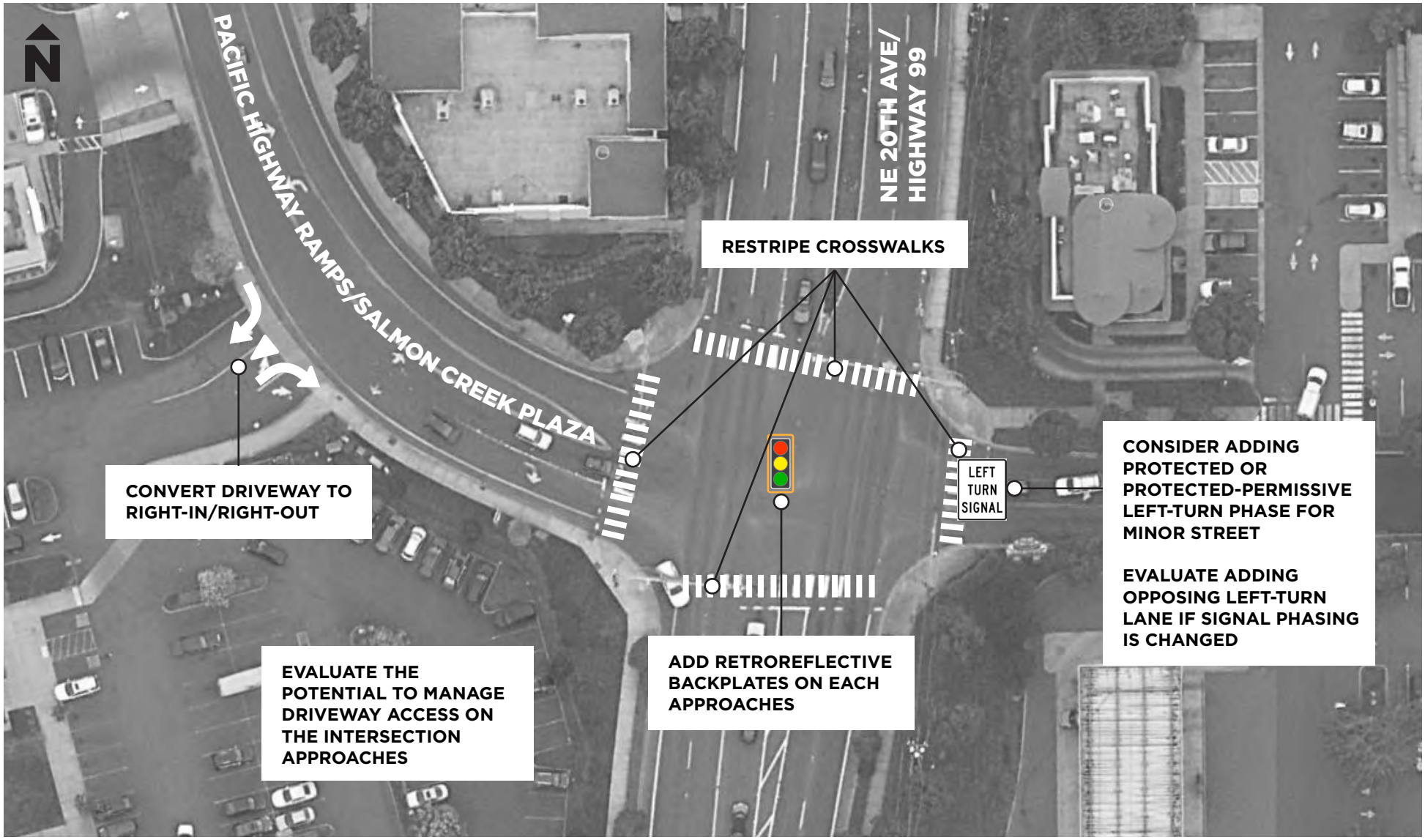

FIGURE 22: **NE 20th Avenue/NE Highway 99 and Pacific Highway Ramps/Salmon Creek Plaza**

NE 20th Avenue/NE Highway 99 Corridor

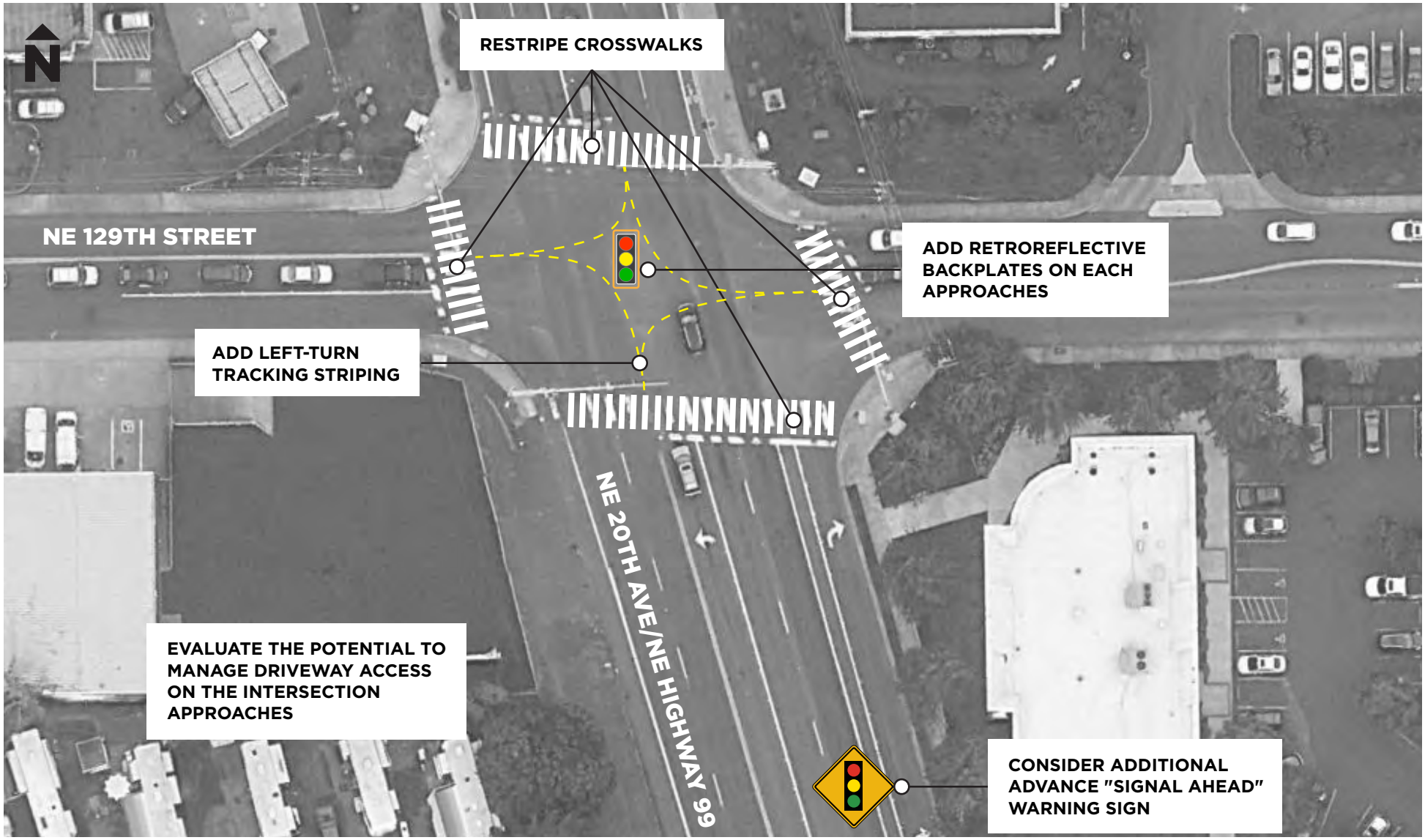

FIGURE 23: **NE 20th Avenue/NE Highway 99 and NE 129th Street**
NE 20th Avenue/NE Highway 99 Corridor

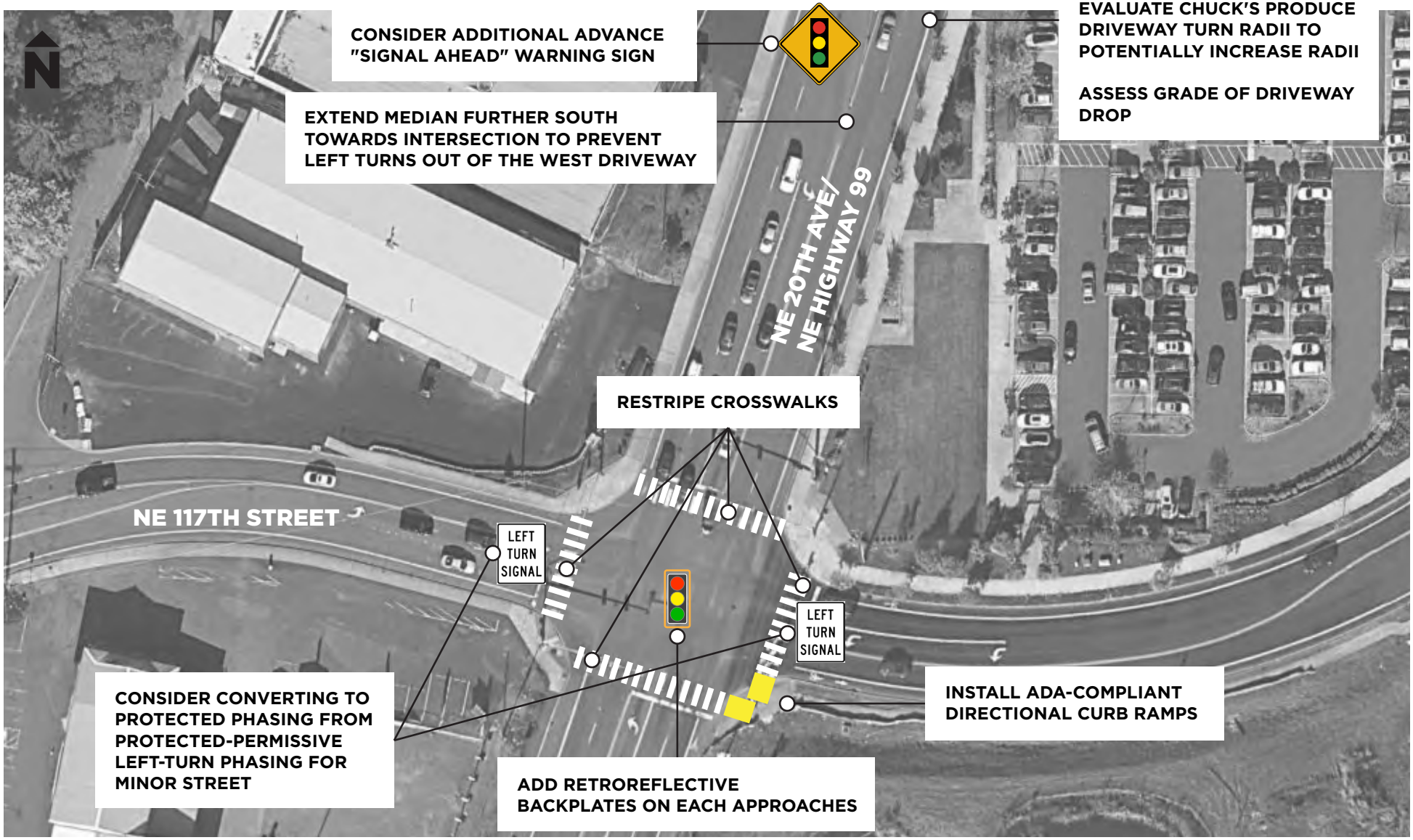

FIGURE 24: **NE 20th Avenue/NE Highway 99 and NE 117th Street**
NE 20th Avenue/NE Highway 99 Corridor

NE 78th Street (Urban Signalized Intersection Corridors)

Corridor Description

NE 78th Street was identified through the Urban Signalized Intersection priority location analysis and subsequent input from County staff. The segment extends from NE Saint Johns Road to NE 47th Avenue and is approximately 800 feet long. The segment consists of two signalized intersections with four through lanes (two in each direction) with left-turn auxiliary lanes on each approach. The corridor has low density commercial and civic land uses surrounding it. The NE 78th Street and NE 47th Avenue intersection has an at-grade rail crossing running north-south through the intersection.

Crash History

There were 66 reported crashes along the corridor during the study period, of which, 57 occurred within 250 feet of an intersection. These crashes include:

- 24 injury crashes
    - 3 severe injury
- 18 night crashes
- 1 single-vehicle crashes (fixed object crash)
- 2 vulnerable road user crashes (both vehicle-pedestrian crashes)
- 63 multi-vehicle crashes
    - 22 with one vehicle entering at an angle
    - 28 rear-end crashes
    - 6 with vehicles colliding from opposite directions (all of which were left-turning related crashes)
    - 3 sideswipe crashes

Corridor Treatments

Kittelson selected the following corridor treatments to reinforce the presence and visibility of a signalized intersection and to clarify intersection movements. Figure 25 shows specific treatments for the NE 78th Street and NE Saint Johns Road intersection. The crash history evaluated as part of the SSIP did not identify crash patterns resulting in potential for countermeasures at NE 78th Street and NE 47th Avenue. The treatments proposed along this corridor include:

- Adding retroreflective backplates on all approaches
- Installing or relocating advance “Signal Ahead” warning signs, as needed
- Adding intersection left-turn tracking striping

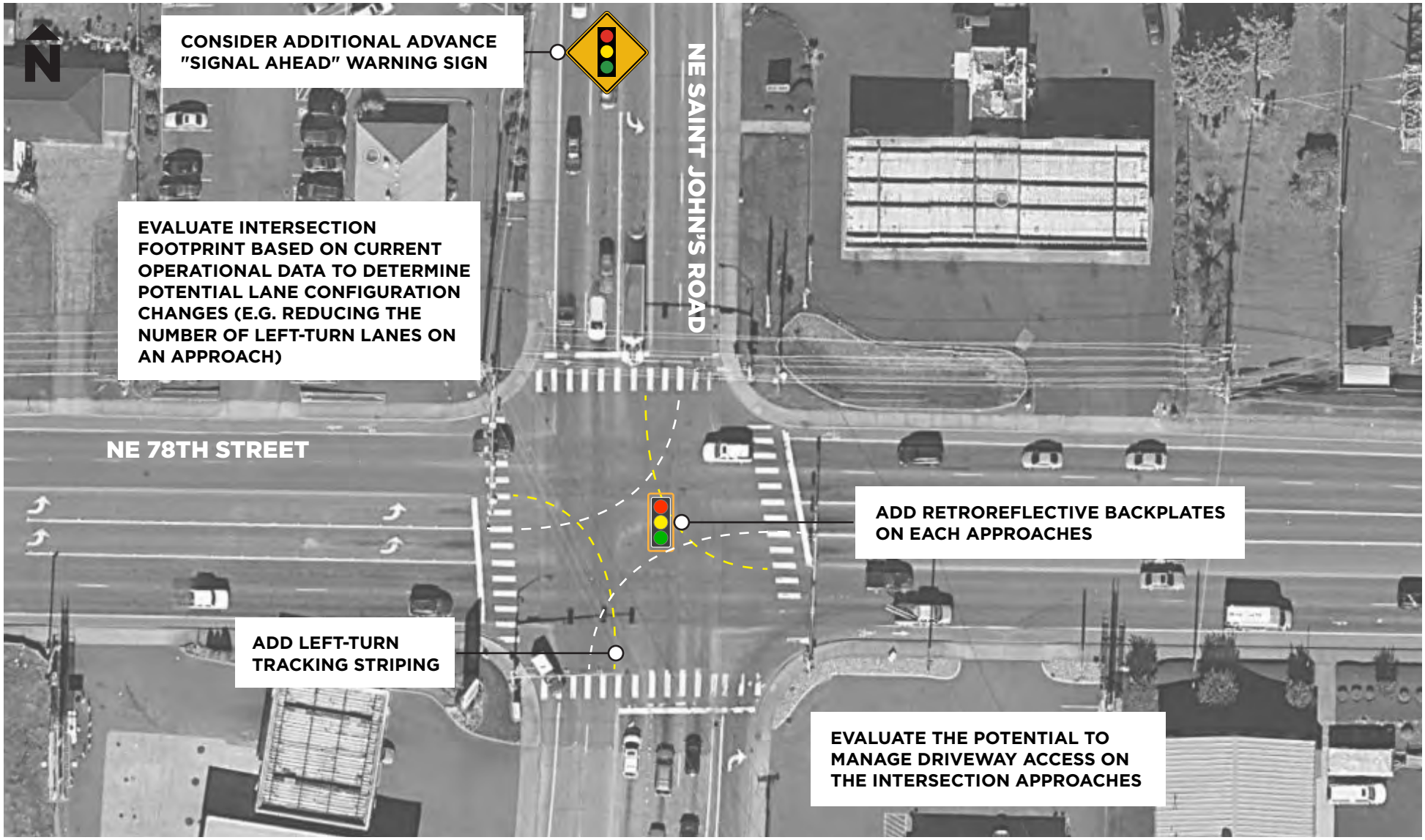

FIGURE 25: **NE 78th Street and NE Saint John's Road**
NE 78th Street Corridor

Additional Urban Signalized Intersection Considerations

In addition to the noted systemic treatments, we identified the potential at several locations to evaluate the overall intersection footprint and manage access on the intersection approaches to potentially reduce roadway conflicts. Opportunities for these considerations have been added, where appropriate, to Figure 21 through Figure 25.

Intersection Footprint Evaluation: Intersections with multiple turn lanes could be evaluated to determine the feasibility of potentially reducing the number of lanes for any given movement. Eliminating lanes could reduce overall intersection footprint, simplify intersection movements, and increase the visibility of potential conflicts.

Access Management: The County could also consider the potential to manage driveway access on the intersection approaches. Several of the intersections have multiple driveways within 250 feet of the intersection. Consolidating, reducing, or controlling driveway movements within the intersection influence area could help clarify or reduce potential conflicts on the intersection approaches and departures.

CONCLUSION

This report is the culmination of work completed by Kittelson and Clark County to develop a Systemic Safety Improvement Program (SSIP). The steps described in the report are meant to illustrate a process by which Clark County can continue to review crash data, identify systemic crash risk factors, and consider where and how to proactively address crash risk on County maintained roads. The systemic risk factors identified as part of the SSIP should be revisited on a regular basis (approximately 5-7 years) to monitor potential crash risk changes. Additionally, Clark County should monitor and evaluate sites where systemic safety treatments are implemented to measure and evaluate the effectiveness of the recommended treatments.

EXHIBIT B

Clark County

Transportation Safety Management Program

Final Report

KITTELSON & ASSOCIATES, INC.
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October 2020

INTEROFFICE MEMORANDUM
Transportation Division

Clark County, Washington
Department of Public Works

TO: Ahmad Qayoumi, P.E., County Engineer
CC: Matt Griswold, P.E., Traffic Engineering Manager
Rob Klug, P.E., Transportation Division Manager, Traffic Engineer
FROM: Ejaz Khan, P.E., Traffic Engineer
Courtney Furman, P.E., Traffic Engineer
DATE: December 1, 2020
SUBJECT: Transportation Safety Management Program

Clark County Traffic Engineering section has established a comprehensive Safety Program that is data-driven and follows the AASHTO's Highway Safety Manual (HSM), for the entire county. The program's primary goals are to screen, and rank safety-focused projects based on HSM performance measures, and to identify and evaluate safety improvements based on established HSM criteria. The "Transportation Safety Management Program" (TSMP) was developed in 2016 and it is currently on the second round of ranking, prioritizing and project development. This document provides a formal summary to outline the methodology and processes utilized in establishing the TSMP, since such a document was not compiled during the first iteration.

The TSMP is a safety-based approach, which focuses on identifying safety locations based on historic safety performance. The county's TSMP strategically selected four "Safety Performance Measures" from the AASHTO's HSM, to screen the network and to identify and rank the top 5% safety locations, including intersections and roadway segments. This innovative approach removed potential bias in screening the safety locations. The adopted performance measures allowed us to screen sites from distinct reference populations and to evaluate the results. The results provided us a ranked list of sites having the greatest potential of reducing crash frequency and severity. The program screens and ranks the worst performing traffic safety locations via an objective process that is based on science and empirical evidence.

Highway Safety Manual is the core philosophy for our safety management plan. One of the salient features of the HSM is that it provides a mathematical value in terms of nominal or quantitative safety. Whereas a traditional safety management plan requires us to make nominal improvements based on design standards, the HSM justifies substantive safety improvements based on roadway safety performance, qualified in terms of crash rate or crash frequency, etc. This approach allows us to make incremental safety improvements afforded by the safety budget and is line with Washington State Department of Transportation's philosophy of "Flexibility in Design".

Clark County Transportation Safety Management Program

Final Report

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Project No. 20717.016.001

October 2020

Contents

Introduction

Clark County (County) developed its Transportation Safety Management Program (TSMP) in 2015 to create a data-driven approach to identify, program, and implement safety-focused projects. This report documents the results of the 2017 analysis following the TSMP process. County staff conducted the 2017 TSMP analysis and has retained Kittelson & Associates, Inc. (Kittelson) to document the results.

From the analysis results, the County identified 15 intersection and 10 segment priority locations for potential safety improvements using five years of crash data covering January 1, 2013 to December 31, 2017. For the 15 priority intersections, the County identified and documented countermeasures with the greatest potential to address the crash patterns and trends. The countermeasures for 10 segment priority locations will be developed by the County at a later date. The 2017 TSMP analysis report documents the County's work through the first three phases of the process. The County will conduct additional project development and project ranking in future phases as staff time and funding permit.

REPORT STRUCTURE

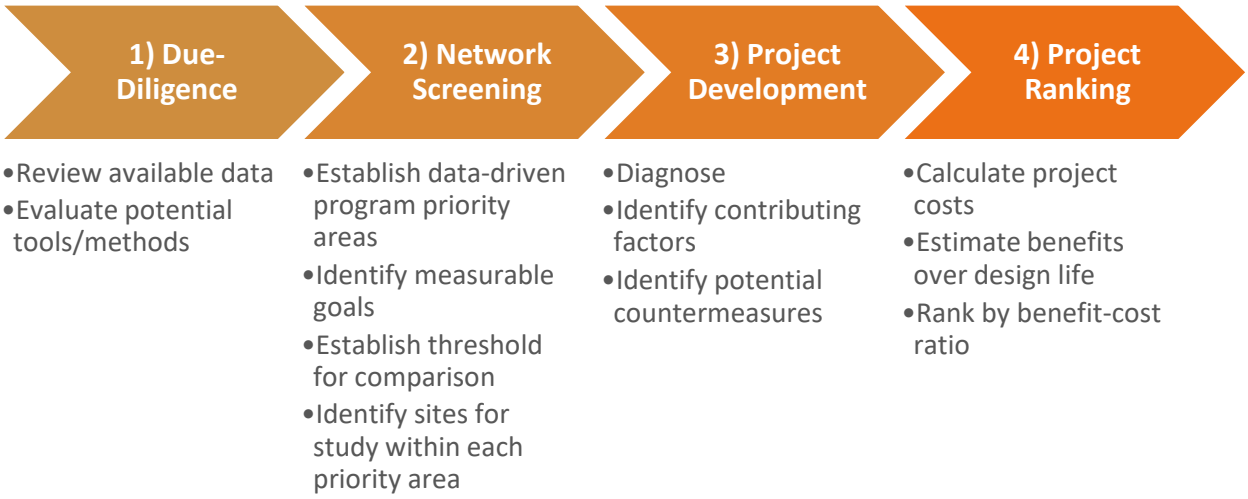
The TSMP Report is structured into the following four sections:

- **TSMP Methodology Summary:** This section summarizes the overall methods of the TSMP process.
- **Network Screening:** This section describes the reference populations, network screening process, performance measures, scoring methodology, and analysis results of the network screening phase of the 2017 analysis.
- **Initial Project Development:** This section presents the 2017 analysis priority locations and initial project development. The County developed summary sheets for each priority intersection and one segment location. These are documented in **Appendix C: Summary Sheet for Intersections** and **Appendix D: Summary Sheet for Segments**, respectively.
- **Conclusion:** The final section outlines next steps in the TSMP process based on the 2017 Analysis Results priority locations.

TSMP Methodology Summary

The TSMP uses a four-phase process to identify, develop, and rank safety projects for implementation based upon the County's available funding. It also identifies locations with the potential for safety improvements and focus funding on investments with the greatest potential for crash reduction. Figure 1 shows the four phase TSMP process from due diligence checks to ranking potential safety projects based on the expected benefit-cost ratio. Each phase of the TSMP process is briefly summarized below.

Figure 1. Clark County Transportation Safety Management Program Framework



Source: Clark County and Kittelson & Associates, Inc., 2015.

DUE DILIGENCE

The Due Diligence phase of the TSMP process is an opportunity at the start of each cycle of TSMP evaluation to consider currently available data and established methodologies to determine if any changes to the TSMP process are warranted. This consists of determining if newly available data could augment the TSMP evaluation or consideration of new or updated performance metrics or evaluation methodologies.

NETWORK SCREENING

The Network Screening phase uses a series of safety performance measures from the AASHTO *Highway Safety Manual, 1st Edition* (HSM) to evaluate the frequency, severity, and type of crashes occurring at intersections and along roadway segments in Clark County. The network screening process uses the most recent five years of crash history as well as available traffic volume and roadway inventory data to calculate four safety performance metrics for every intersection and roadway segment in Clark County jurisdiction.

These safety performance metrics are calculated for a series of reference populations based on roadway classification and land use type. After the initial performance measure calculation, locations are prioritized across all reference populations with the most promising locations for safety improvements moving into

the Project Development phase. The network screening process and the 2017 network screening results are described in more detail in the Network Screening section.

PROJECT DEVELOPMENT

The Project Development phase evaluates the priority locations identified in the network screening. The phase consists of diagnosing historic crash trends and patterns, conducting field reviews of roadway and intersection characteristics, and observing road user behavior at each priority site. For the 2017 analysis, County staff documented potential safety treatments to address any identified crash patterns or safety improvement opportunities at each priority intersection site. Crash patterns were identified for segment locations, but further project development will occur at a later date for the priority segments. The intersection and segment project development analysis and recommendations are documented in the Initial Project Development section of the report.

PROJECT RANKING

The TSMP Project Ranking phase evaluates the expected safety benefits and project costs to rank the identified safety improvement projects. Safety benefits were quantified per the societal costs established in the WSDOT Safety Analysis Guide (2017). The WSDOT societal costs are shown in Table 1. The ranking is achieved by calculating the expected crash reduction at each site using safety performance functions and crash modification factors. Planning-level cost estimates are then calculated and a benefit-cost ratio for each safety improvement project is calculated by dividing the estimated the cumulative safety benefits (based on the improvements' expected design life) by the project cost. This phase of the TSMP process was not covered by the 2017 analysis. It is anticipated that the Project Ranking phase will be conducted following future analysis of the priority locations identified in this report.

Table 1. WSDOT Societal Costs by Crash Severity

Code	Crash Severity Level	Crash Cost
K	Fatal	$3,423,400
A	Suspected Serious Injury	$3,423,400
B	Suspected Minor Injury	$237,400
C	Possible Injury	$142,300
O	Property Damage Only	$14,800

Source: WSDOT Safety Analysis Guide, 2017.

Due Diligence

The Due Diligence phase provides the opportunity at the start of each evaluation cycle to consider currently available data and established methodologies to determine any warranted changes. As part of this phase, the performance measure scoring for prioritization process were updated. These updates reflect adjustments to the original TSMP scoring to provide better differentiation between the sites evaluated. The relative weight between scoring categories was also adjusted to provide slightly less emphasis on fatal and severe injury crash frequencies and slightly more emphasis on exceeding the priority crash types. These changes are reflected in Table 1 in the Network Screening section of the report but are summarized briefly below:

- **Critical Crash Rate:** The scoring for this evaluation criterion was updated to index the scoring of the performance metric to the location with the highest critical crash rate ratio value. This update allows for greater differentiation in scoring across all sites instead of only scoring locations with a value of one or zero.
- **Fatal and Severe Injury Crash Frequency:** This criterion was updated to provide more variation in the scoring by varying the applied score based on the frequencies of fatal and severe injury crashes. The revised scoring provides four scoring classifications where previously there were only two. The overall score for this criterion was also lowered from a maximum of two points to a maximum of 1.5 points.
- **Crash Type Proportion:** The scoring for this criterion was modified to score the sites consistent with the Transportation Improvement Program and consider multiple crash type proportions for intersections and segments. The scoring was revised to consider the primary crash type (**angle crashes** for intersections, and **opposite direction** and **fixed object** crashes for roadway segments) as well as all other crash types with the primary crash types receiving a higher score when exceeded. The overall score for this criterion was also raised from a maximum of one point to a maximum of 1.5 points.
- **Equivalent Property Damage Only:** The scoring for this evaluation criterion was updated to index the scoring of the performance metric to the location with the highest equivalent property damage only score. This update allows for greater differentiation in scoring across all sites instead of only scoring locations with a value of one or zero.

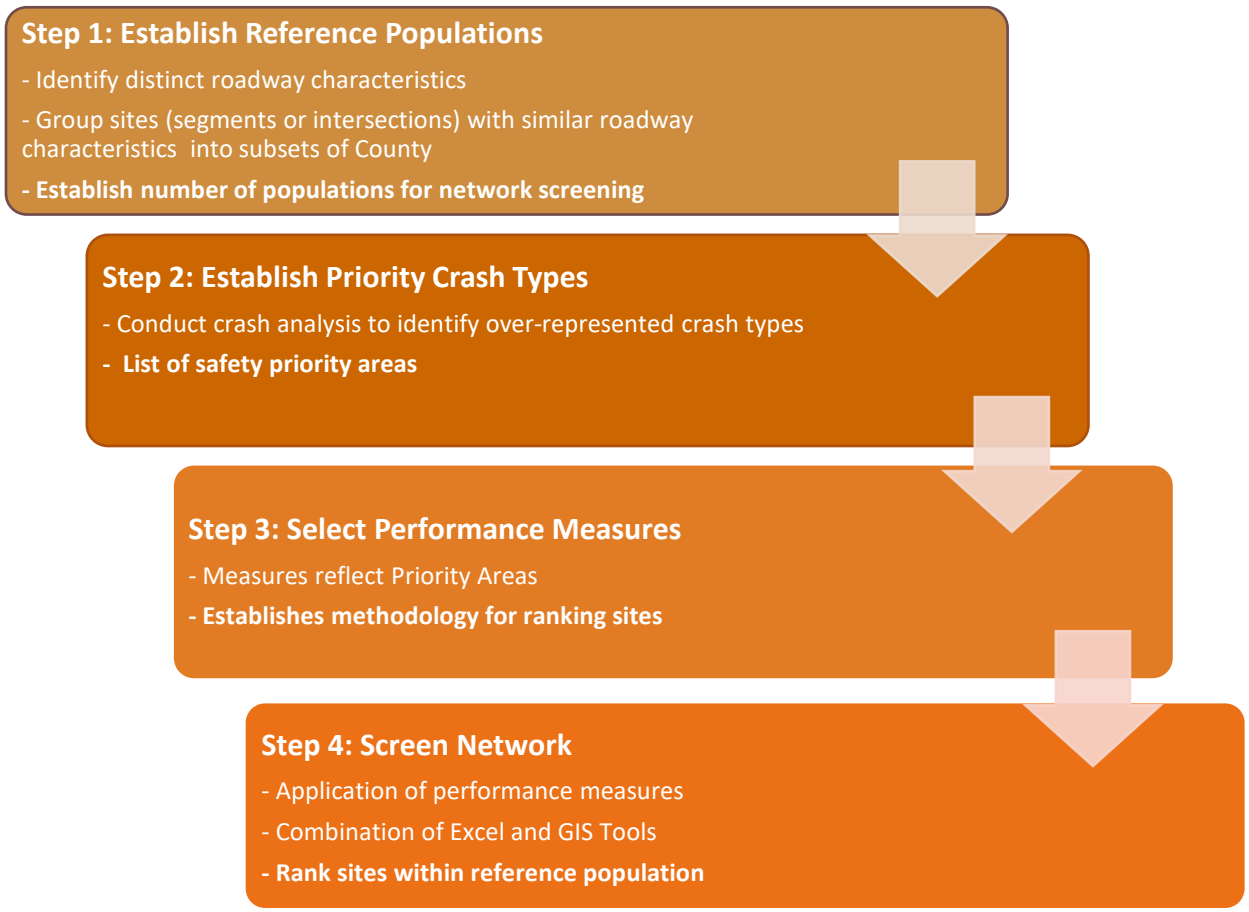
Network Screening

The objective of the network screening phase is to rank roadway segments and intersections based on the crash history. County staff used the most recent five-year crash data (2013-2017) and available roadway characteristic data to evaluate the safety performance of every county-maintained intersection and roadway using four safety performance metrics. This section describes the TSMP network screening methodology and presents the crash rate and equivalent property damage only (EPDO) score results of the network screening for each reference population.

METHODOLOGY

Figure 2 shows the four-step TSMP network screening process. This process follows the approach recommended in Chapter 4 of the HSM. The first three steps determine the populations, crash types, and performances measures to be used. The fourth step applies the performance metrics and prioritizes the locations with the highest potential for safety improvements to move forward for project development consideration. The bold, bulleted text indicates the outcomes of each step. Each step is described in the following subsections.

Figure 2: Network Screening Process

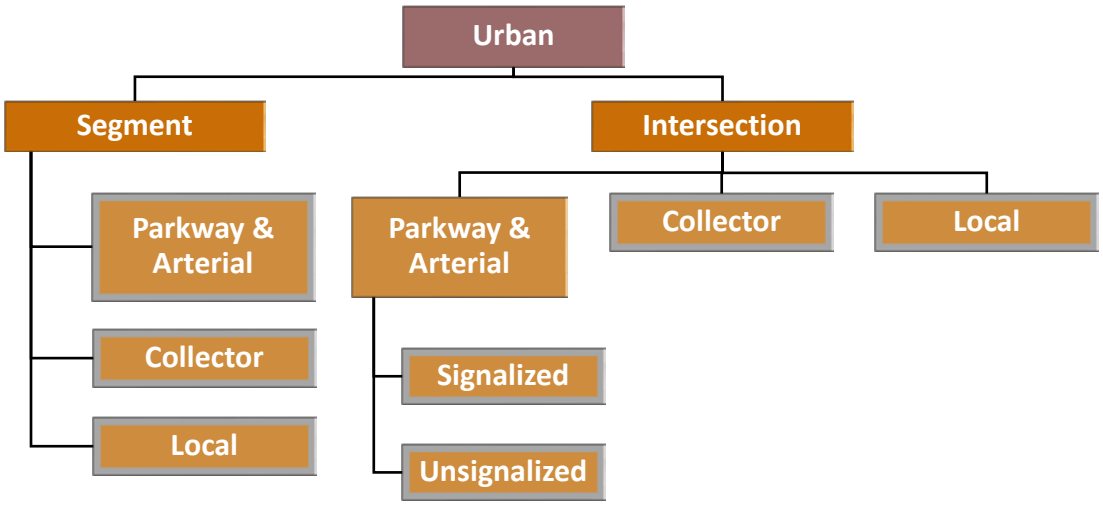


Source: Clark County and Kittelson & Associates, Inc., 2015.

STEP 1: REFERENCE POPULATION

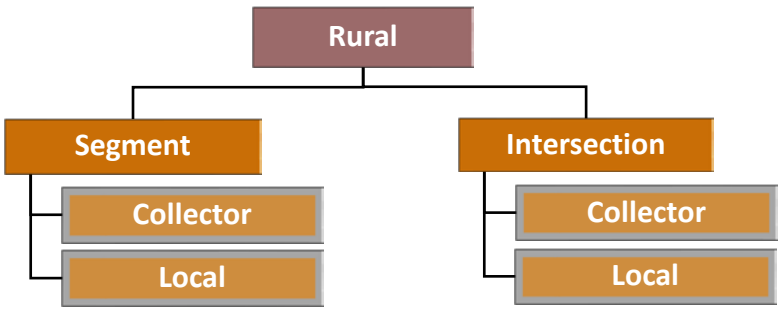
Figure 3 and **Figure 4** show tree diagrams of the reference populations for the urban and rural areas of the county, respectively. Each reference population groups similar facilities together so that common crash and roadway characteristics are taken into consideration in the prioritization process. The seven urban reference populations and four rural reference populations allow the county to prioritize locations with similar characteristics and score locations based on different priority crash types specific to the reference population. Reference populations were developed based on land use context (rural versus urban), roadway classification, and intersection control type for urban parkways and arterials. Signalized intersections were not separated out for other reference populations because of the small population of signalized intersections within those contexts. Roadway segments were analyzed using half-mile "sliding window" analysis segments that were iterated at one-tenth of a mile increments to analyze all roadways in each reference population.

Figure 3. Urban Reference Populations



Source: Clark County and Kittelson & Associates, Inc., 2015.

Figure 4. Rural Reference Populations



Source: Clark County and Kittelson & Associates, Inc., 2015.

STEP 2: PRIORITY CRASH TYPES

The County applied the same priority crash types identified in the *2016 Transportation Safety Management Plan* report (analyzing crashes between 2010-2015) for the 2020 TSMP analysis (analyzing crashes between 2013-2017). Crash characteristics that are prioritized by reference population are summarized below:

- **Crash Severity:** sites with fatal and severe injury crashes for all reference populations
- **Crash Types:** priority crash types for each reference population were identified based on the elevated frequency and severity of those crash types for each specific reference population. The five priority crash types identified are:
  - At Angle Crashes
  - Opposite Direction Crashes
  - Fixed Object Crashes
  - Alcohol-Impaired Crashes
  - Bicycle- and Pedestrian-Involved Crashes

STEP 3: PERFORMANCE MEASURES

County staff identified four safety performance measures to account for crash frequency, severity, and type in the network screening process. The performance measures are described below:

1. **Critical Crash Rate** – This metric accounts for crash frequency and establishes a threshold for comparison across the County based on the overall crash rate for the reference population.
2. **Fatal or Injury A Crash Frequency** – This metric accounts for the presence of one or more Fatal or Injury A crashes at a site, an important consideration for various funding sources and federal safety goals.
3. **Crash Type Threshold Proportion** – This metric identifies locations where the proportion of a specific crash type exceeds a threshold proportion based on the average proportion for the reference population. The priority crash type(s) evaluated varies based on the most frequent crash type for each reference population.
4. **Equivalent Property Damage Only (EPDO) Score** – This metric assigns weighting factors to crashes by severity to develop a combined frequency and severity score for each site.

Prioritization Scoring

County staff identified priority sites within each reference population group to narrow the locations considered for field diagnosis and project development. After calculating the performance metrics for each site in all reference populations, the County scored each site to prioritize across all reference populations.

The primary performance metrics were used to prioritize identify sites where:

1. The crash rate exceeded the critical crash rate for each reference population; and/or,
2. At least one Fatal or Injury A crash was reported during the study period.

County staff then scored the secondary performance metrics for sites that exceeded one or both primary screening performance measures. This screening was based on the crash type threshold proportion method and EPDO threshold. **Table 1** summarizes the evaluation criteria, the associated threshold, and points for each performance measure.

Table 2. Prioritization Criteria and Scoring

Performance Measure		Criteria	Score
Critical Crash Rate		The location with the highest critical crash rate ratio value	1.0
		All other locations	Indexed to the highest value
Fatal or Severe Injury Crash Frequency		No fatal or severe injury crashes	0
		One (1) fatal or severe injury crash	0.5
		Two (2) fatal or severe injury crashes	1.0
		Three (3) or more fatal or severe injury crashes	1.5
Crash Type Proportion[1]	Intersection	Crash type proportion exceeds system-wide average proportion for angle crashes	0.75
		Crash type proportion exceeds system-wide average proportion for all other crash types	0.25 each
	Segment	Crash type proportion exceeds system-wide average proportion for opposite direction AND fixed object crashes	1.0
		Crash type proportion exceeds system-wide average proportion for opposite direction OR fixed object crashes	0.75
		Crash type proportion exceeds system-wide average proportion for all other crash types	0.25 each
Equivalent Property Damage Only (EPDO)		The locations with the highest EPDO score	1.0
		All other locations	Indexed to the highest value
Total			Maximum of 5

Source: Clark County Local Road Safety Plan, 2019.

STEP 4: NETWORK SCREENING

County staff applied the safety performance metrics and prioritization scoring to each site by referenced population using custom GIS analysis scripts and spreadsheet calculations. Network screening was conducted for intersections and segments separately.

- **Intersection Screening:** Crashes reported within 250 feet of an intersection are classified as intersection related. Crashes within this influence area are then associated with each intersection and the safety performance measures are calculated for each site. Each intersection site is then scored and ranked based on the total prioritization score using the criteria in Table 2.
- **Roadway Screening:** Roadways segments are evaluated using the "Sliding Window Method" that uses an analysis length and analysis interval to "slide" over the roadway network associated with each roadway segment reference population. In the sliding window methodology, the roadway network is segmented into overlapping segments equal to the analysis length. The overlap between segments is determined by the analysis interval, with each segment shifting along the

[1] For crash type proportions, a crash type proportion is defined as exceeding the system-wide average proportion if the probability of being statistically significant is above 50 percent.

roadway segment by the analysis interval length. After the segmentation is created, the crashes along each segment are associated with the roadway segment and the safety performance metrics are calculated for every segment. Each roadway segment is then scored and ranked based on the total prioritization score using the criteria in Table 2. Note that because the roadway segments overlap, crashes occurring within the overlap are counted for each overlapping segment in order to identify the segments with the highest potential for safety improvement.

NETWORK SCREENING RESULTS

Using the methodology described above, the County conducted the network screening and prioritization scoring for all 11 reference populations. The network screening results for each reference population by EPDO score and crash rate are shown in **Figure 5** through **Figure 26**. The intersections and segments within the top five percent of prioritization scores were then moved forward into the project development process described in the following section.

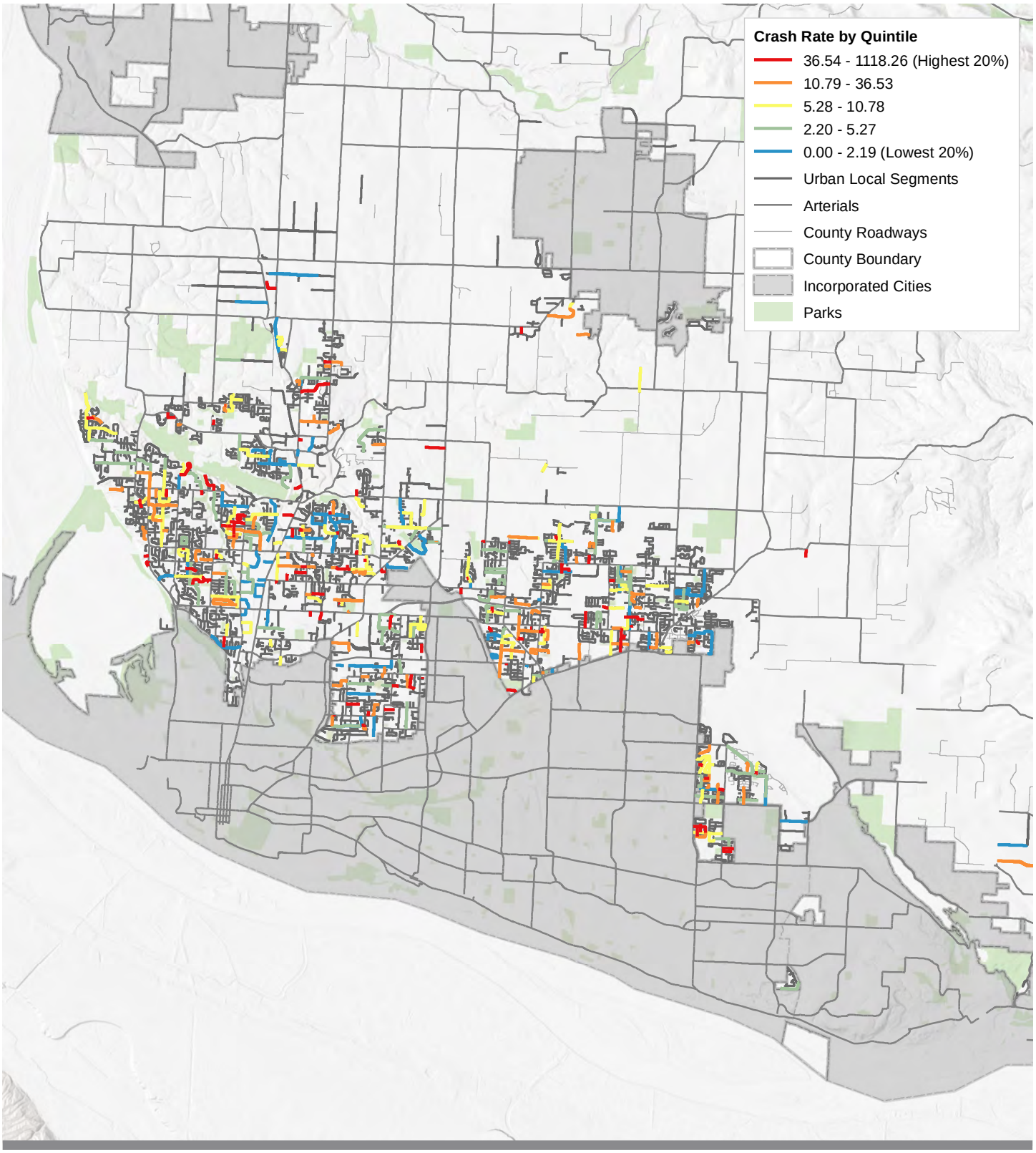


Figure 5

Network Screening Results
Crash Rate
Urban Local Segments Reference Population

KITTELSON & ASSOCIATES

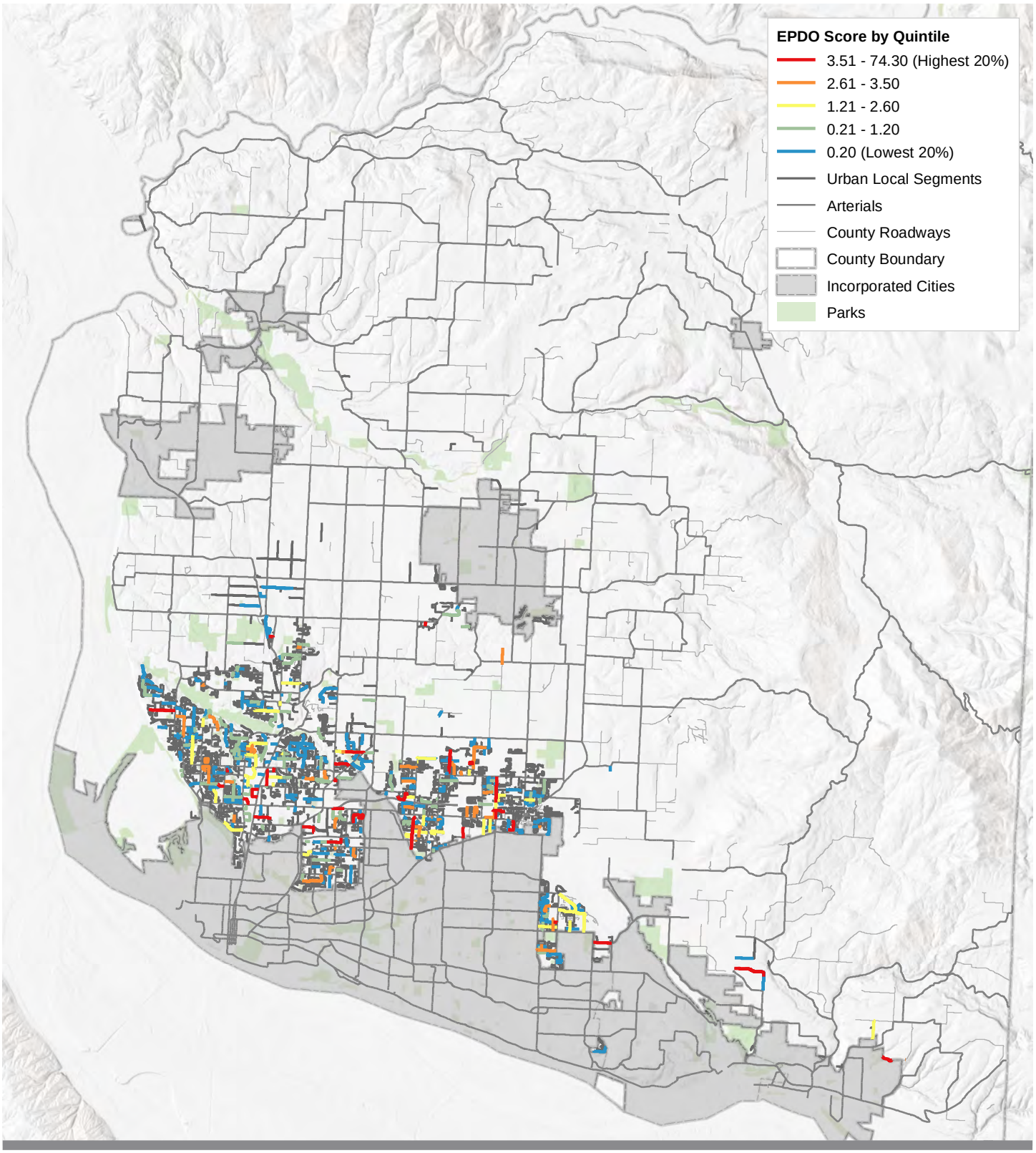


Figure 6

Network Screening Results
Equivalent Property Damage Only Score
Urban Local Segments Reference Population

KITTELSON & ASSOCIATES

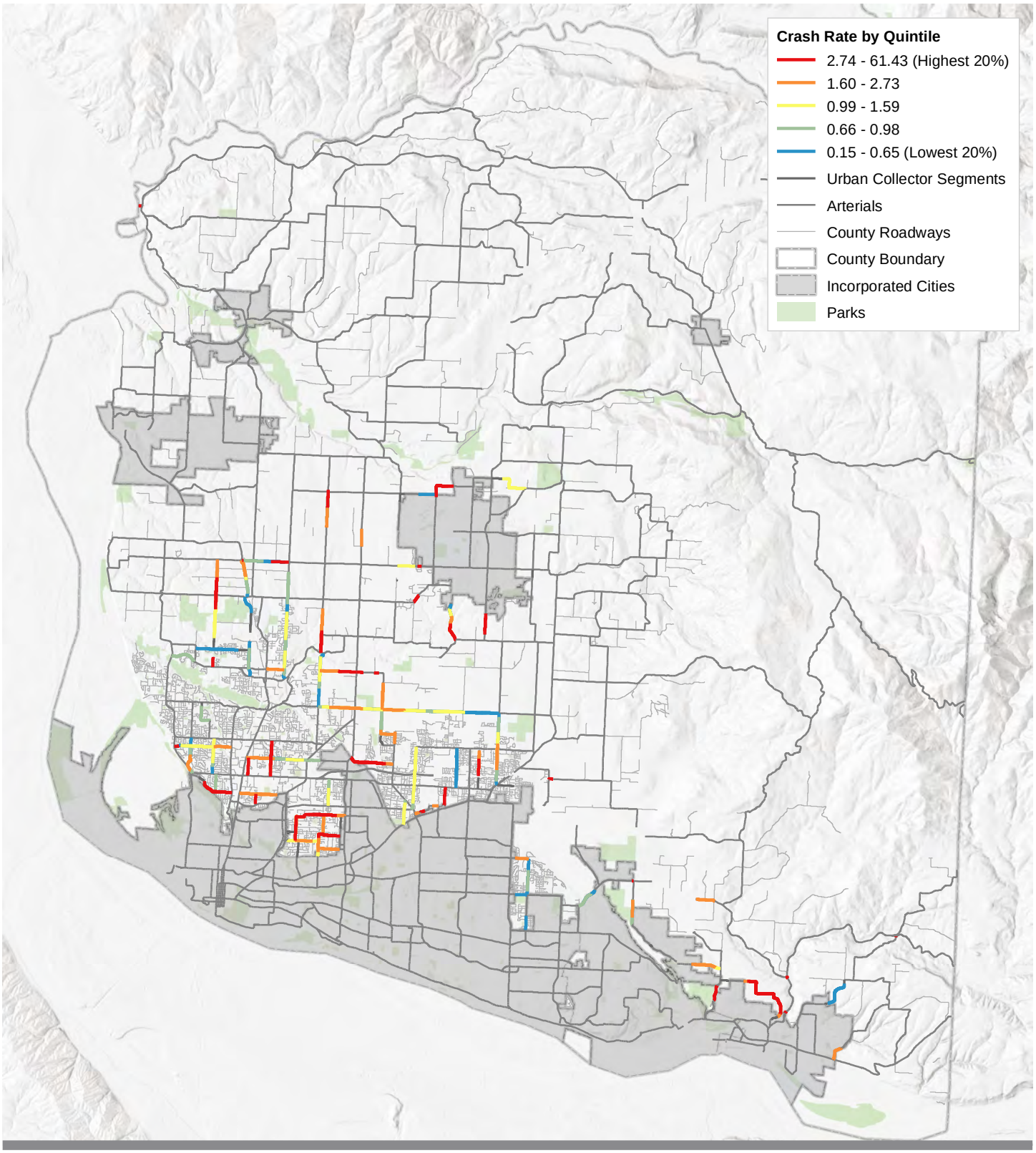


Figure 7

Network Screening Results
Crash Rate
Urban Collector Segments Reference Population

KITTELSON & ASSOCIATES

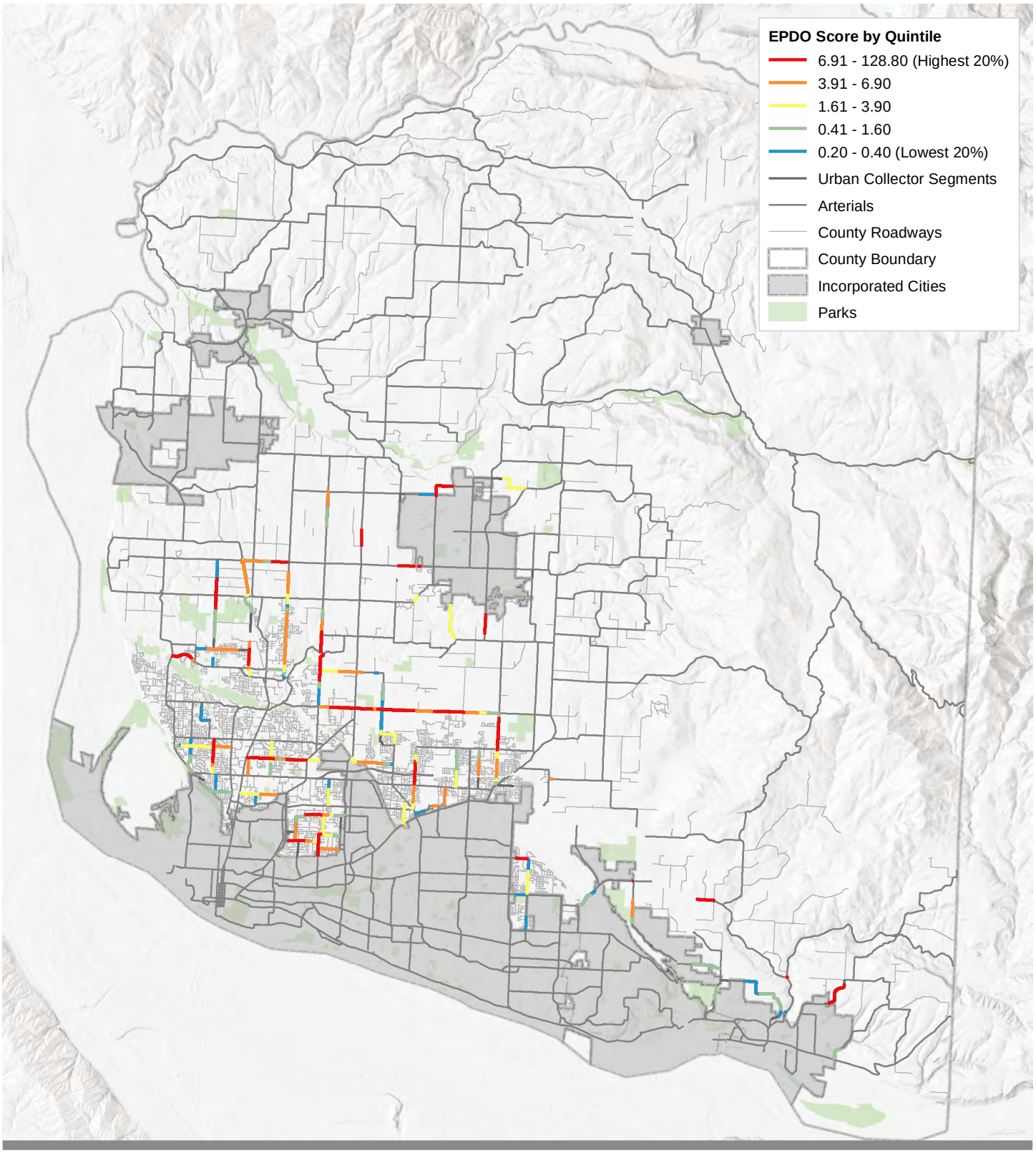


Figure 8

Network Screening Results
Equivalent Property Damage Score
Urban Collector Segments Reference Population

KITTELSON & ASSOCIATES

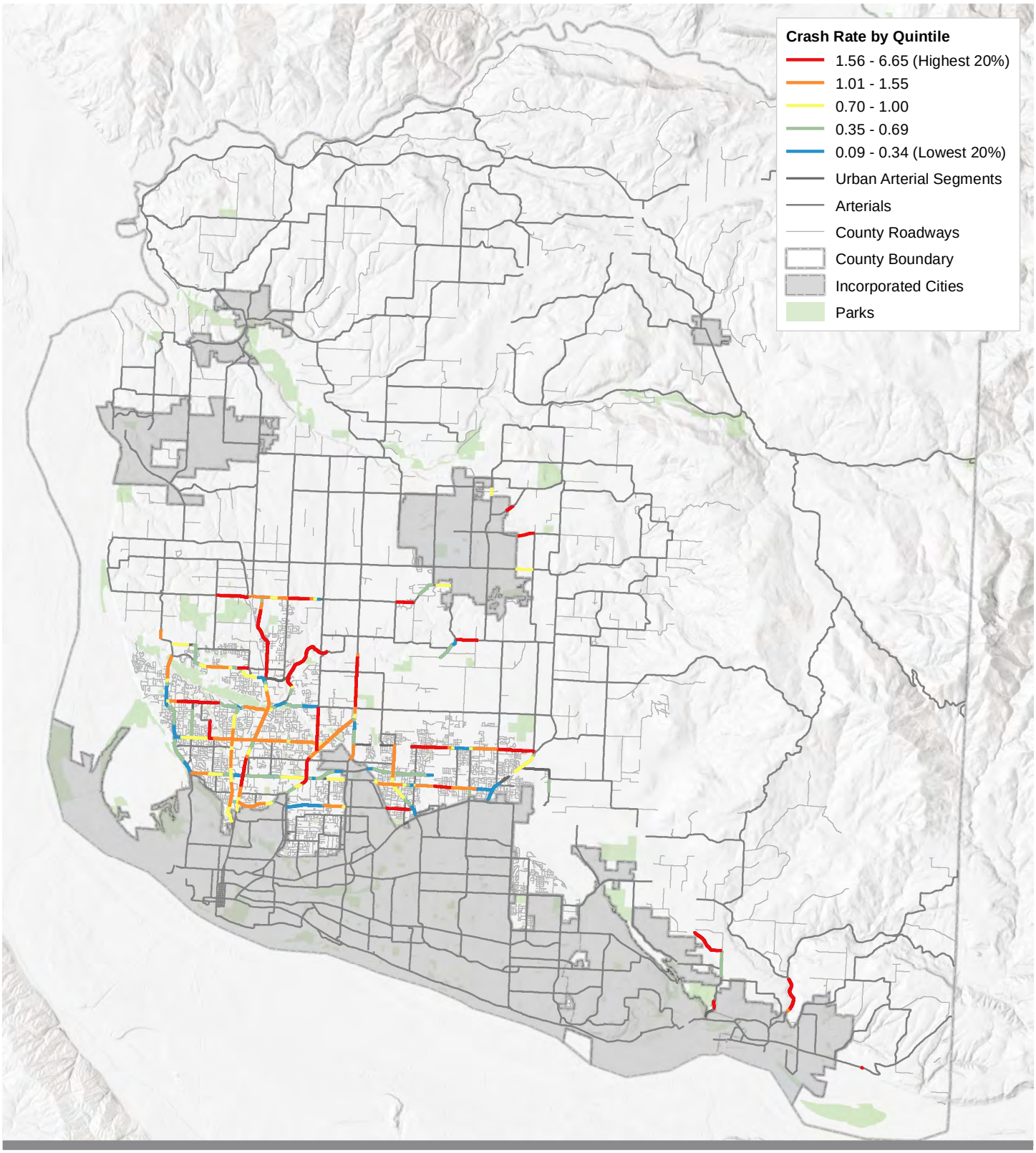


Figure 9

Network Screening Results
Crash Rate
Urban Arterial Segments Reference Population

KITTELSON & ASSOCIATES

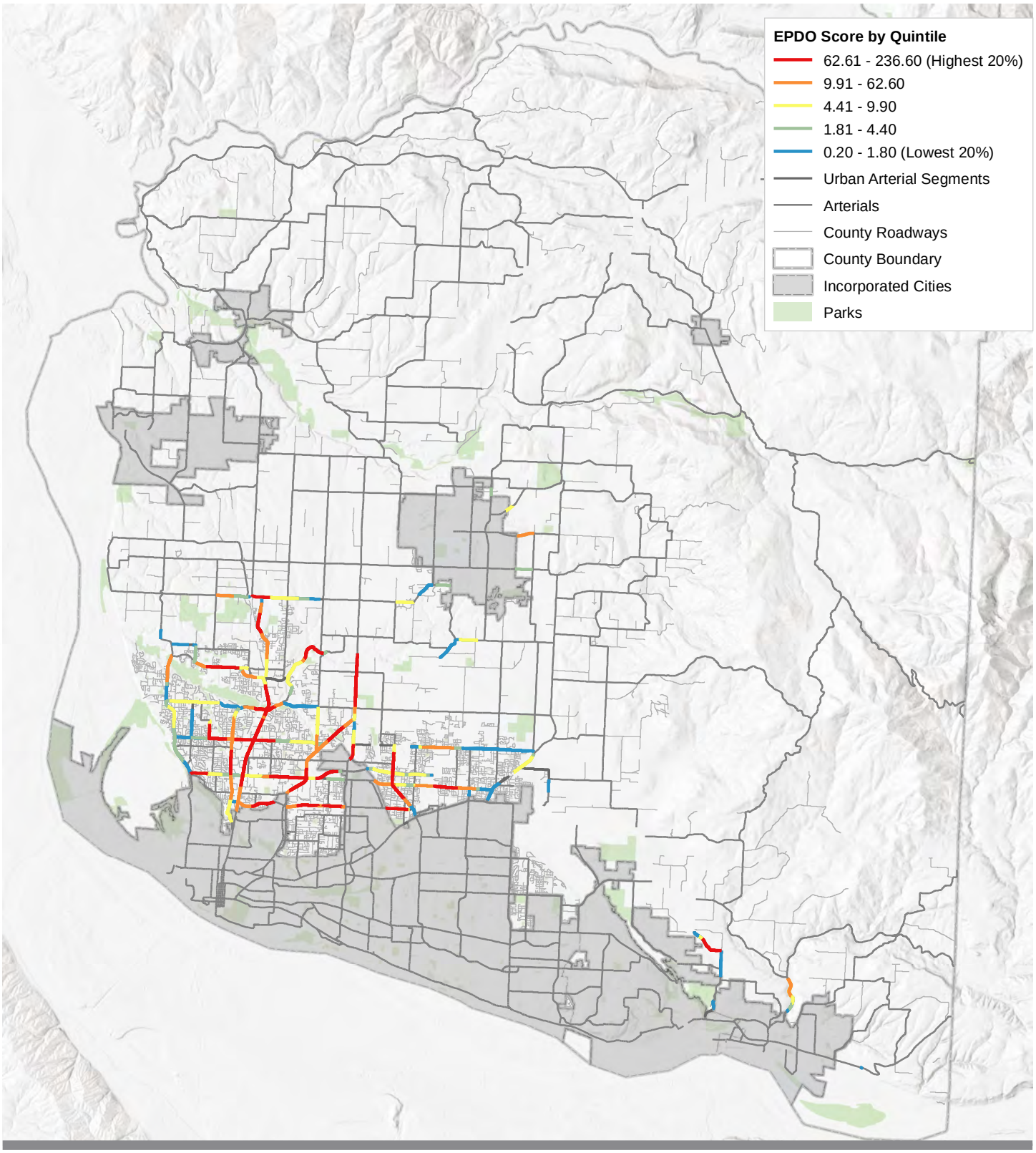


Figure 10

Network Screening Results
Equivalent Property Damage Score
Urban Arterial Segments Reference Population

KITTELSON & ASSOCIATES

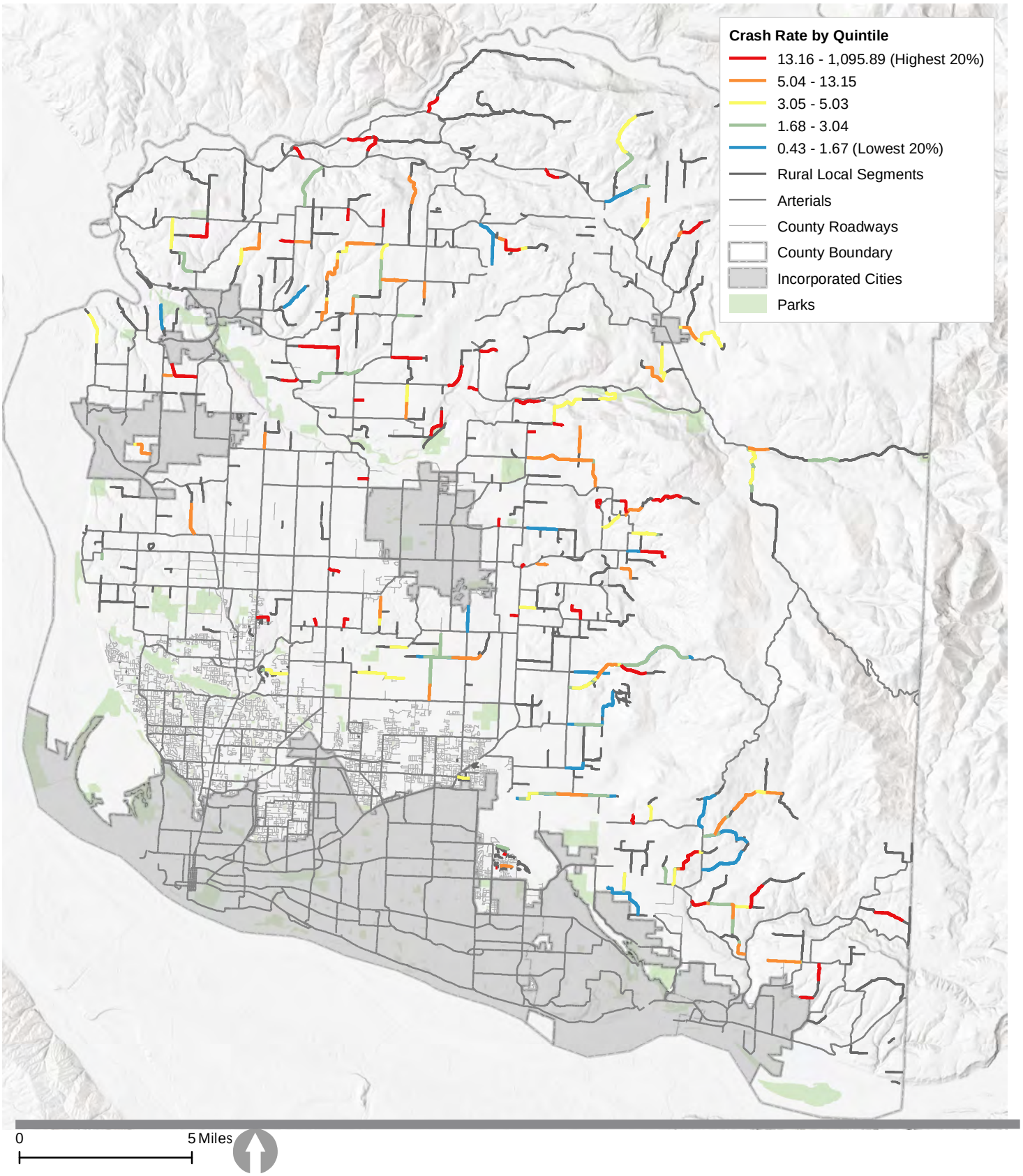


Figure 11

Network Screening Results
Crash Rate
Rural Local Segments Reference Population

KITTELSON & ASSOCIATES

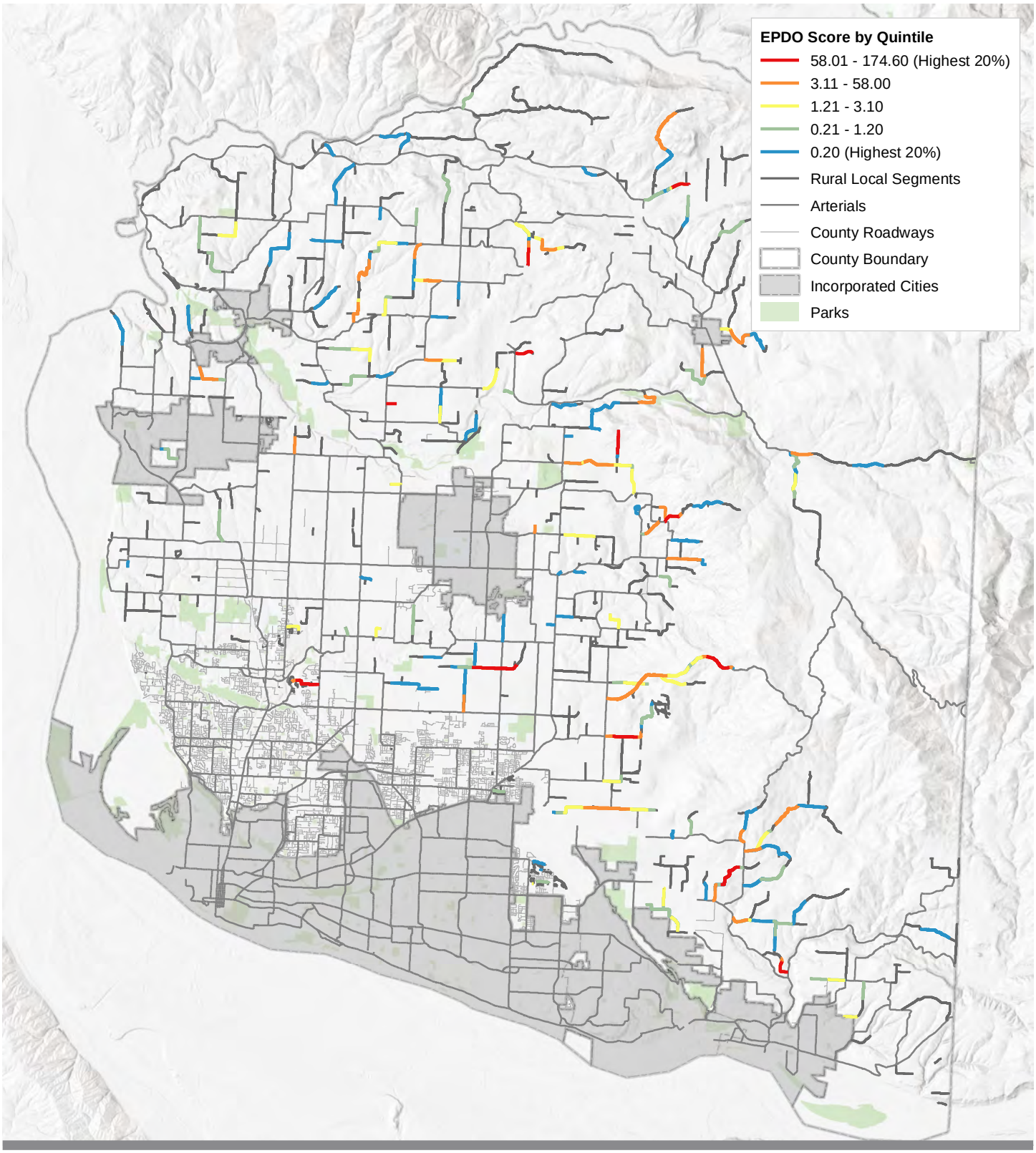


Figure 12

Network Screening Results
Equivalent Property Damage Only Score
Rural Local Segments Reference Population

KITTELSON & ASSOCIATES

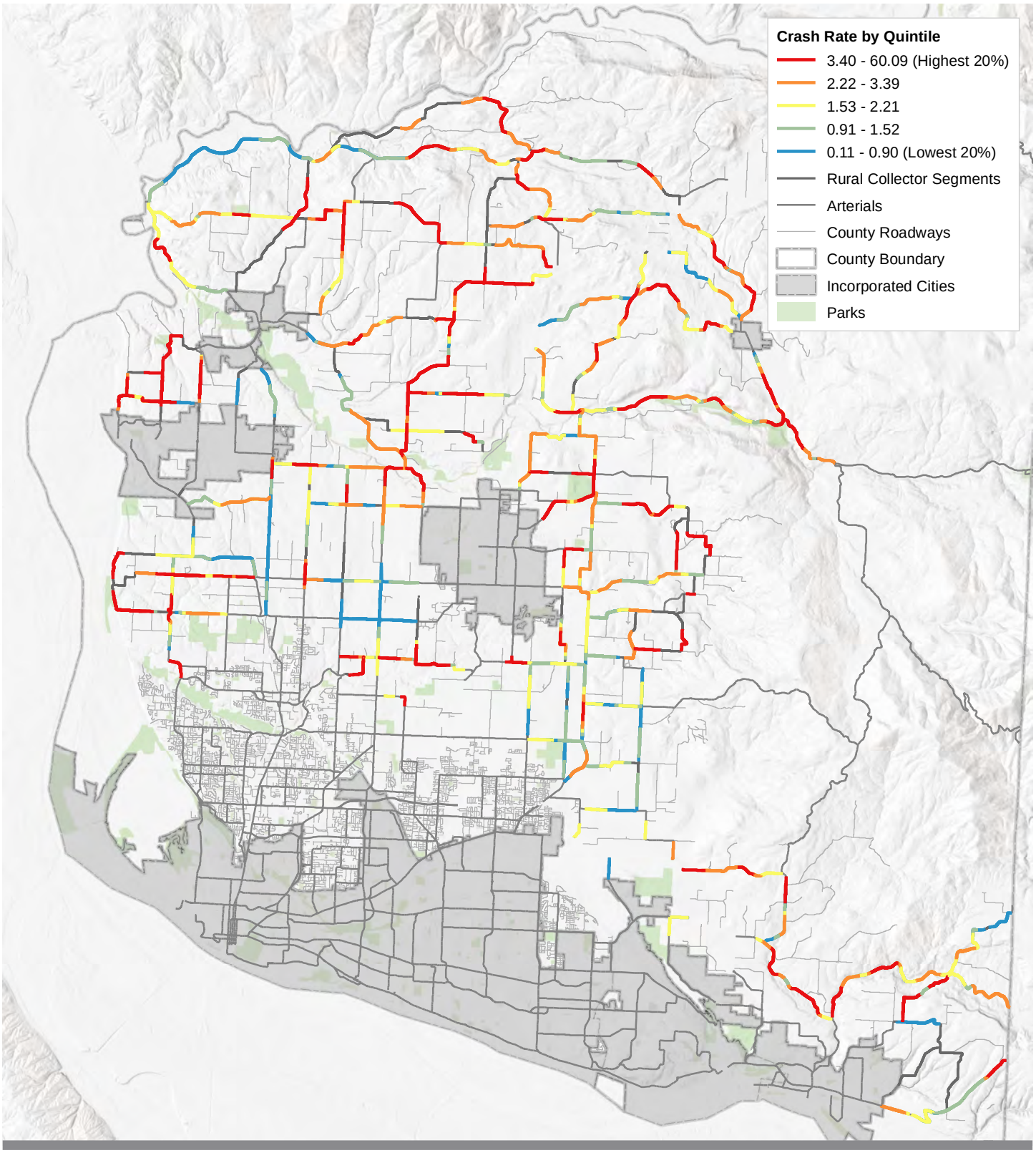


Figure 13

Network Screening Results
Crash Rate
Rural Collector Segments Reference Population

KITTELSON & ASSOCIATES

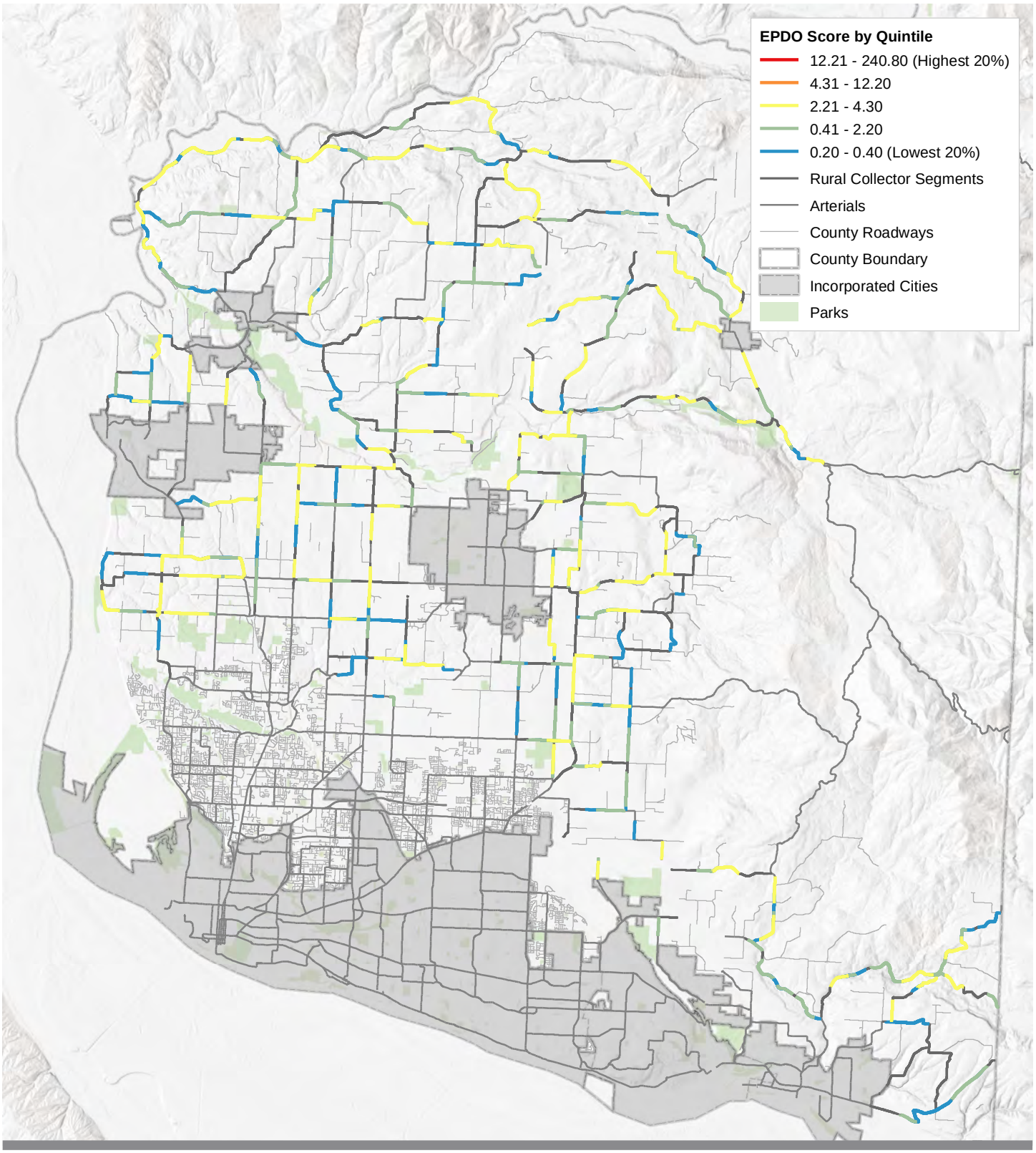


Figure 14

Network Screening Results
Equivalent Property Damage Only Score
Rural Collector Segments Reference Population

KITTELSON & ASSOCIATES

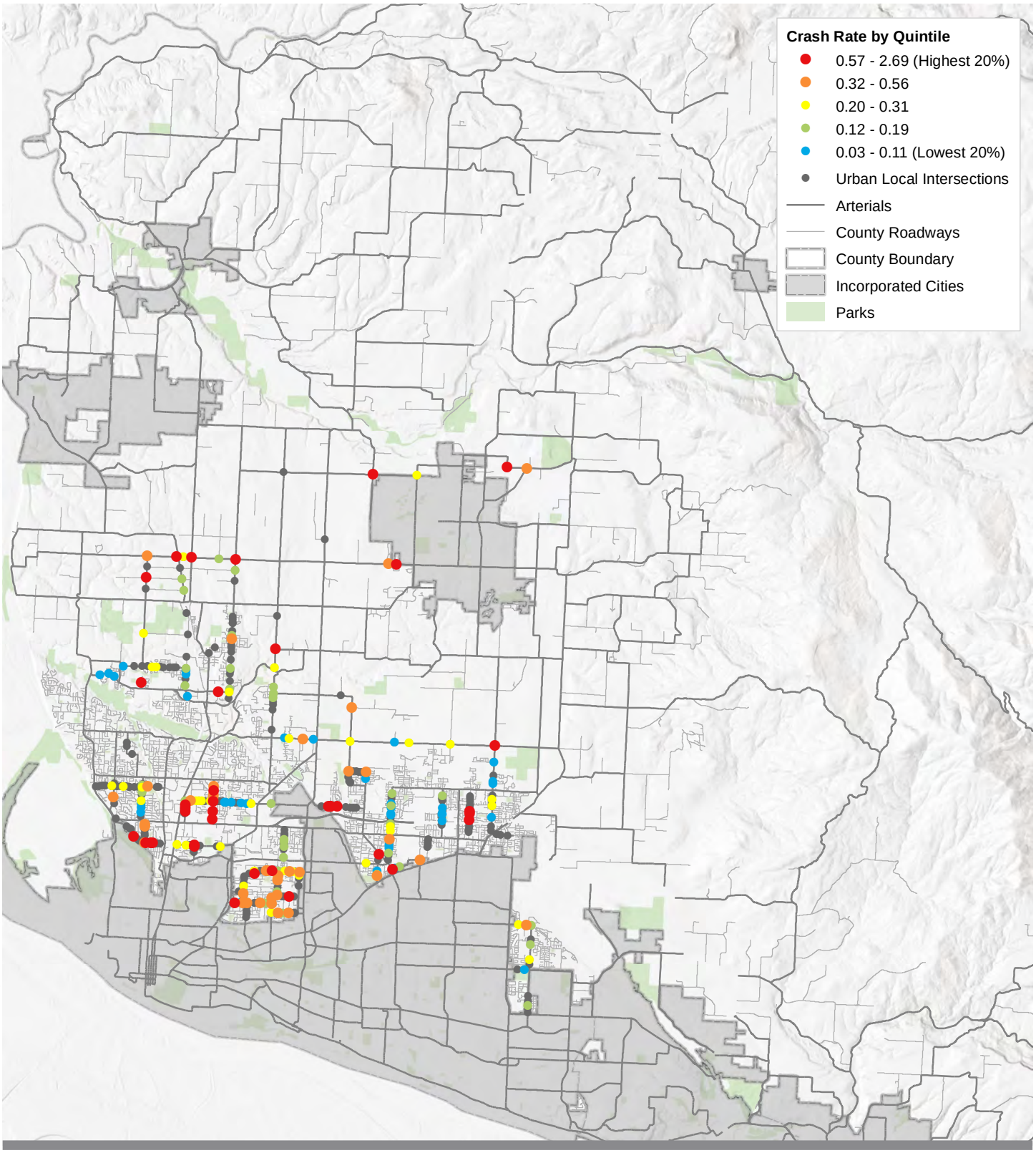


Figure 15

Network Screening Results
Crash Rate
Urban Local Intersections Reference Population

KITTELSON & ASSOCIATES

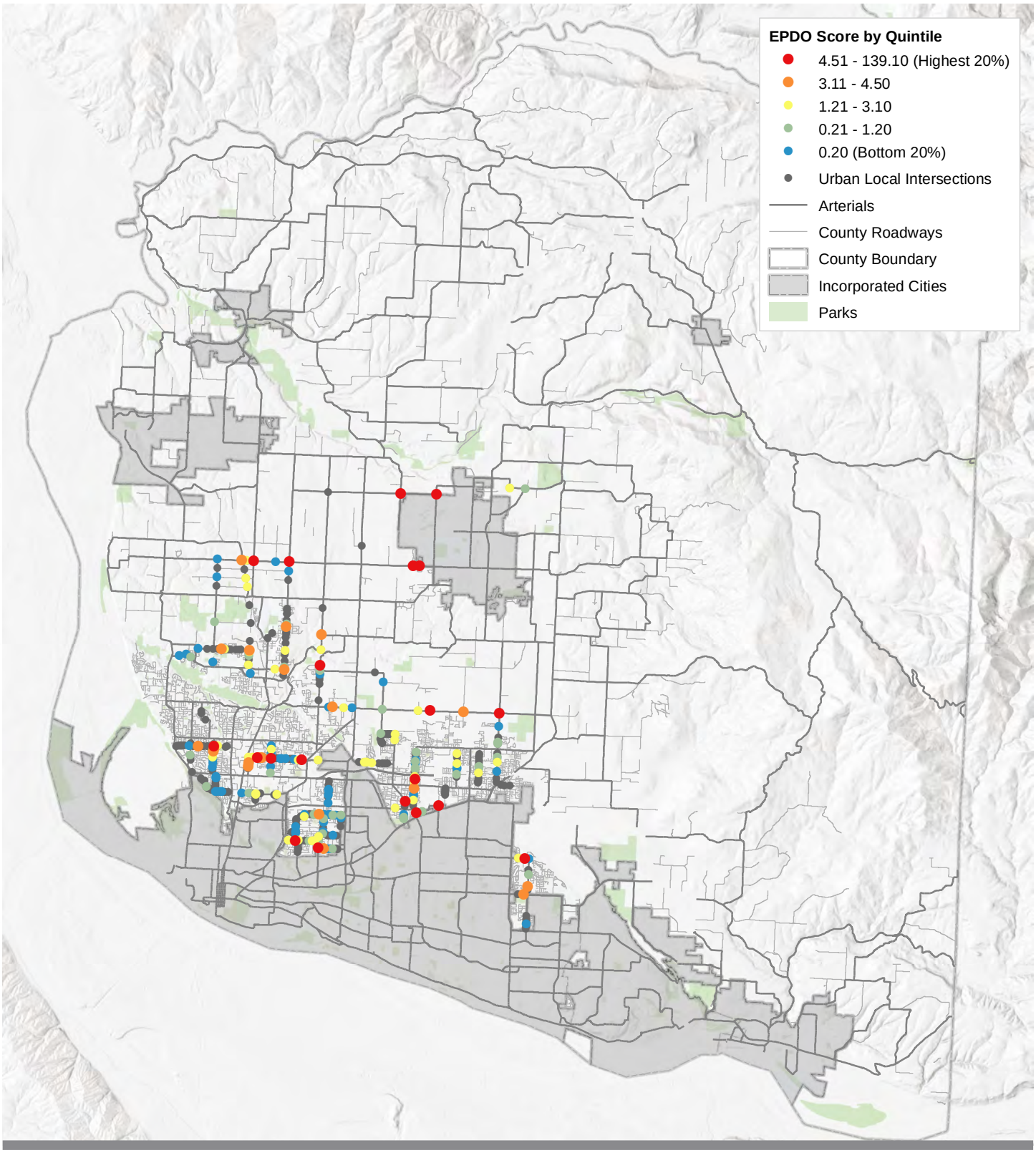


Figure 16

Network Screening Results
Equivalent Property Damage Only Score
Urban Local Intersections Reference Population

KITTELSON & ASSOCIATES

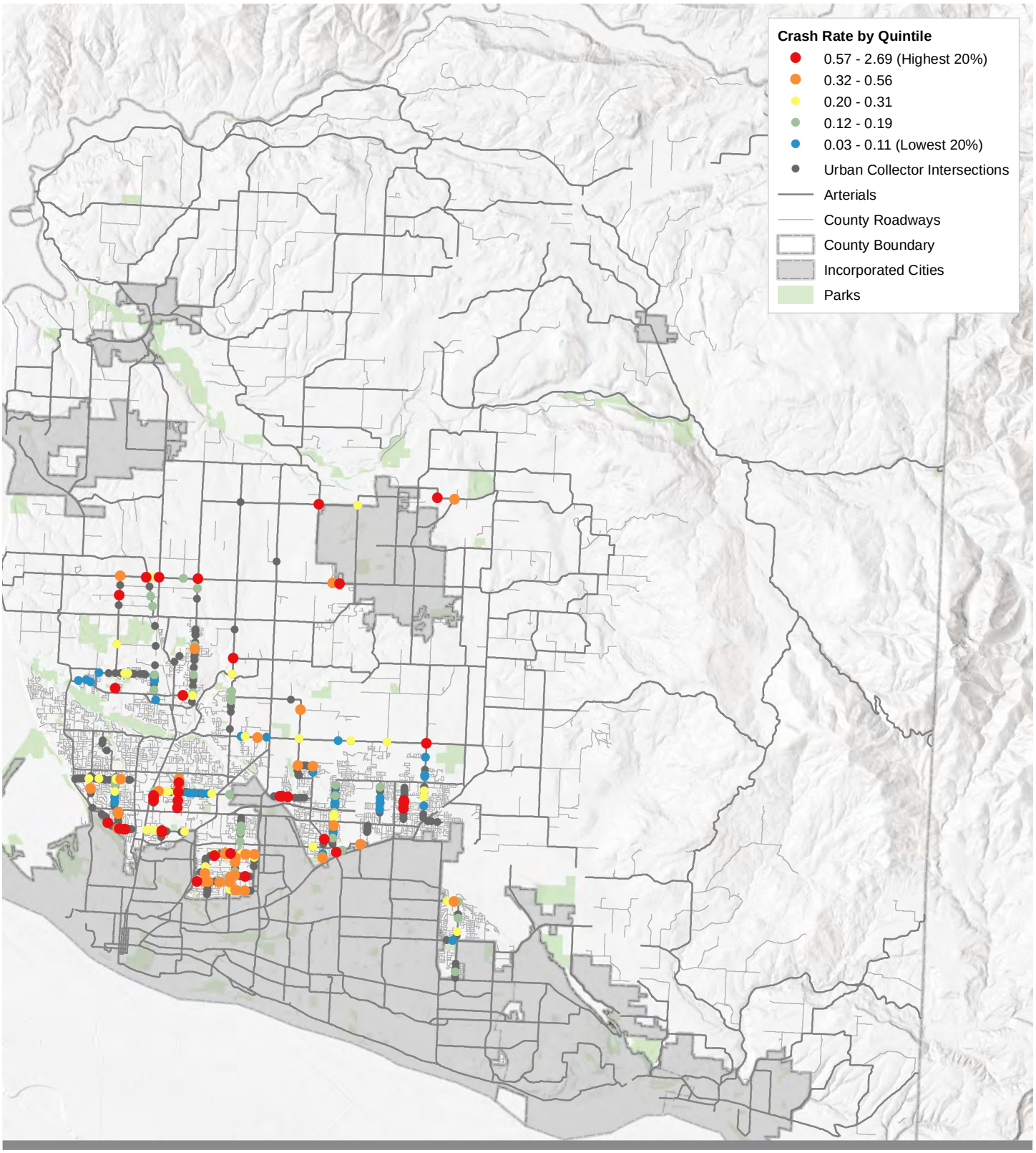


Figure 17

Network Screening Results
Crash Rate
Urban Collector Intersections Reference Population

KITTELSON & ASSOCIATES

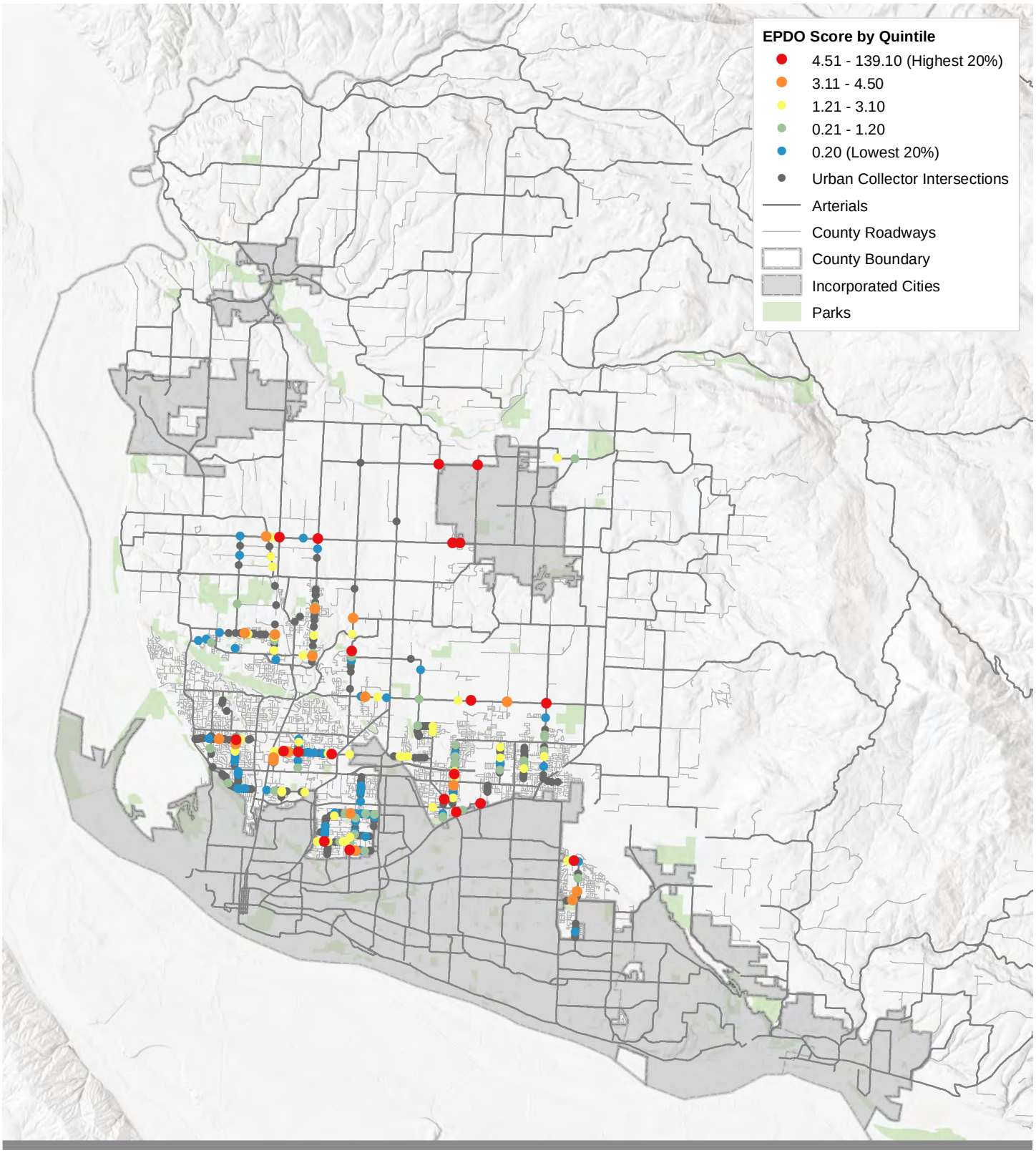


Figure 18

Network Screening Results
Equivalent Property Damage Only Score
Urban Collector Intersections Reference Population

KITTELSON & ASSOCIATES

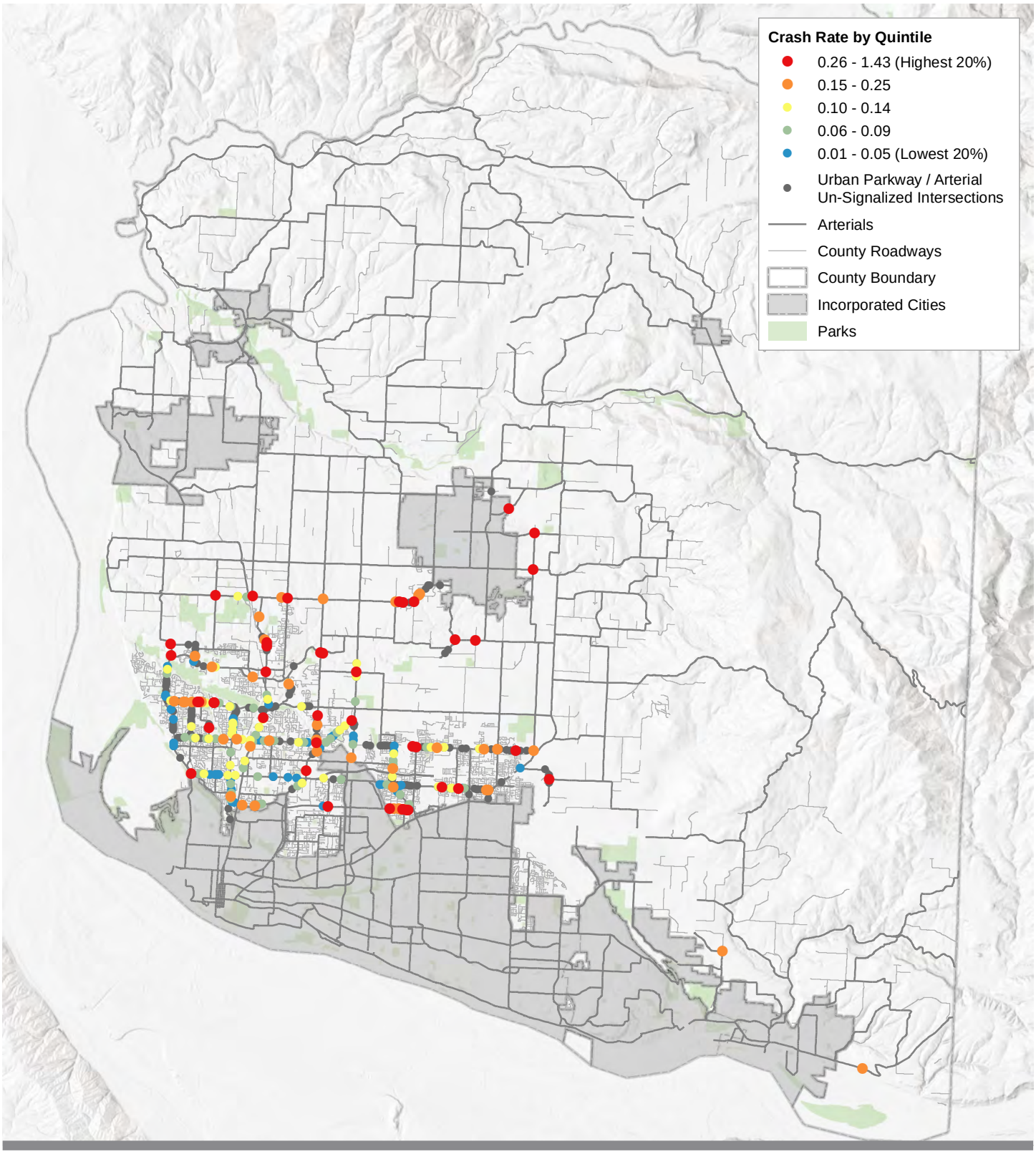


Figure 19

Network Screening Results
Crash Rate
Urban Parkway/Arterial Unsignalized Intersections
Reference Population

KITTELSON & ASSOCIATES

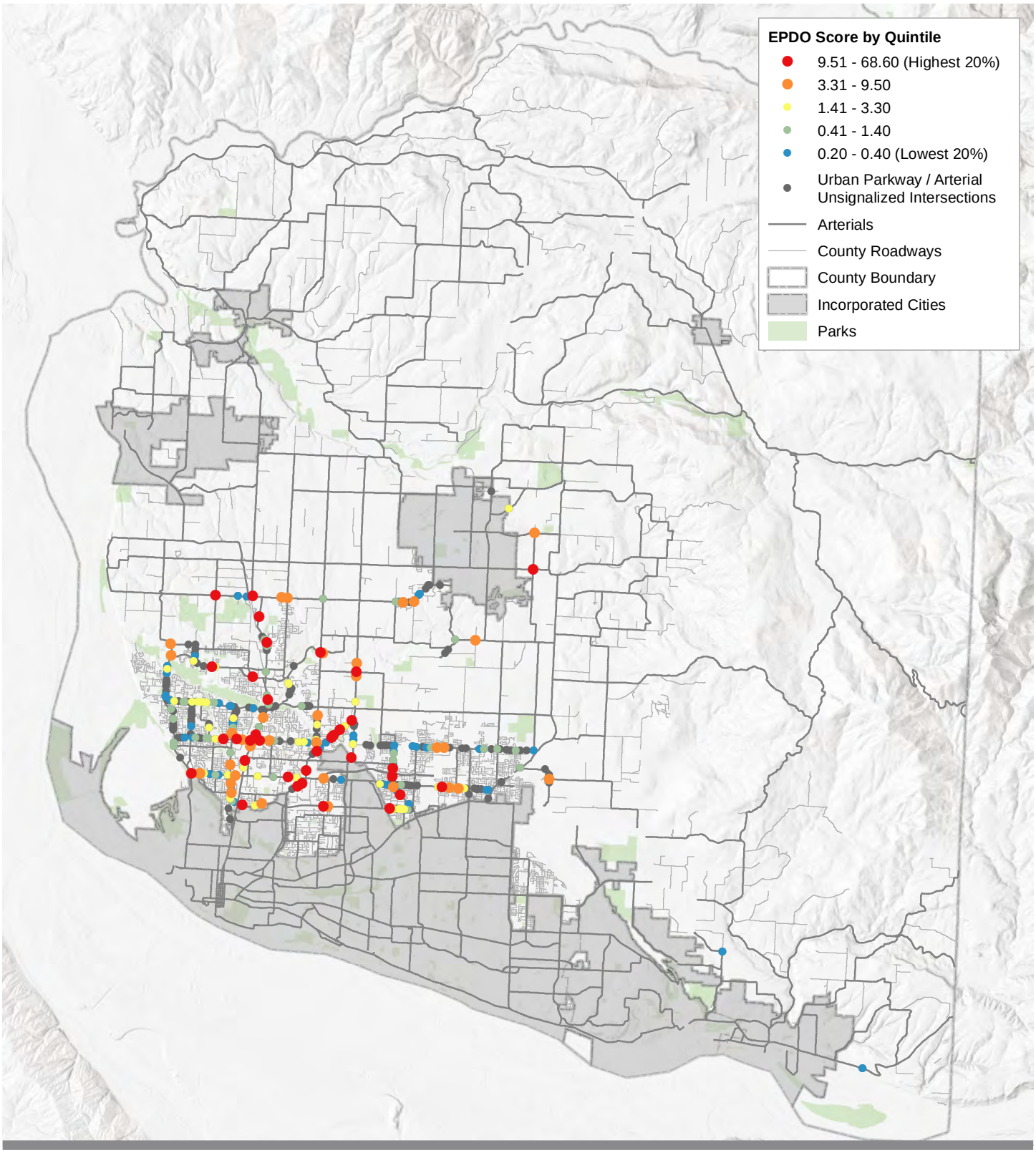


Figure 20

Network Screening Results
Crash Rate
Urban Parkway/Arterial Unsignalized Intersections
Reference Population

KITTELSON & ASSOCIATES

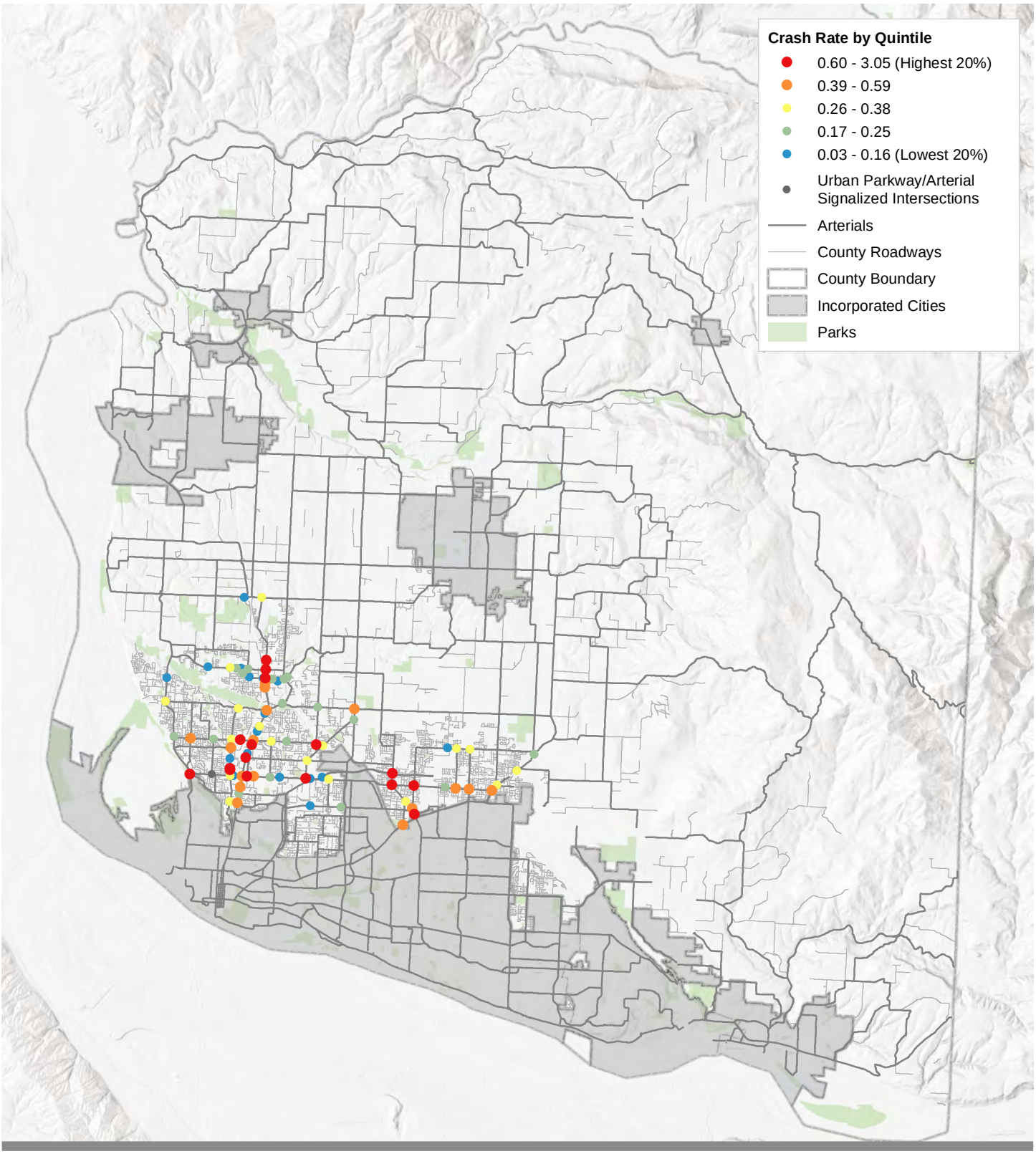


Figure 21

Network Screening Results
Crash Rate
Urban Parkway/Arterial Signalized Intersections
Reference Population

KITTELSON & ASSOCIATES

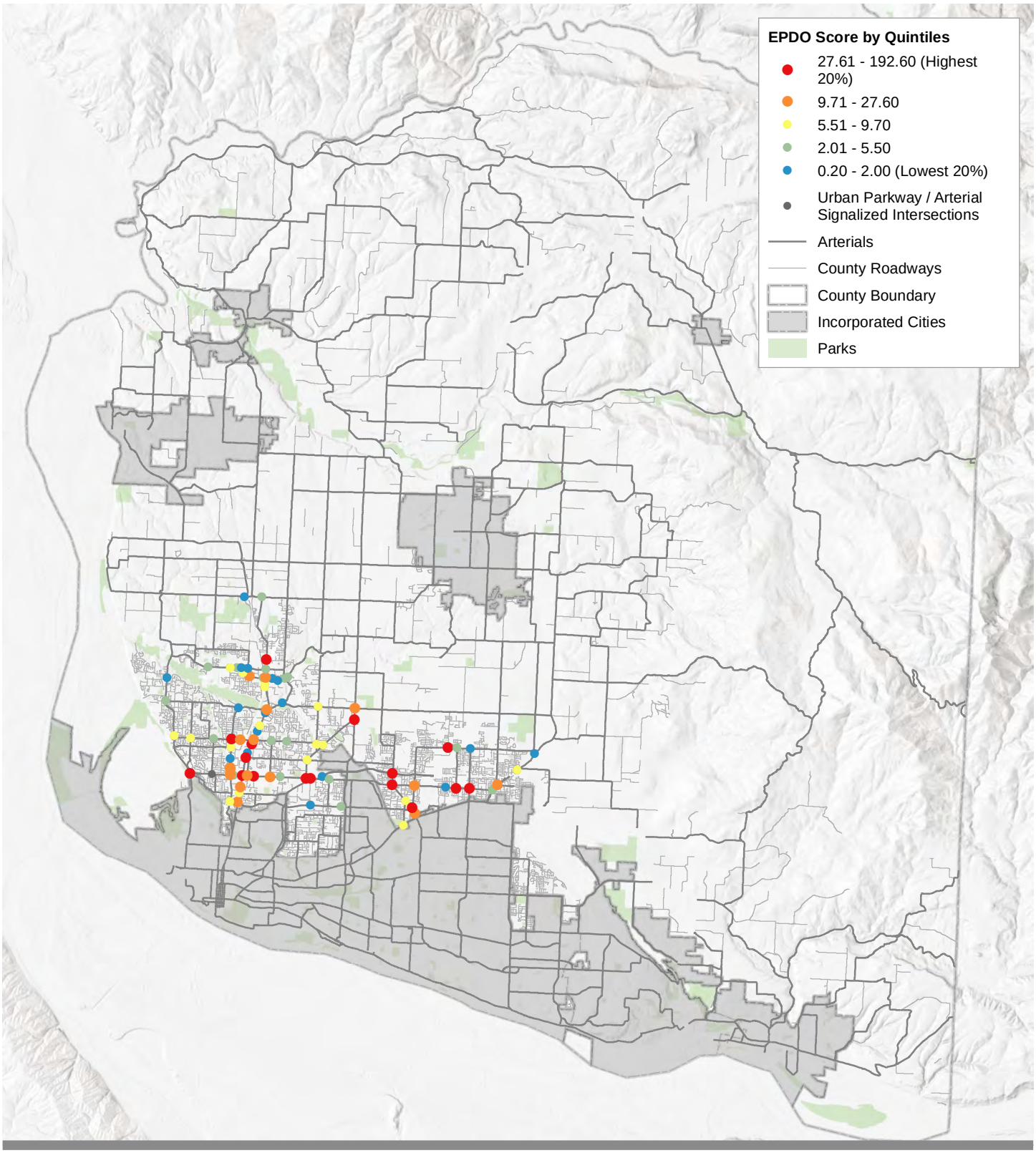


Figure 22

Network Screening Results
Equivalent Property Damage Only Score
Urban Parkway/Arterial Signalized Intersections
Reference Population

KITTELSON & ASSOCIATES

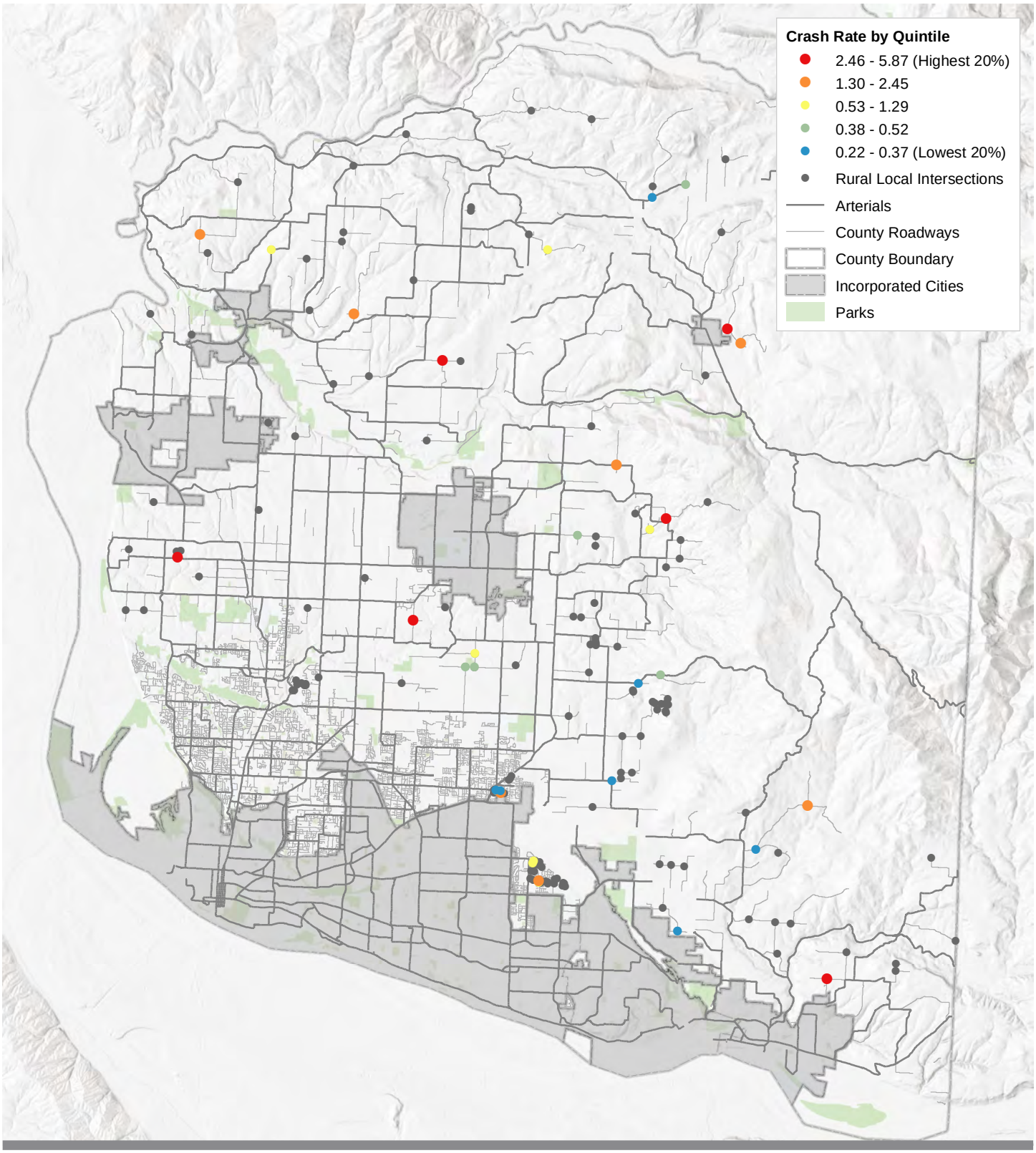


Figure 23

Network Screening Results
Crash Rate
Rural Local Intersections Reference Population

KITTELSON & ASSOCIATES

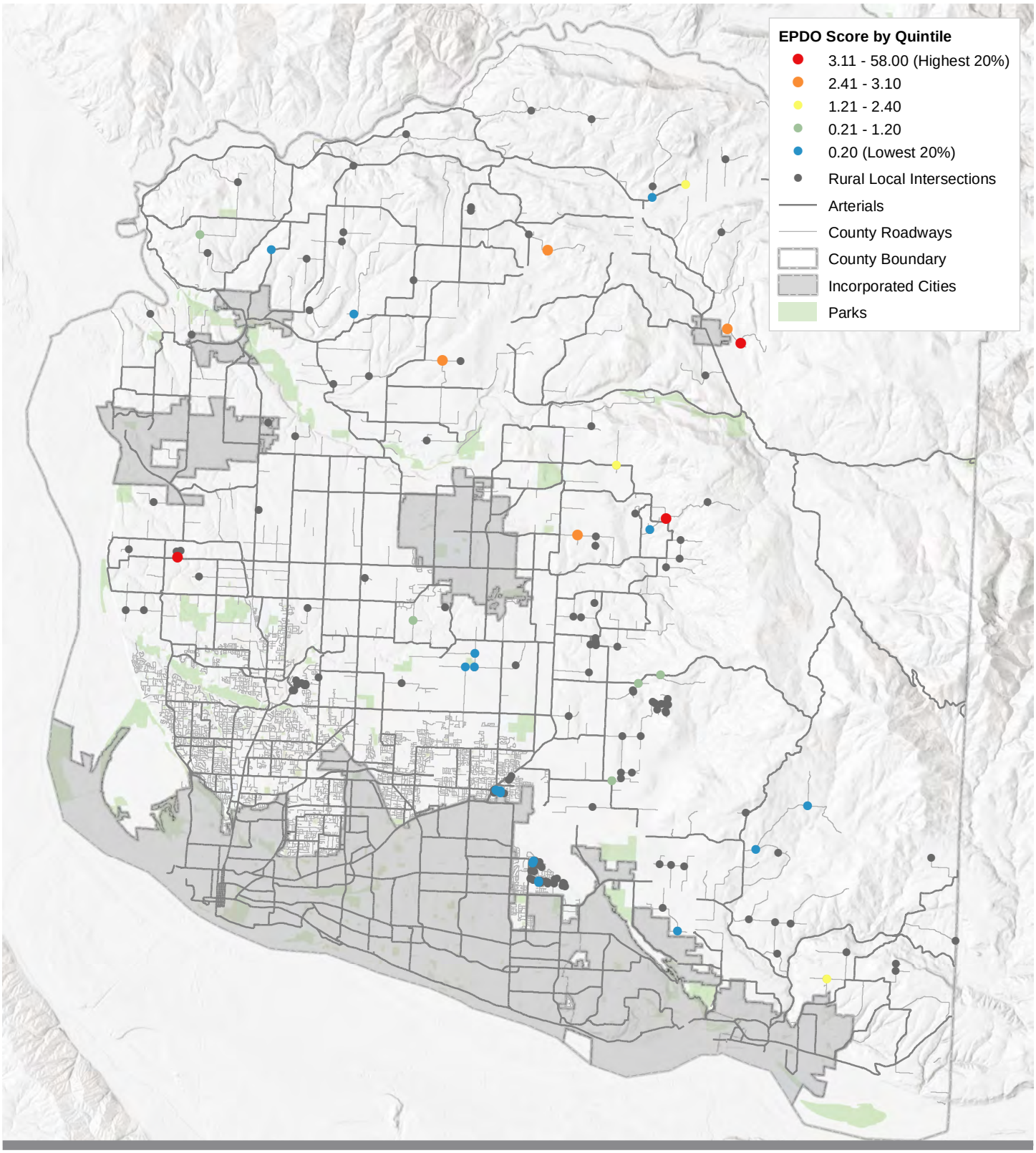
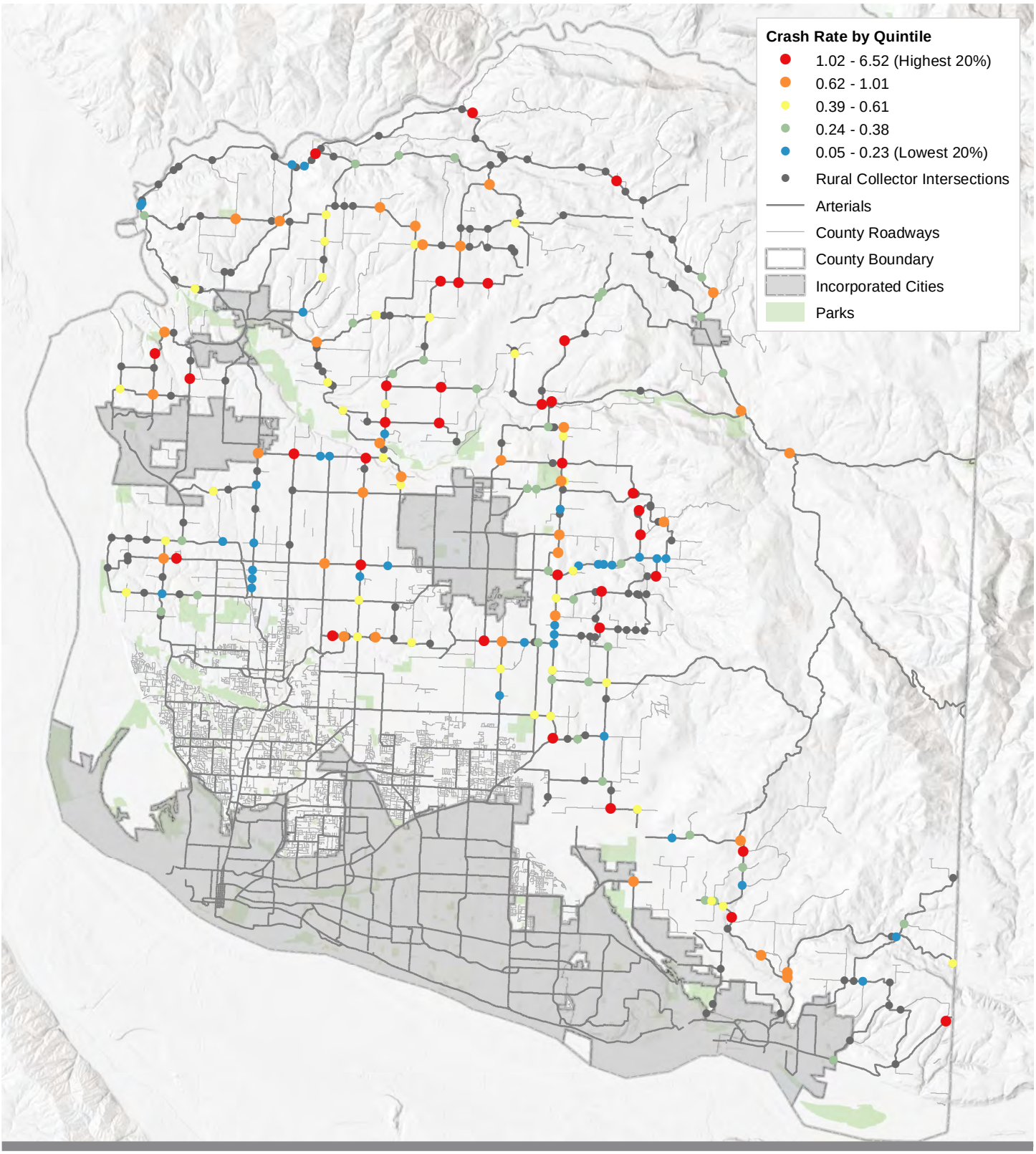


Figure 24

Network Screening Results
Equivalent Property Damage Only Score
Rural Local Intersections Reference Population

KITTELSON & ASSOCIATES



Document Path: C:\Users\mbraughton\Desktop\OneDrive - Kittelson & Associates, Inc\20717 - Clark County On-Call\016 - Safety Tasks\task1_TSMP_documentation\GIS\Figure25_RuralCollectors_Crashrate.mxd Date: 9/28/2020

Figure 25

Network Screening Results
Crash Rate
Rural Collector Intersections Reference Population

KITTELSON & ASSOCIATES

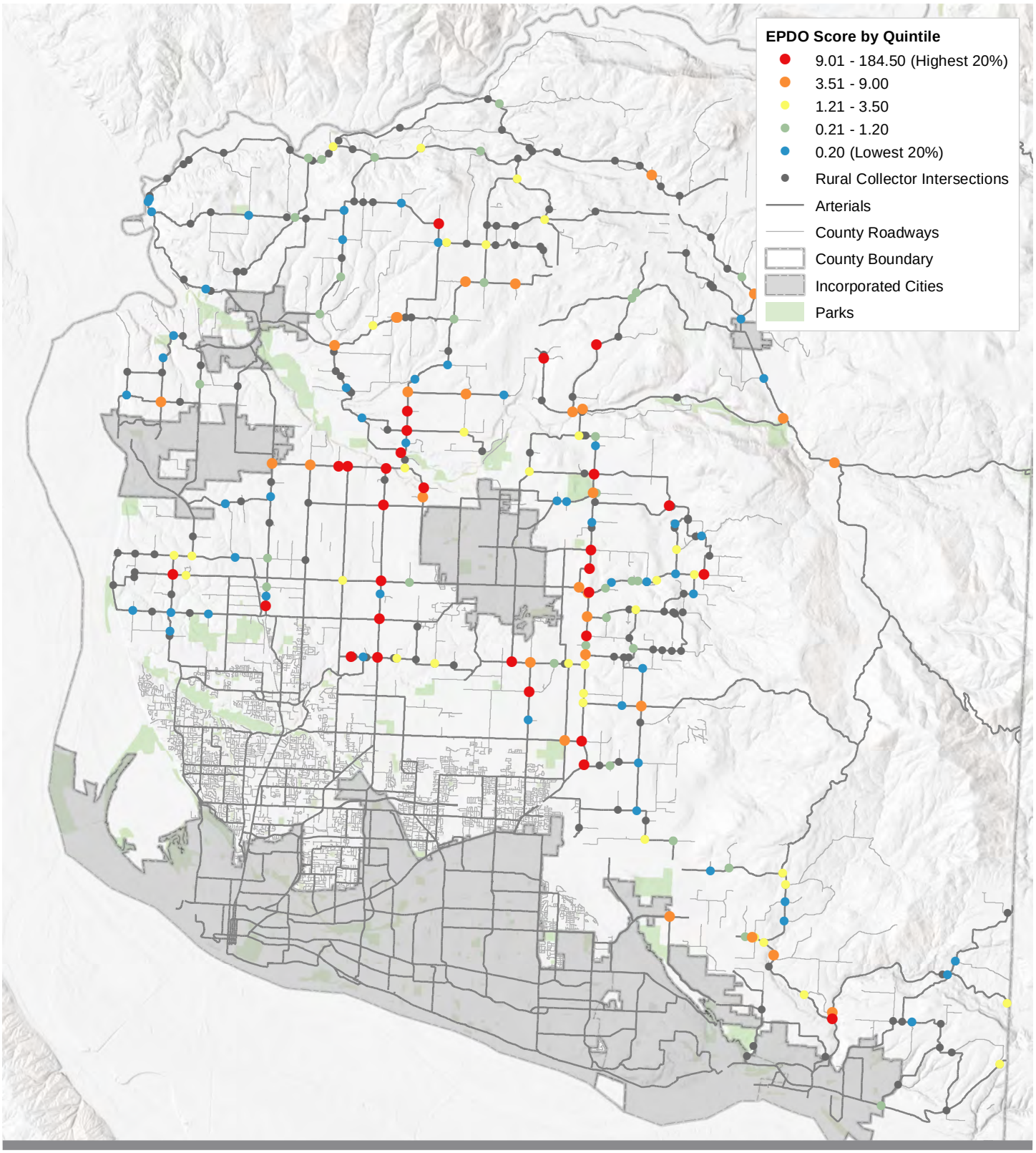


Figure 26

Network Screening Results
Equivalent Property Damage Only Score
Rural Collector Intersections Reference Population

KITTELSON & ASSOCIATES

Initial Project Development

Based on the network screening results, County staff considered the top five percent of sites from the prioritized intersection and segment sites to advance into detailed crash analysis, field diagnosis, and project development. A total of 178 intersections and 407 segments representing the top five percent of locations were considered in the first project development stage. The top five percent intersection and segment locations are depicted in **Figure 27** and **Figure 28**, respectively**.**

EPDO scores ranged from 0.2 to 240.8 and crash rates from 0.27 to 816.8 for the top five percent of segments. Most sites had at least one fatal or severe injury crash. EPDO scores for intersections ranged from 0.2 to 192.6 and crash rates varied from 0.02 to 11.41. Ten intersections had one or more fatal crashes a while 30% of the top five percent intersections reported at least one severe injury crash.

County staff considered recent road/intersection improvements and repaving for the highest scoring sites to determine the top intersection and segment sites to advance into diagnosis and project development. Locations with recent improvements (e.g., dynamic speed signs and rumble strips) installed during the analysis period or programmed for upcoming improvements were removed from consideration. These sites should be monitored to evaluate whether the recent improvements were effective in addressing safety considerations.

Figure 29 shows the top 15 intersection locations and top 10 segments locations selected as priority locations to move forward in the TSMP process for project development. **Table 2** and **Table 3** provide an overview of the priority locations. **Appendix A: Priority Intersection Data** and **Appendix B: Priority Segment Data** include tables with additional crash and safety performance details on each of the intersection and segment priority locations, respectively.

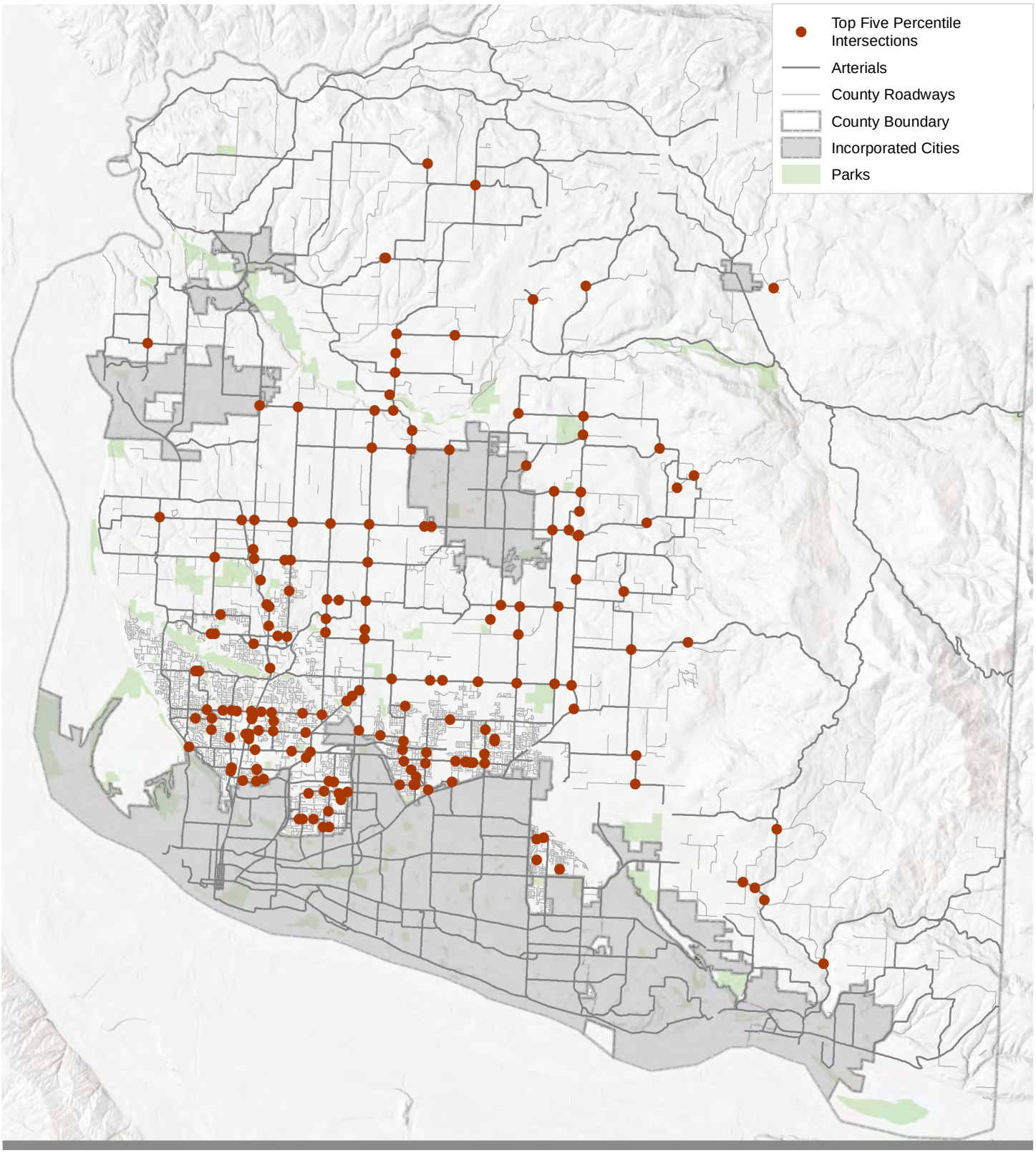


Figure 27

Network Screening Results
Priority Intersections
Top 5 Percentile

KITTELSON & ASSOCIATES

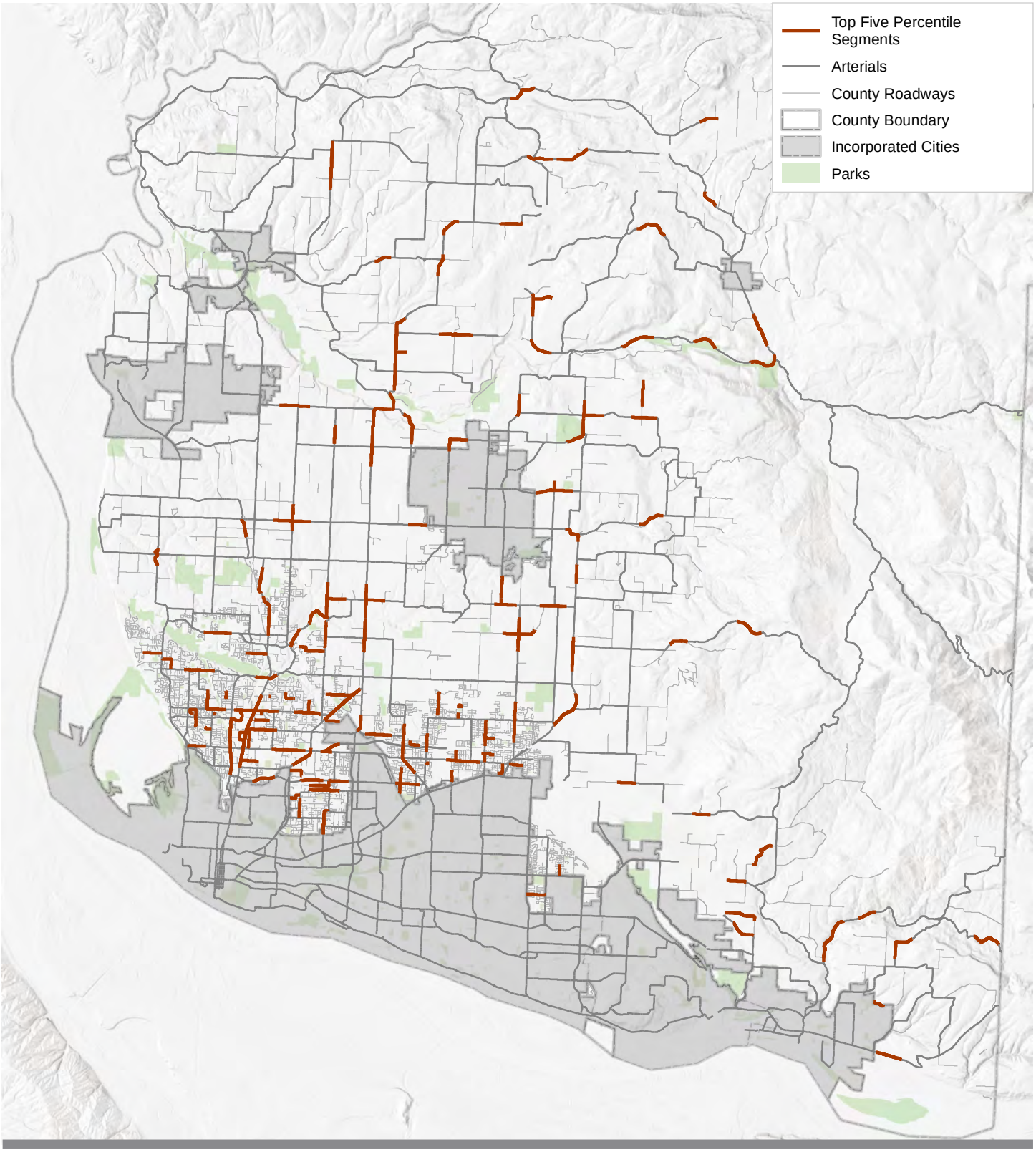


Figure 28

Network Screening Results
Priority Segments
Top 5 Percentile

KITTELSON & ASSOCIATES

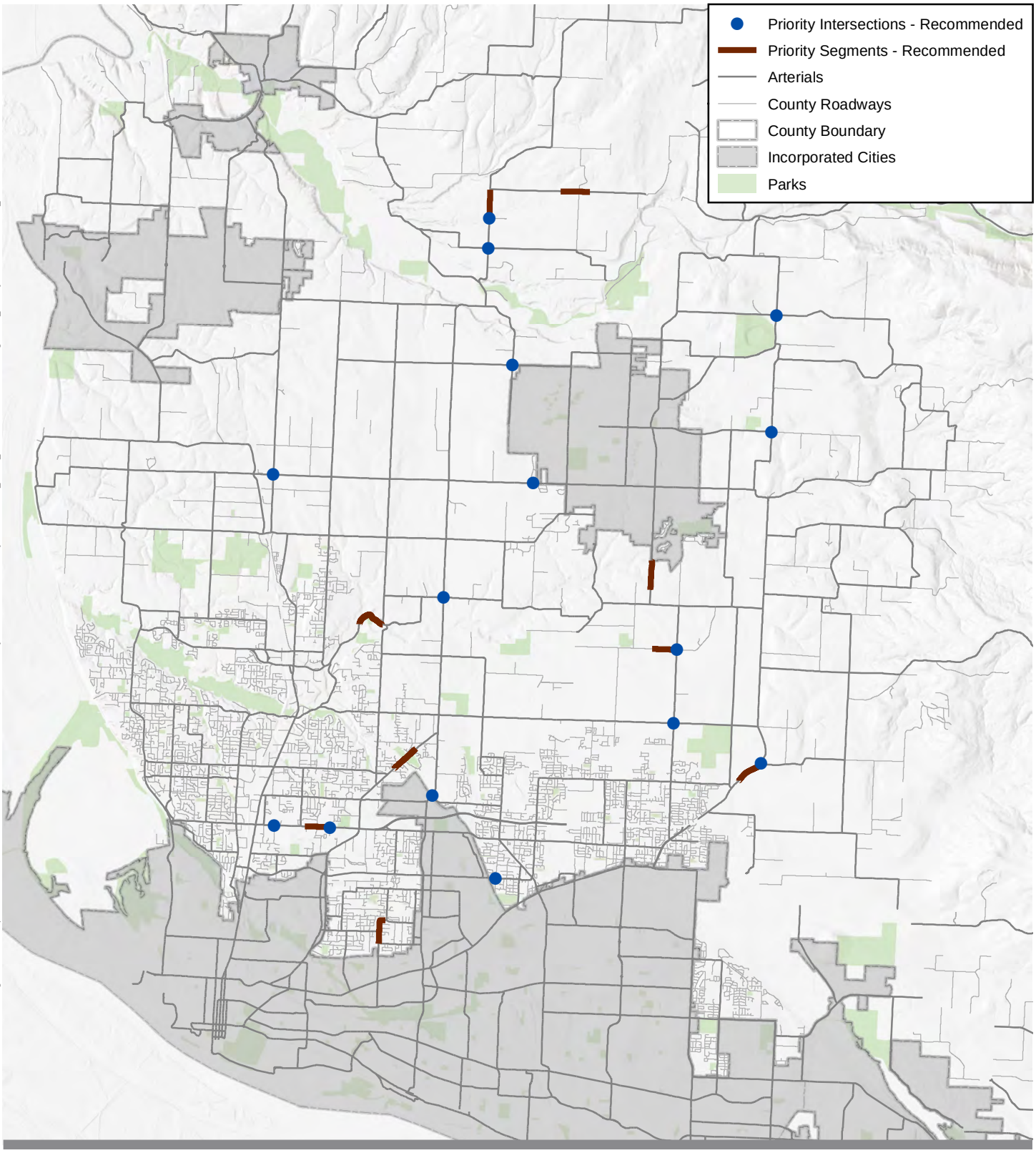


Figure 29

Network Screening Results
Recommended Priority Locations
Intersections and Segments

KITTELSON & ASSOCIATES

Table 3. Priority Locations - Intersections

ID	Location	Site Rank	Traffic Control	Crash Characteristics	Potential Treatments
I1	NE 289th St / NE 82nd Ave	2	TWSC	Two fatal or severe injuries	Speed reduction treatments
				Pedestrian-involved crashes	
I2	NE 119th St / NE 152nd Ave	3	Signal	Two fatal or severe injuries	Add left turn lanes
				High proportion of angle crashes	Convert to roundabout
I3	NE 199th St / NE 101st Ave	5	TWSC	High proportion of fixed object and alcohol impaired crashes	Illumination
					Signing and striping improvements
I4	NE Davis Rd / NE Ward Rd	6	TWSC	High proportion of fixed object and angle crashes	Convert to roundabout or traffic signal
					Add left turn lanes
					Illumination
I5	NE 279th St / NE 82nd Ave	6	TWSC	High proportion of angle crashes	Add left turn lanes
					Illumination
I6	NE 88th St / NE Andresen Rd	8	TWSC	High proportion of angle crashes	Convert to traffic signal
					Install raised median
					Illumination
I7	NE 144th St / NE 152nd Ave	9	TWSC	2 fatal or severe injuries	Signing and striping improvements
				High proportion of angle crashes	Illumination
I8	NE 159th St / NE 72nd Ave	13	TWSC	High proportion of angle crashes	Convert to roundabout or traffic signal
					Illumination
I9	NE 219th St / NE 182nd Ave	14	AWSC	High proportion of angle crashes	Add left turn lanes
					Illumination
I10	NE 63rd St / NE 94th Ave	17	TWSC	High proportion of angle crashes	Illumination
					Signing and striping improvements
I11	NE 78th St / NE 16th Ave	18	Signal	3 fatal or severe injuries	Adjust left turn phasing
				High proportion of left turning crashes	
I12	NE 259th St / NE 182nd Ave	19	TWSC	High proportion of angle crashes	Add left turn lanes
					Illumination
I13	NE 78th St / NE 34th Ave	21	TWSC	High proportion of angle crashes	None
I14	NE 239th St / NE 92nd Ave	22	AWSC	2 fatal or severe injuries	Convert signal to roundabout
I15	NE 199th St / NE 10th Ave	23	Signal	High proportion of angle crashes	Left turn lanes

Source: Clark County, 2018.

Table 4. Priority Locations - Segments

ID	Location	Site Rank	Roadway Classification	Crash Summary
S1	NE Parkinen Rd	6	Rural Local Access	Three fatal or severe injury crashes. High proportion of at angle crashes
S2	NE 78th St	9	Urban Arterial	Three severe injury crashes
S3	NE Ward Rd	12	Rural Collector	Two fatal or severe injury crashes. High proportion of fixed object and PDO crashes
S4	NE 82nd Ave	13	Rural Collector	Two fatal or severe injury crashes.
S5	NE 54th Ave	16	Urban Collector	High proportion of fixed object and PDO crashes
S6	NE St Johns Rd	18	Urban Arterial	High proportion of at angle crashes
S7	NE 41st Ave	19	Rural Collector	Two severe injury crashes
S8	NE 142nd Ave	23	Urban Collector	High proportion of fixed object crashes
S9	NE 299th St	29	Rural Collector	High proportion of fixed object and PDO crashes
S10	NE Salmon Creek Ave	29	Urban Arterial	High proportion of fixed object crashes

Source: Clark County, 2018.

SUMMARY SHEETS

County staff prepared summary sheets from the priority locations for all fifteen intersections. Summary sheets prepared by County staff for intersections are provided in **Appendix C: Summary Sheet for Intersections**. The summary sheets provide a one-page snapshot of the following items for each location:

- **Safety Performance Scores** – The intersection or segment safety performance scores based on the primary and secondary criteria are given along with the overall rankings from the network screening evaluation.
- **Crash Diagrams** – Crash diagrams depict the type and number of reported crashes that occurred at the intersection or segment. The diagram also notes the number of fatalities and severe injuries.
- **Crash Analysis Summary** – Crash trends and patterns summarized in this section.
- **Field Review** – This section includes images and comments from site reviews conducted via Google Street View by County staff.
- **Suggested Countermeasures** - Countermeasures to help address identified crash patterns or other safety considerations at the site.

Common crash patterns, physical characteristics, and recommended treatments for the summarized intersections (by control type) are provided below. Priority segment locations except one have not been reviewed and none had countermeasures selected at this time. These locations may be further developed by the County in future phases of the TSMP analysis.

SIGNALIZED INTERSECTIONS

Signalized intersections are three of the fifteen priority intersections. These locations accounted for 34% of reported crashes of all priority intersections.

Crash Patterns:

- Left turn crashes were prominent at signalized intersections. They were 54% of all reported crashes. This pattern was observed at each signalized intersection.
- Angle crashes were 34% of all crashes at signalized intersections.
- Two of the three intersections reported two or more fatal or severe injury crashes.
- Only one intersection (NE 78th St/NE 16th Ave) reported alcohol-impaired crashes and crashes involved bicyclists or pedestrians.

Site Characteristics:

- Two of the three signalized intersections were on collector roads (one rural and one urban) and one on an urban arterial road.
- One of the intersections (NE 119th St/NE 152nd Ave) lacked left turns lanes and had tight turning radii. This intersection accounted for 50% all crashes reported at signalized intersections.

Treatments:

- Constructing left turn lanes or changing existing left-turn phasing was recommended at two of the three sites.
- One intersection was recommended to be converted to a single lane roundabout.

UNSIGNALIZED INTERSECTIONS

There were twelve unsignalized intersections on the priority location list. Seven of the twelve intersections were located on rural collectors. Only two of the unsignalized intersections had all way stop control. The remaining ten locations were two way stop controlled intersections.

Crash Patterns:

- Every location except one had at least one fatal or severe injury crash.
- Crashes involving turning vehicles were nearly 52% of the total reported crashes.
- Fixed object crashes accounted for 27% of all reported crashes.

Site Characteristics:

- Common physical characteristics of the priority intersections as noted during field review included insufficient intersection sight distance (sight triangles) and opportunities to improve signing and striping.

Treatments:

- Illumination was recommended at nine of the twelve intersections.
- Adding left turn lanes as well as signing and striping improvements were the next most common recommended countermeasures.
- Converting to a signalized intersection was recommended at four intersections (if warrants are met).

SEGMENTS

County staff have not yet advanced the priority segment locations into project development. Ten locations were included in the priority list and common characteristics for the priority segments are described below:

- The majority of these segments (6) are on collector roads (rural or urban).
- An additional three are on urban arterials and one is a local access road.
- Approximately half (49%) of reported segment crashes were fixed object crashes and 26% were angle crashes.

Conclusion

County staff conducted the 2017 TSMP analysis and identified priority intersections and segments that can be further refined as part of the project development phase. These priority sites will then be ranked and compared in the final phase of the TSMP. After potential project packages are identified for each location, these safety projects can be evaluated to calculate the expected safety benefits and develop planning-level cost estimates. The benefits and costs can then be compared across projects by calculating the projected benefited-cost ratio. Using this evaluation, County staff will be able to better direct limited funding and staff time to implement the projects most likely to provide the greatest safety benefit.

Appendix A: Priority Intersection Data

Table A- 1 Priority Intersection Summary Data

ID#	Intersection Name	Context	Traffic Control	Average Daily Traffic	Million Entering Vehicles	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	PDO Crashes	Total Crashes
2561	NE 289th St/NE 82nd Ave	Rural Collector	TWSC	2,817	5.14	1	1	0	0	3	5
3213	NE 119th St/NE 152nd Ave	Urban Collector	Signal	8,197	14.96	2	0	7	5	7	21
2468	NE 199th St/NE 101st Ave	Urban Collector	TWSC	7,009	12.79	0	1	0	3	2	6
3361	NE 279th St/NE 82nd Ave	Rural Collector	TWSC	2,293	4.18	0	1	2	3	1	7
1308	NE Davis Rd/NE Ward Rd	Rural Collector	TWSC	8,934	16.30	0	1	1	2	13	17
1098	NE 88th St/NE Andresen Rd	Urban Arterial Unsignalized	TWSC	20,384	37.20	0	1	0	2	4	7
3236	NE 144th St/NE 152nd Ave	Rural Collector	TWSC	6,000	10.95	0	2	0	0	1	3
3278	NE 159th St/NE 72nd Ave	Rural Collector	TWSC	11,397	20.80	0	1	2	1	4	8
3350	NE 219th St/NE 182nd Ave	Rural Collector	AWSC	5,510	10.06	0	1	0	1	7	9
2810	NE 63rd St/NE 94th Ave	Urban Arterial Unsignalized	TWSC	3,826	6.98	0	1	3	1	5	10
852	NE 78th St/NE 16th Ave	Urban Arterial Signalized	Signal	22,975	41.93	0	3	4	3	7	17
2535	NE 259th St/NE 182nd Ave	Rural Collector	TWSC	1,320	2.41	0	1	2	1	1	5
838	NE 78th St/NE 34th Ave	Urban Arterial Unsignalized	TWSC	35,994	65.69	0	1	0	0	2	3
3352	NE 239th St/NE 92nd Ave	Urban Collector	AWSC	5,388	9.83	0	0	1	2	5	8
3344	NE 199th St/NE 10th Ave	Rural Collector	Signal	9,778	17.84	0	0	2	2	8	12

Source: Clark County, 2018.

Table A- 2 Priority Intersection Summary Data

ID#	Intersection Name	At Angle Crashes	Opposite Direction Crashes	Fixed Object Crashes	Alcohol Impaired Crashes	Bike/Ped Crashes	Angle Crashes Proportion Excess	Opposite Direction Crashes Excess	Fixed Object Proportion Excess Probability	Alcohol Impaired Excess Probability	Bike/Ped Crashes Excess
I1	NE 289th St/NE 82nd Ave	1	0	1	0	1	0.16	-0.07	0.04	-0.04	0.33
I2	NE 119th St/NE 152nd Ave	9	11	0	0	0	0.32	0.49	-0.13	-0.05	-0.01
I3	NE 199th St/NE 101st Ave	1	1	3	2	0	0.03	0.11	0.37	0.28	-0.01
I4	NE 279th St/NE 82nd Ave	4	3	1	1	0	0.33	0.30	-0.17	0.08	-0.01
I5	NE Davis Rd/NE Ward Rd	8	1	8	1	0	0.23	-0.02	0.11	0.01	-0.01
I6	NE 88th St/NE Andresen Rd	4	1	0	0	1	0.34	0.05	-0.14	-0.06	0.10
I7	NE 144th St/NE 152nd Ave	5	0	1	0	0	0.66	-0.07	-0.12	-0.04	-0.01
I8	NE 159th St/NE 72nd Ave	5	0	3	2	0	0.28	-0.07	-0.02	0.14	-0.01
I9	NE 219th St/NE 182nd Ave	3	0	1	2	0	0.26	-0.07	-0.15	0.24	-0.01
I10	NE 63rd St/NE 94th Ave	7	0	1	0	0	0.47	-0.09	-0.04	-0.06	-0.05
I11	NE 78th St/NE 16th Ave	2	8	0	1	2	-0.94	-0.59	-0.30	-0.22	-0.09
I12	NE 259th St/NE 182nd Ave	3	0	2	0	0	0.26	-0.07	0.00	-0.04	-0.01
I13	NE 78th St/NE 34th Ave	1	1	1	0	0	0.10	0.24	0.19	-0.06	-0.05
I14	NE 239th St/NE 92nd Ave	5	0	2	1	0	0.49	-0.06	0.12	0.07	-0.01
I15	NE 199th St/NE 10th Ave	3	3	2	0	0	0.14	0.21	0.05	-0.05	-0.01

Source: Clark County, 2018.

Table A- 3 Priority Intersection Performance Measure Results

ID#	Intersection Name	Traffic Control	Critical Crash Rate	Crash Rate	Crash-Critical Crash Rate Ratio	Equivalent PDO Score	Annual Equivalent PDO Score	Score 1	Score 2	Score 3	Score 4	Total Score
I1	NE 289th St/NE 82nd Ave	Two Way Stop	1.18	0.58	0.49	0.99	116.2	0.8	1	1.25	0.99	4.04
I2	NE 119th St/NE 152nd Ave	Signal	0.62	1.34	2.17	1	139.1	0.99	1	1	1	3.99
I3	NE 199th St/NE 101st Ave	Two Way Stop	0.64	0.47	0.73	0.99	63.0	0.94	0.5	1.5	0.99	3.93
I4	NE 279th St/NE 82nd Ave	Two Way Stop	1.26	1.91	1.51	0.98	68.2	0.98	0.5	1.25	0.98	3.71
I5	NE Davis Rd/NE Ward Rd	Two Way Stop	0.88	1.23	1.39	0.98	70.7	0.98	0.5	1.25	0.98	3.71
I6	NE 88th St/NE Andresen Rd	Two Way Stop	0.22	0.19	0.84	0.97	61.2	0.87	0.5	1.25	0.97	3.59
I7	NE 144th St/NE 152nd Ave	Two Way Stop	0.96	0.55	0.57	0.99	119.7	0.84	1	0.75	0.99	3.58
I8	NE 159th St/NE 72nd Ave	Two Way Stop	0.84	0.53	0.63	0.98	70.7	0.86	0.5	1	0.98	3.34
I9	NE 219th St/NE 182nd Ave	All Way Stop	0.98	0.70	0.71	0.95	59.2	0.88	0.5	1	0.95	3.33
I10	NE 63rd St/NE 94th Ave	Two Way Stop	0.40	1.43	3.56	1	68.6	0.99	0.5	0.75	1	3.24
I11	NE 78th St/NE 16th Ave	Signal	0.18	0.43	2.43	1	192.6	0.73	1.5	0	1	3.23
I12	NE 259th St/NE 182nd Ave	Two Way Stop	1.54	2.91	1.89	0.98	68.9	0.99	0.5	0.75	0.98	3.22
I13	NE 78th St/NE 34th Ave	Two Way Stop	0.19	0.05	0.24	0.95	59.4	0.51	0.5	1.25	0.95	3.21
I14	NE 239th St/NE 92nd Ave	All Way Stop	0.69	0.81	1.18	0.96	6.5	0.97	0	1.25	0.96	3.18
I15	NE 199th St/NE 10th Ave	Signal	0.59	0.62	1.04	0.96	8.1	0.96	0	1.25	0.96	3.17

Source: Clark County, 2018.

Appendix B: Priority Segment Data

Table B-1. Rural Local Access Priority Segment Summary Data

ID#	Road Name	Start Mile Post	End Mile Post	Average Daily Traffic	Segment Million Vehicles	Fatal Crashes	Injury A Crashes	Injury B Crashes	Injury C Crashes	PDO Crashes	Total Crashes
51500	NE Parkinen Rd	0.7	1.6	638	0.58	1	2	0	0	3	6
91300	NE 78th St	5	5.6	23969	21.87	0	3	0	3	3	9
95050	NE Ward Rd	2.15	2.65	8888	8.11	1	1	2	7	13	24
91250	NE 82nd Ave	12.17	12.87	1901	1.73	1	1	0	1	4	7
21790	NE 54th Ave	0.5	1.1	4095	3.73	0	2	1	2	5	10
91250	NE St Johns Rd	2	2.6	8293	7.56	0	2	0	1	5	8
61400	NE 41st Ave	3.1	3.7	1191	1.08	0	2	0	0	2	4
51650	NE 142nd Ave	0.25	0.75	590	0.53	0	2	4	0	2	8
62500	NE 299th St	1.1	1.8	1526	1.39	1	0	2	4	3	10
94130	NE Salmon Creek Ave	1.96	2.56	3383	3.08	0	2	0	3	11	16

Source: Clark County, 2018.

Table B-2. Rural Local Access Priority Segment Summary Data

ID#	Road Name	At Angle Crashes	Opposite Direction Crashes	Fixed Object Crashes	Alcohol Impaired Crashes	Bike/Ped Crashes	Angle Crashes Proportion Excess	Opposite Direction Crashes Excess	Fixed Object Proportion Excess Probability	Alcohol Impaired Excess Probability	Bike/Ped Crashes Excess
S1	NE Parkinen Rd	5	0	1	0	0	0.727	-0.071	-0.503	-0.017	-0.095
S2	NE 78th St	3	1	1	0	1	0.059	0.016	-0.090	0.047	-0.063
S3	NE Ward Rd	8	1	11	2	0	0.203	-0.046	-0.088	-0.005	0.003
S4	NE 82nd Ave	2	0	3	0	1	0.156	-0.088	-0.118	0.137	-0.079
S5	NE 54th Ave	0	3	6	3	1	-0.228	0.212	0.244	0.070	0.207
S6	NE St Johns Rd	4	0	3	0	1	0.225	-0.094	0.173	0.061	-0.063
S7	NE 41st Ave	1	2	1	0	0	0.120	0.411	-0.296	-0.005	-0.079
S8	NE 142nd Ave	0	1	5	1	0	-0.228	0.037	0.269	-0.029	0.032
S9	NE 299th St	4	1	5	1	0	0.270	0.011	-0.046	-0.005	0.023
S10	NE Salmon Creek Ave	0	2	14	2	0	-0.274	0.030	0.673	-0.063	0.061

Source: Clark County, 2018.

Table B-3. Rural Local Access Priority Segment Performance Measure Results

ID#	Road Name	Critical Crash Rate	Crash Rate	Crash-Critical Crash Rate Ratio	Total Fatal + Injury A Crashes	EPDO Score	Annual EPDO Score	Score 1	Score 2	Score 3	Score 4	Total Performance Measure Score
S1	NE Parkinen Rd	5.51	10.31	1.87	3	0.6	174.6	0.98	1.5	0.75	1	4.23
S2	NE 78th St	1.33	0.41	0.31	3	0.6	178.2	0.38	1.5	1.25	0.99	4.12
S3	NE Ward Rd	2.55	2.96	1.15	2	2.6	133.2	0.94	1	1	0.99	3.93
S4	NE 82nd Ave	3.67	4.03	1.09	2	0.8	118	0.93	1	1	0.99	3.92
S5	NE 54th Ave	2.64	2.68	1.01	2	1	122.5	0.9	1	1	0.99	3.89
S6	NE St Johns Rd	1.61	1.05	0.65	2	1	118.2	0.66	1	1.25	0.95	3.86
S7	NE 41st Ave	4.27	3.68	0.86	2	0.4	116.4	0.86	1	1	0.98	3.84
S8	NE 142nd Ave	5.12	14.86	2.89	2	0.4	128.8	0.99	1	0.75	1	3.74
S9	NE 299th St	3.93	7.18	1.82	1	0.6	69.6	0.99	0.5	1.25	0.97	3.71
S10	NE Salmon Creek Ave	2.04	5.18	2.53	2	2.2	121.8	0.99	1	0.75	0.97	3.71

Source: Clark County, 2018.

Appendix C: Summary Sheet for Intersections

Intersection Performance Summary (2013-2017)

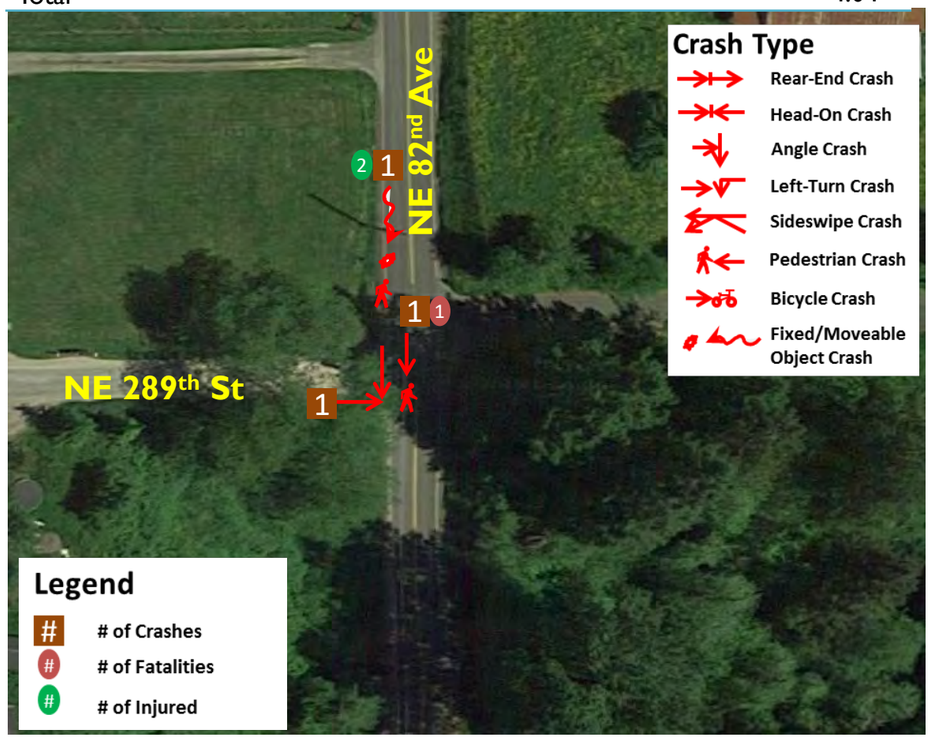
Table 1-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#2** location countywide.

Key reasons the intersection was selected for further review include:

- The number of fatal and severe injuries.
- The high proportion of angle, fixed object and pedestrian crashes.

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	0.49	0.80
Number of Fatal & Severe Injuries	2	1
Excess Proportion of Angle Crash Type	0.16	0.75
Excess Proportion of Fixed Object Crash Type	0.04	0.25
Excess Proportion of Bicycle or Pedestrian Crash Type	0.33	0.25
Annual Equivalent Property Damage Only Score	116.2	0.99
Total		4.04



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 1 of 3 crashes were angle related (Exhibit I-IA).
- 2 of 3 crashes involved a pedestrian (Exhibit 1-1A).
- 1 crash resulted in injuries (Exhibit I-1A).
- 1 crash resulted in a fatality (Exhibit I-1A).

Field Review Observations

- Intersection visibility limited due to sag curve (Photo 1-IA)
- Triangle sight distance from minor street is limited due to vegetation and hillside.

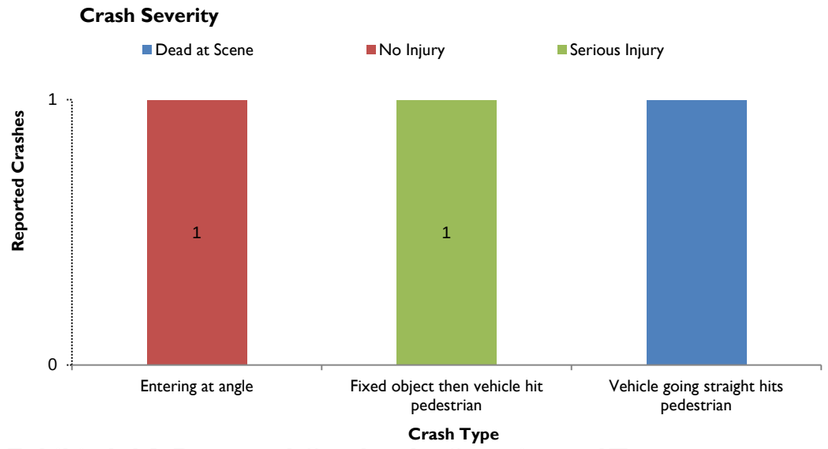


Exhibit 1-1A Reported Crashes by Severity and Type

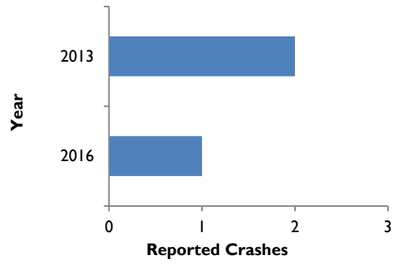


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Limited visibility due to sag curve
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Increase pavement friction
- Increase triangle sight distance
- Install transverse rumble strips on approach(es)
- Widen paved shoulder
- Flatten side slope
- Install dynamic speed feedback sign
- Install edge line markings (from 4 to 6 in)
- 10% reduction in mean speed

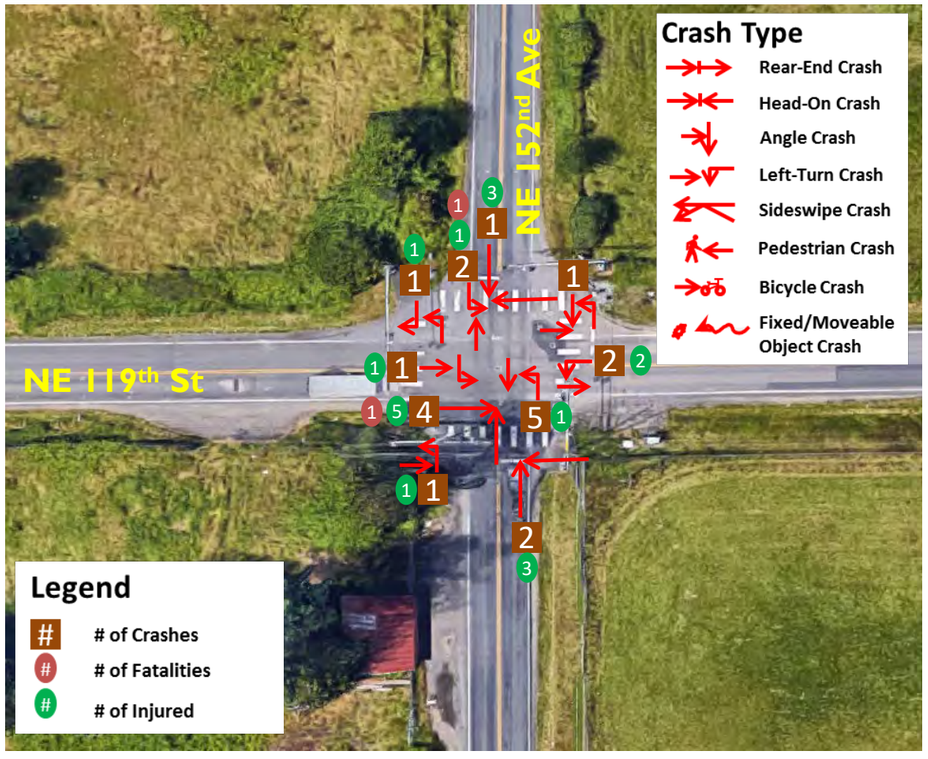
Intersection Performance Summary (2013-2017)

Table I-IA provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#3** location countywide.
Key reasons the intersection was selected for further review include:

- The number of fatal and severe injuries.
- The high proportion of angle and opposite direction crashes.

Table I-IA Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	2.17	0.99
Number of Fatal & Severe Injuries	2	1
Excess Proportion of Angle Crash Type	0.32	0.75
Excess Proportion of Opposite Direction Crash Type	0.49	0.25
Annual Equivalent Property Damage Only Score	139.1	1
Total		3.99



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 9 of 20 crashes were angle related (Exhibit I-IA).
- 11 of 20 crashes were left turning related (Exhibit 1-IA).
- Half of the crashes resulted in injuries (Exhibit I-IA).
- 2 crashes resulted in fatalities (Exhibit I-IA).

Field Review Observations

- Lack of left turns lanes and tight turning radius (Photo 1-IA)

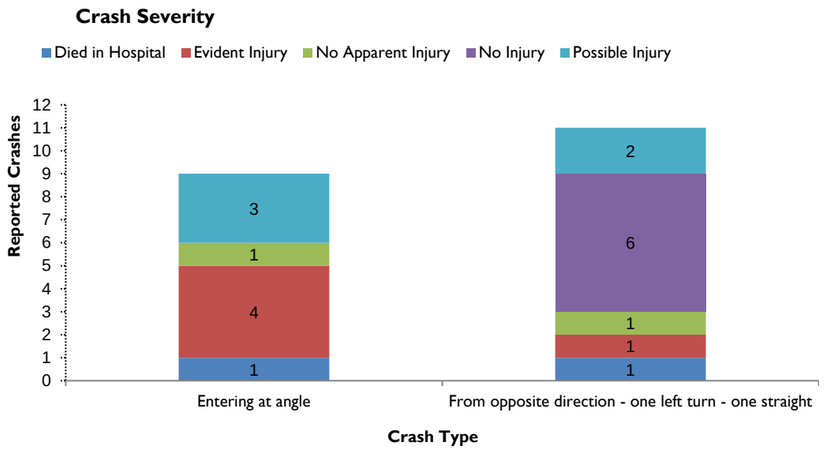


Exhibit I-IA Reported Crashes by Severity and Type

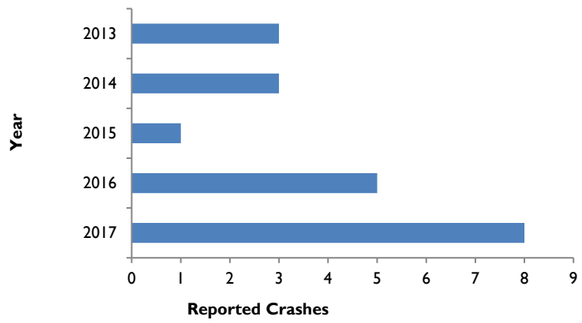


Exhibit I-IB Reported Crashes by Year

Site Photo

Photo I-IA: Lack of existing left turn lanes and tight turning radius
Source: Clark County, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Installation of left-turn lanes on both major road approaches
- Change major approaches from permissive to protected left-turn phasing
- Change minor approaches from permissive to protected/permissive or permissive/protected phasing
- Convert signalized intersection to modern roundabout

Intersection Performance Summary (2013-2017)

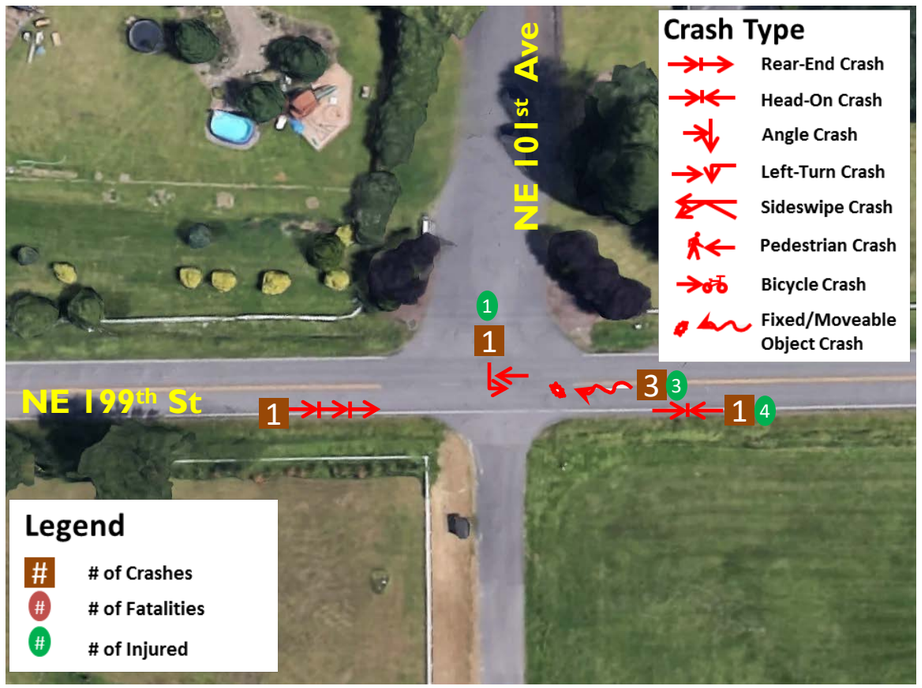
Table I-IA provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#5** location countywide.

Key reasons the intersection was selected for further review include:

- The high proportion of angle, opposite direction, fixed object and alcohol impaired crashes.

Table I-IA Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	0.73	0.94
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.03	0.75
Excess Proportion of Opposite Direction Crash Type	0.11	0.25
Excess Proportion of Fixed Object Crash Type	0.37	0.25
Excess Proportion of Alcohol Impaired Crashes	0.28	0.25
Annual Equivalent Property Damage Only Score	63	0.99
Total		3.93



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- Half of the crashes were fixed object related (Exhibit I-IA).
- 5 of the 6 crashes resulted in injuries (Exhibit I-IA).
- 2 crashes resulted in fatalities (Exhibit I-IA).
- One third of the crashes were related to alcohol impairment.

Field Review Observations

- Steep drop-off on all corners of the intersection (Photo 1-IA)
- No definition of the intersection approach for the north leg

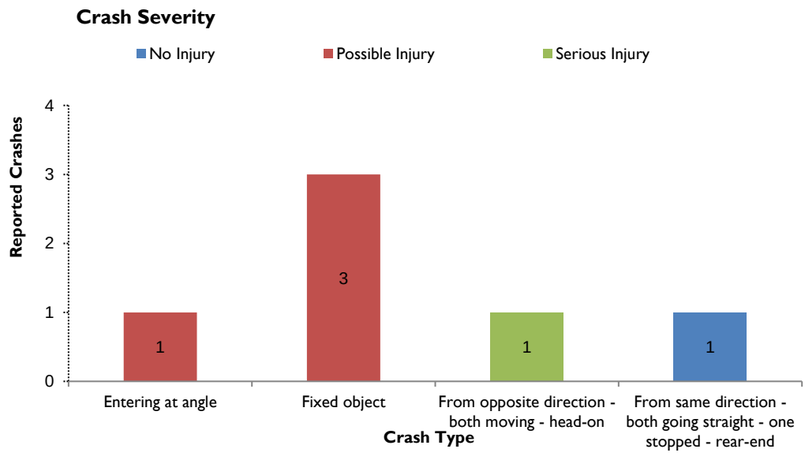


Exhibit I-IA Reported Crashes by Severity and Type

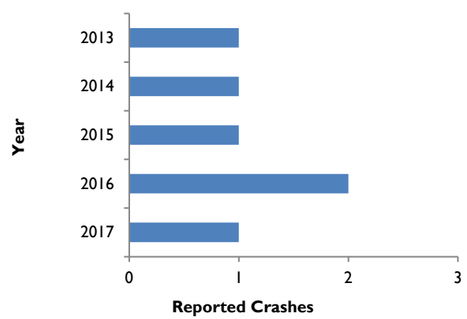


Exhibit I-IB Reported Crashes by Year

Site Photo

Photo I-IA: No definition of intersection approach on north leg
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Convert minor-road stop control to all-way stop control
- Increase distance to roadside features from 3.3 ft to 16.7 ft
- Increase triangle sight distance
- Signing and striping improvements

Intersection Performance Summary (2013-2017)

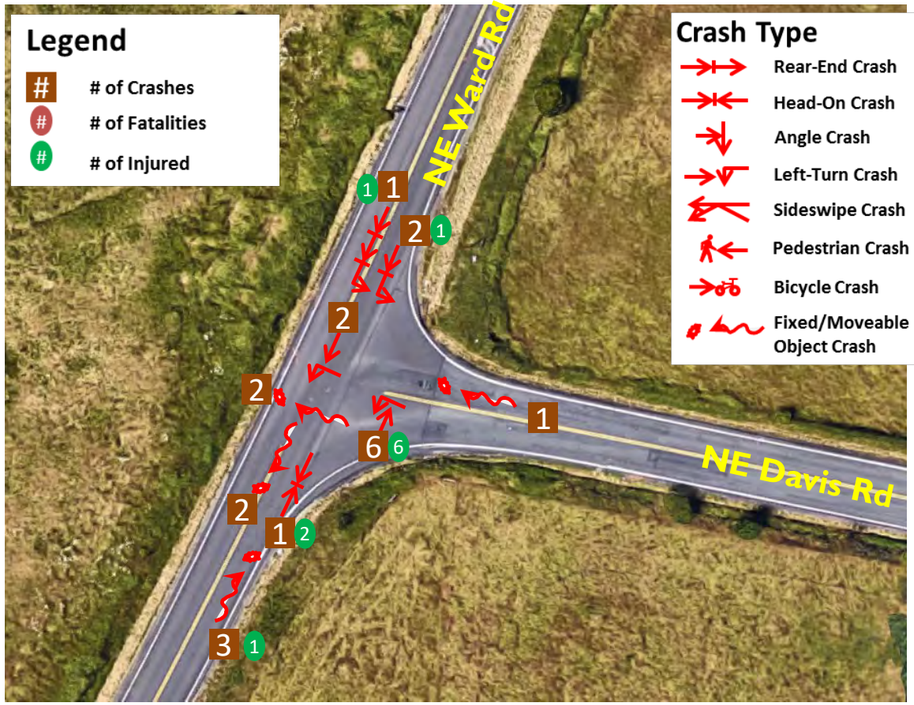
Table 1-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#6** location countywide.

Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle, fixed object and alcohol impaired crashes.

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	1.39	0.98
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.23	0.75
Excess Proportion of Fixed Object Crash Type	0.11	0.25
Excess Proportion of Alcohol Impaired Crashes	0.01	0.25
Annual Equivalent Property Damage Only Score	70.7	0.98
Total		3.71



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 8 of the 20 crashes were fixed object related (Exhibit 1-1A).
- 8 of the 20 crashes were left turning crashes (Exhibit 1-1A).
- 8 of the 20 crashes resulted in injuries (Exhibit 1-1A).
- 1 of the 20 crashes were related to alcohol impairment.

Field Review Observations

- Curved approach on the south side limits visibility.
- Minor approach on downslope and no pavement markings (Photo 1-1A)

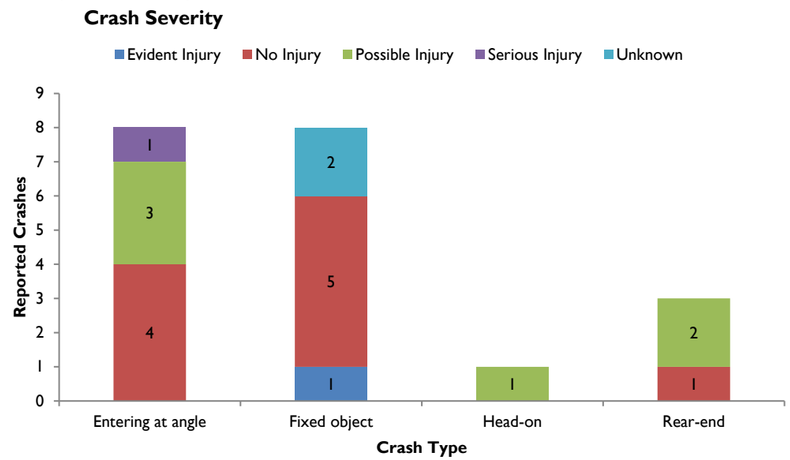


Exhibit 1-1A Reported Crashes by Severity and Type

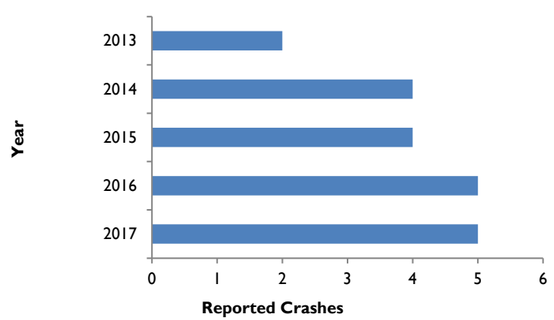


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-1A: Minor street approach to Davis Road
Source: Clark County, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Install southbound left turn lane
- Provide right-turn lane on major approach
- Widen shoulders around intersection
- Convert intersection with minor-road stop control to modern roundabout
- Provide intersection illumination
- Install a traffic signal (meets signal warrants)
- Signing and striping improvements

Intersection Performance Summary (2013-2017)

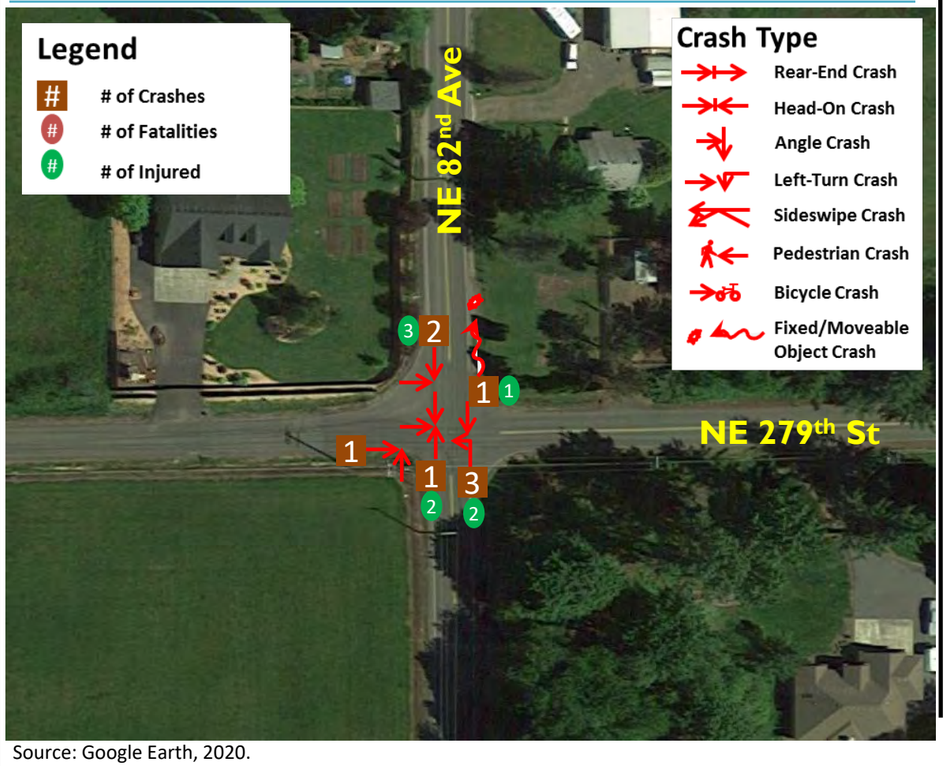
Table I-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#6** location countywide.

Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle, fixed object and alcohol impaired crashes.

Table I-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	1.51	0.98
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.33	0.75
Excess Proportion of Fixed Object Crash Type	0.30	0.25
Excess Proportion of Alcohol Impaired Crashes	0.08	0.25
Annual Equivalent Property Damage Only Score	68.2	0.98
Total		3.71



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 3 of the 8 crashes were left turning related (Exhibit I-IA).
- 4 of the 8 crashes were angle crashes (Exhibit I-IA).
- 6 of the 8 crashes resulted in injuries (Exhibit I-1A).
- 1 of the 8 crashes were related to alcohol impairment.

Field Review Observations

- Intersection sight distance limited by vegetation (Photo 1-IA).
- Minor street approaches not delineated.

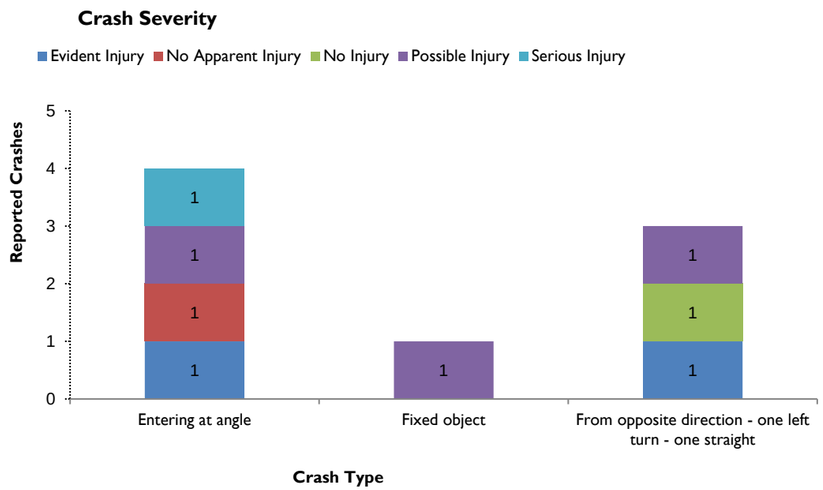


Exhibit I-1A Reported Crashes by Severity and Type

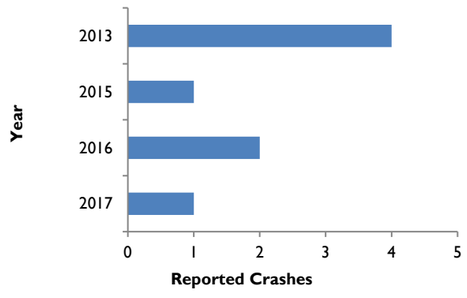


Exhibit I-1B Reported Crashes by Year

Site Photo

Photo I-IA: Limited intersection sight distance
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Convert minor-road stop control to all-way stop control
- Provide a left-turn lane on both major-road approaches
- Increase triangle sight distance

Intersection Performance Summary (2013-2017)

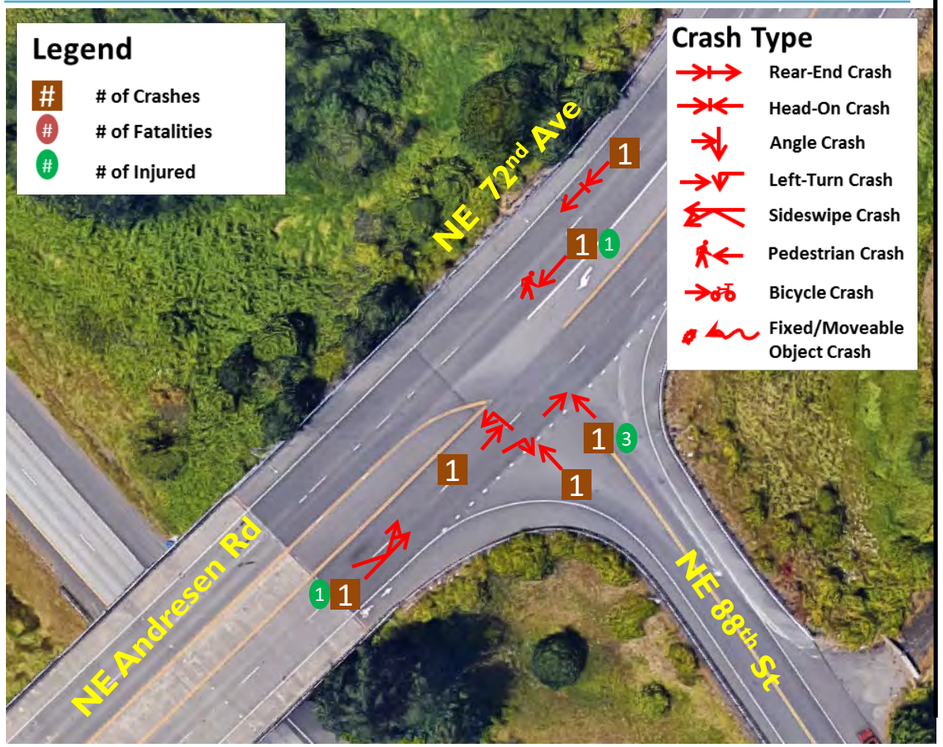
Table 1-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#8** location countywide.

Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle, opposite direction and bicycle or pedestrian crashes.

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	0.84	0.87
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.34	0.75
Excess Proportion of Opposite Direction Crash Type	0.05	0.25
Excess Proportion of Bicycle or Pedestrian Crashes	0.10	0.25
Annual Equivalent Property Damage Only Score	61.2	0.97
Total		3.59



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- Half of the crashes were angle crashes (Exhibit 1-1A).
- Half of the crashes resulted in injuries (Exhibit 1-1A).
- 1 of the 6 crashes involved a pedestrian (Exhibit 1-1A).

Field Review Observations

- All approaches to the intersection are curved.
- Minor road approach on a crest curve (Photo 1-1A).

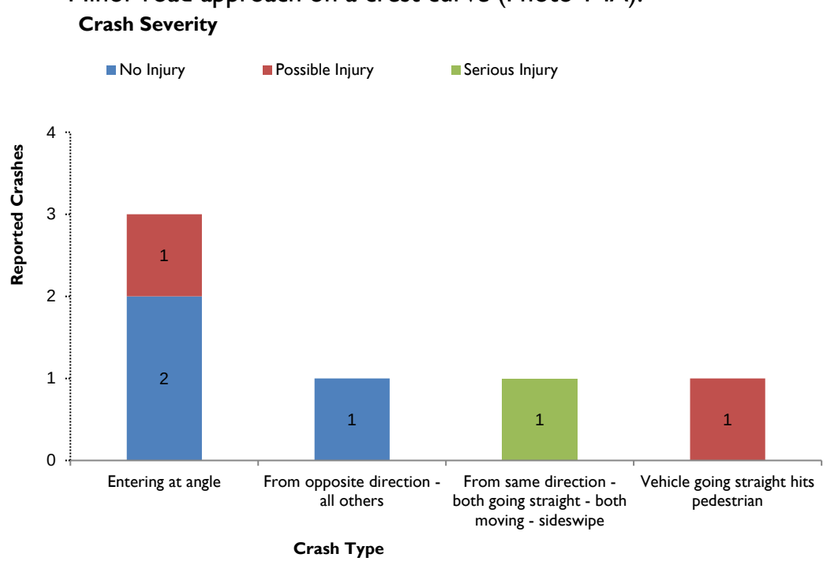


Exhibit 1-1A Reported Crashes by Severity and Type

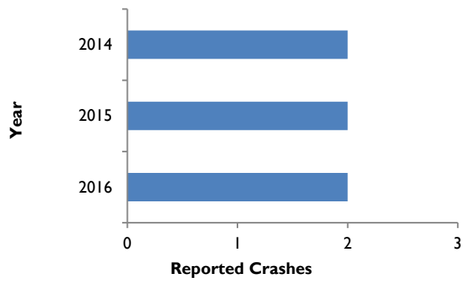


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA: Minor approach on a crest curve
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Install a traffic signal (meets signal warrants)
- Increase triangle sight distance
- Install raised median

Intersection Performance Summary (2013-2017)

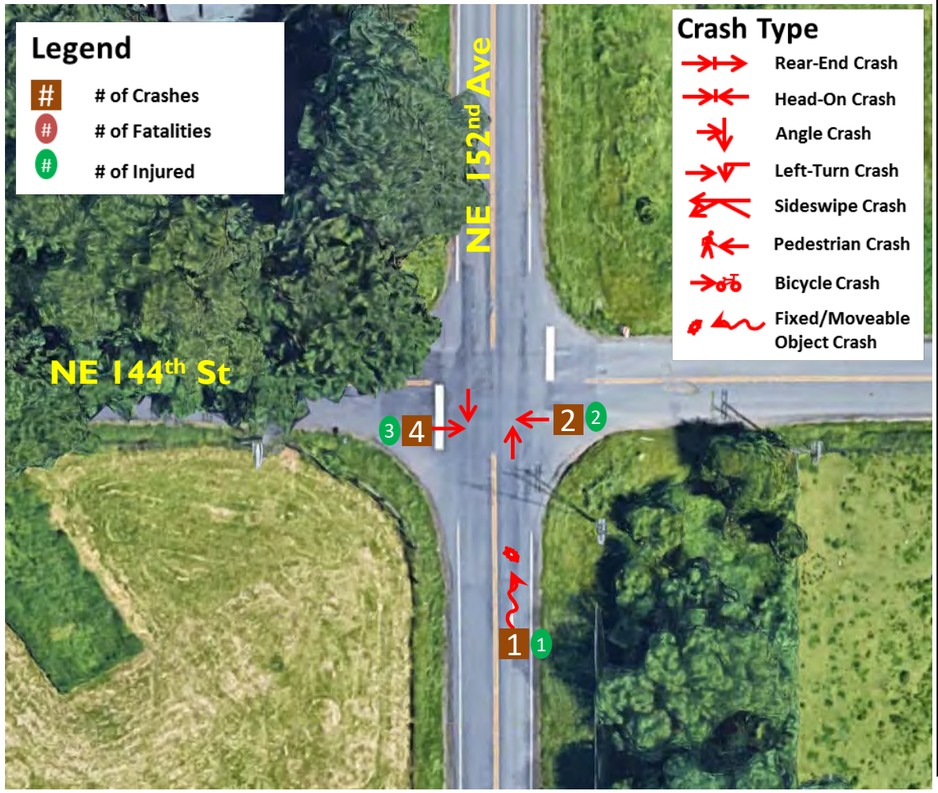
Table I-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#9** location countywide.

Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle crashes.

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	0.57	0.84
Number of Fatal & Severe Injuries	2	1.00
Excess Proportion of Angle Crash Type	0.66	0.75
Annual Equivalent Property Damage Only Score	119.7	0.99
Total		3.58



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 6 of the 7 crashes were angle crashes (Exhibit I-IA).
- 4 of the 7 crashes resulted in injuries (Exhibit I-1A).

Field Review Observations

- Limited intersection sight distance due to vegetation in the southwest and northeast corners (Photo 1-IA).

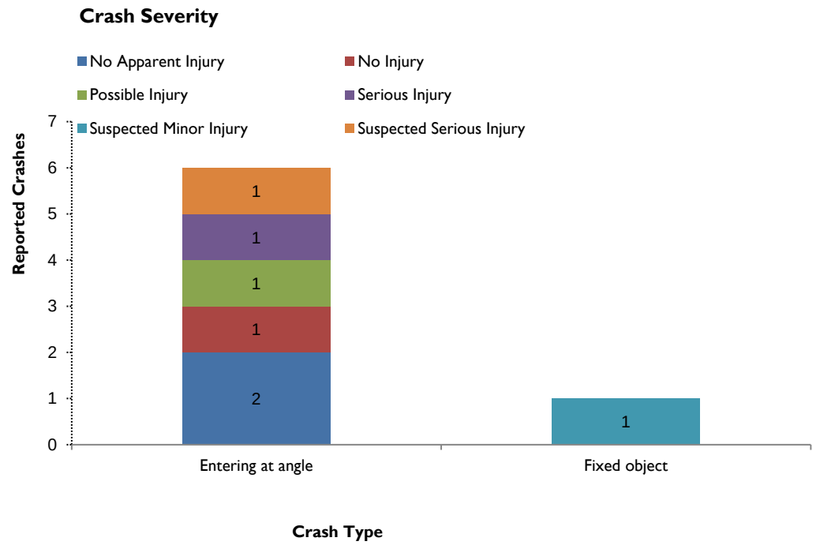


Exhibit 1-1A Reported Crashes by Severity and Type

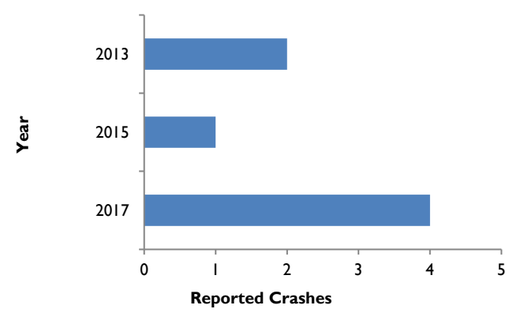


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Limited intersection sight distance due to vegetation

Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Convert minor-road stop control to all-way stop control
- Signing and striping improvements

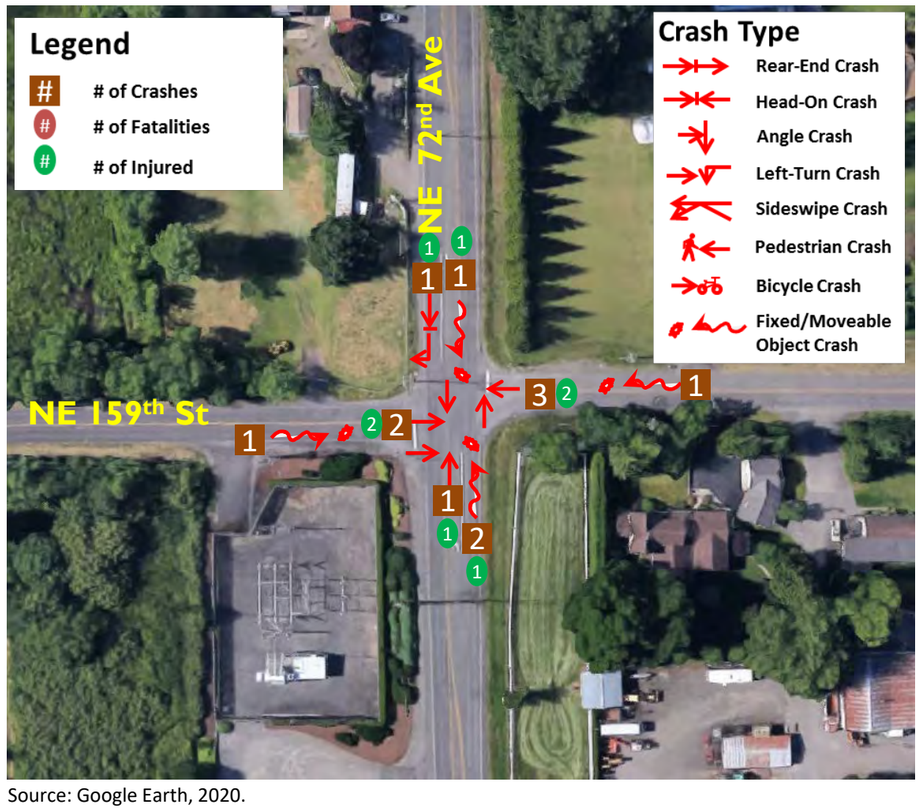
Intersection Performance Summary (2013-2017)

Table 1-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#13** location countywide.
Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle and alcohol impaired crashes.

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	0.63	0.86
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.28	0.75
Excess Proportion of Alcohol Impaired Crash Type	0.14	0.25
Annual Equivalent Property Damage Only Score	70.7	0.98
Total		3.34



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- Half of the crashes were angle crashes (Exhibit 1-IA).
- A quarter of the crashes were fixed object crashes (Exhibit 1-IA).
- Half of the crashes resulted in injuries (Exhibit 1-1A).
- 2 of the 12 crashes involved alcohol impairment.

Field Review Observations

- Minor street approaches are offset (Photo 1-IA).
- Multiple driveways within the intersection influence area.

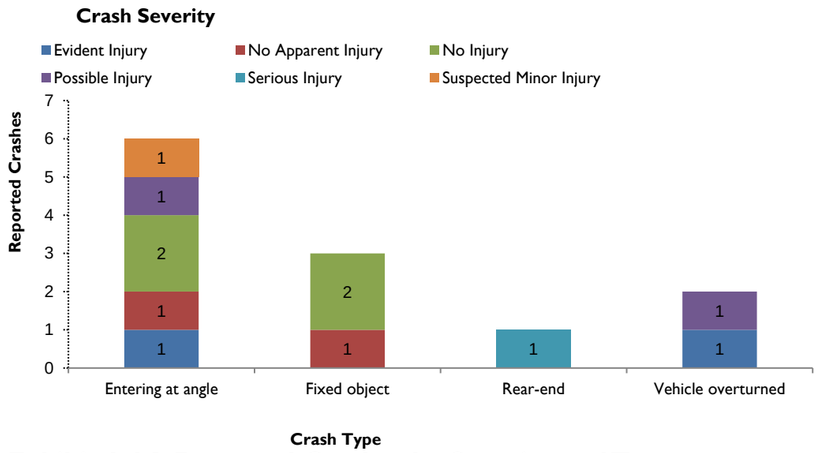


Exhibit 1-1A Reported Crashes by Severity and Type

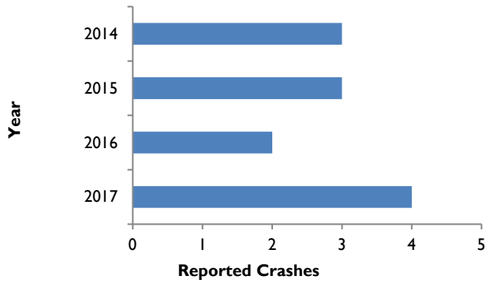


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Offset minor street approaches
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Convert intersection with minor-road stop control to modern roundabout
- Provide intersection illumination
- Install a traffic signal (meets signal warrants)
- Provide triangle sight distance

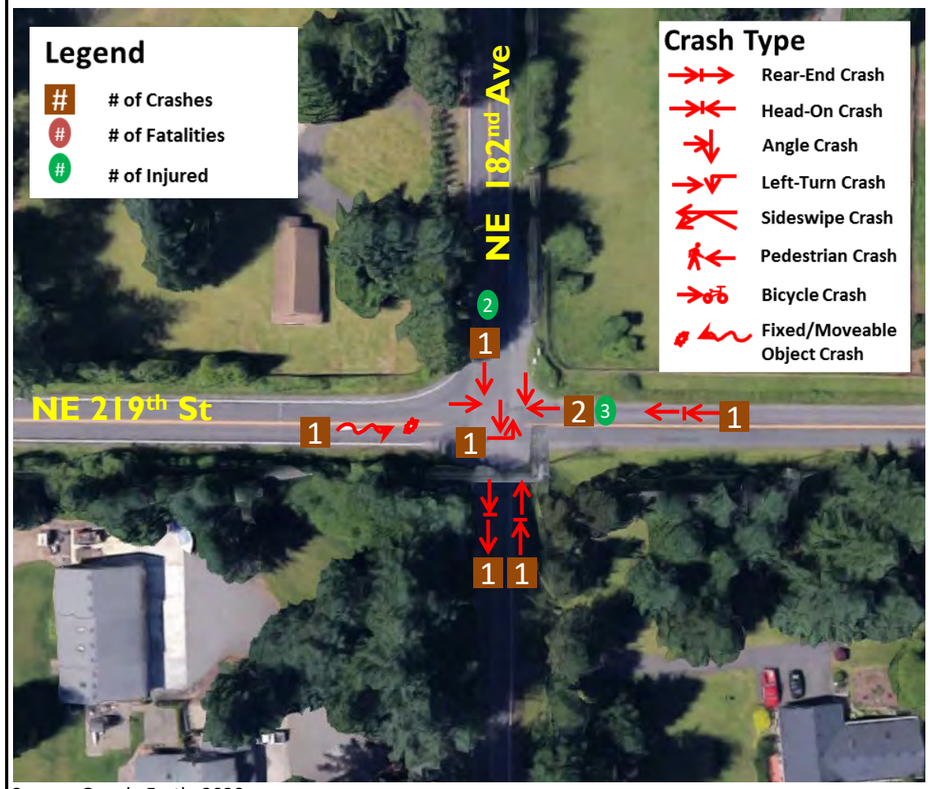
Intersection Performance Summary (2013-2017)

Table 1-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#14** location countywide.
Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle and alcohol impaired crashes.

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	0.71	0.88
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.26	0.75
Excess Proportion of Alcohol Impaired Crash Type	0.24	0.25
Annual Equivalent Property Damage Only Score	59.2	0.95
Total		3.33



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- Half of the crashes were angle crashes (Exhibit I-IA).
- 3 of the 8 crashes were rear-end crashes (Exhibit I-IA).
- 2 of the 8 crashes resulted in injuries (Exhibit I-1A).
- 2 of the 8 crashes involved alcohol impairment.

Field Review Observations

- Limited delineation and pavement markings at the intersection (Photo 1-IA)

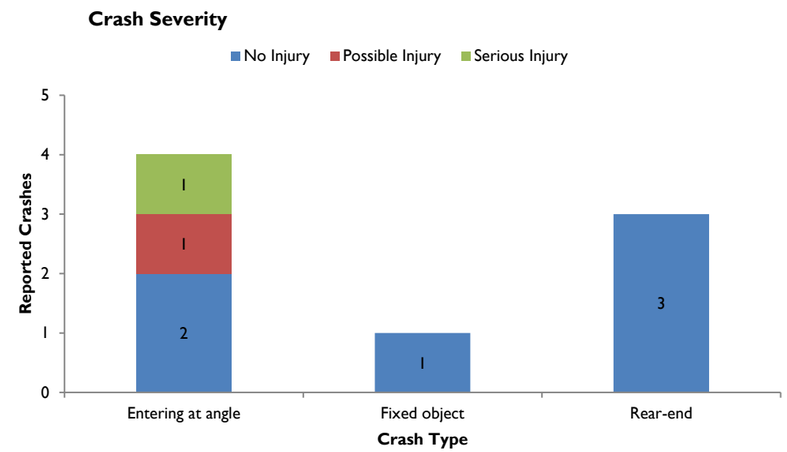


Exhibit 1-1A Reported Crashes by Severity and Type

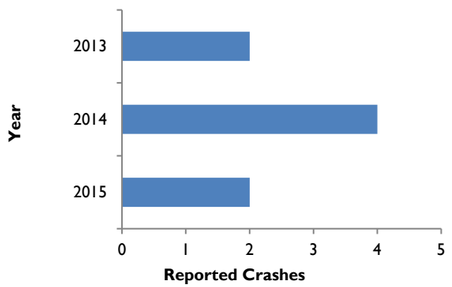


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Limited delineation at intersection
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Provide a left-turn lane on both major-road approaches
- Provide triangle sight distance

Note: Traffic signal warrant analysis was conducted in 2018 and the criteria was not met

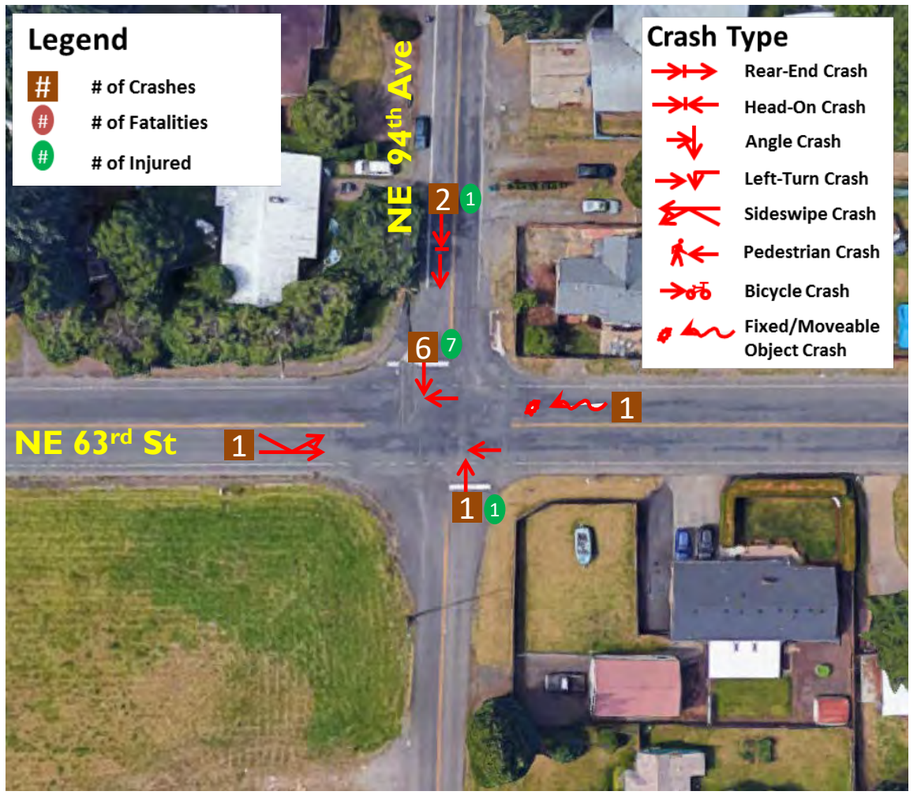
Intersection Performance Summary (2013-2017)

Table I-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#17** location countywide.
Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle crashes.

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	3.56	0.99
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.47	0.75
Annual Equivalent Property Damage Only Score	68.6	1.00
Total		3.24



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 7 of the 11 crashes were angle crashes (Exhibit I-IA).
- 6 of the 11 crashes resulted in injuries (Exhibit I-1A).

Field Review Observations

- Northeast corner has limited intersection sight distance because of fencing (Photo 1-IA)

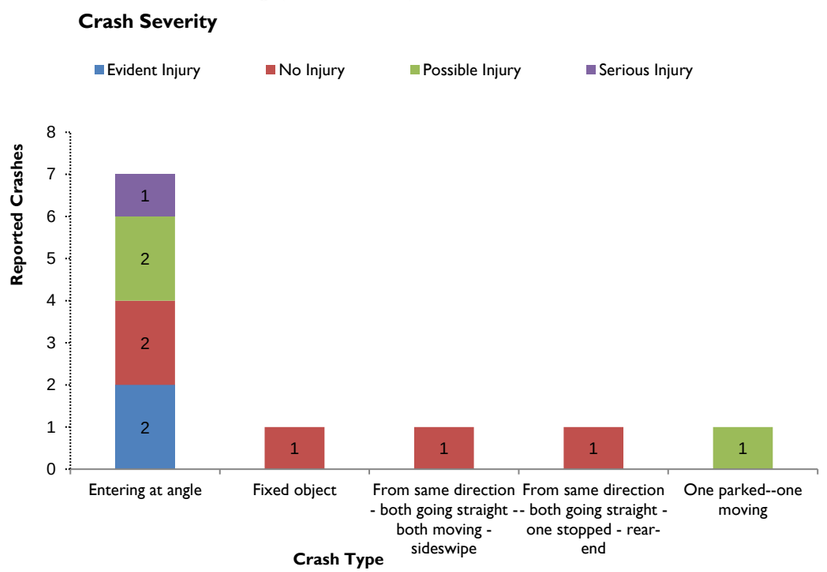


Exhibit 1-1A Reported Crashes by Severity and Type

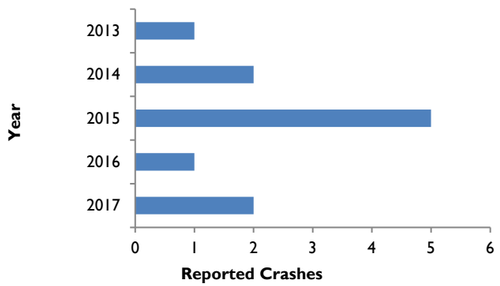


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Limited intersection sight distance because of Fencing
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Provide triangle sight distance

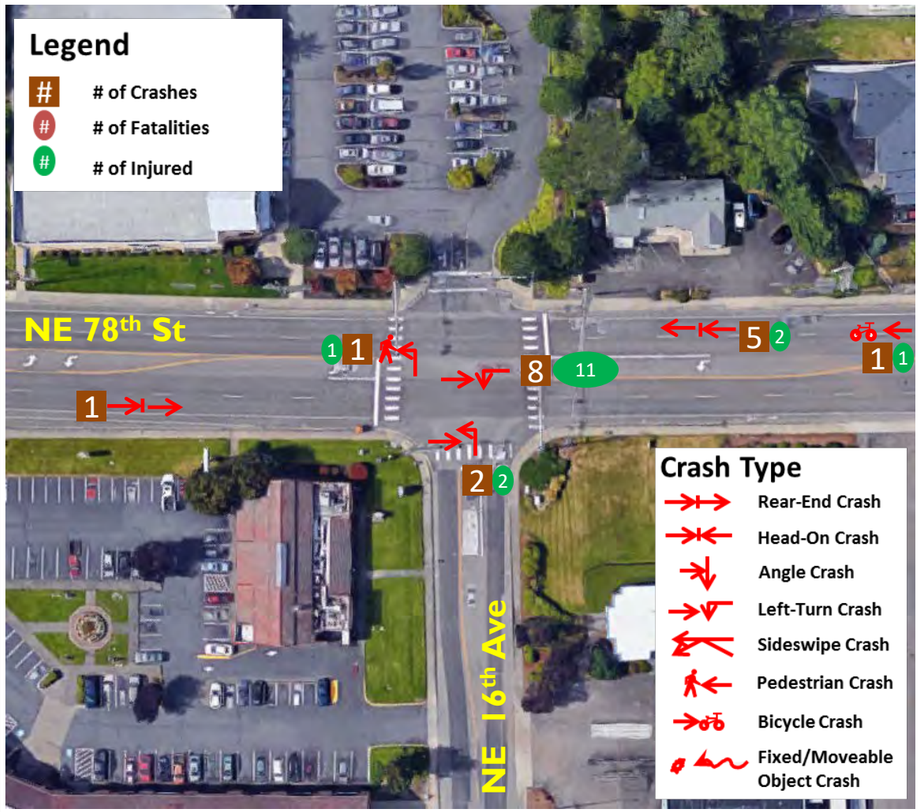
Intersection Performance Summary (2013-2017)

Table I-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#18** location countywide.
Key reasons the intersection was selected for further review include:

- The crash frequency and severity

Table I-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	2.43	0.73
Number of Fatal & Severe Injuries	3	1.50
Annual Equivalent Property Damage Only Score	192.6	1.00
Total		3.23



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- Almost half of the crashes involved left turning (Exhibit I-IA).
- 5 of the 18 crashes were rear-end crashes (Exhibit I-IA).
- 2 of the 18 crashes involved bicyclists or pedestrians (Exhibit I-IA).
- 11 of the 18 crashes resulted in injuries (Exhibit I-1A).

Field Review Observations

- Limited sight distance for north bound left and south bound left (Photo 1-IB).

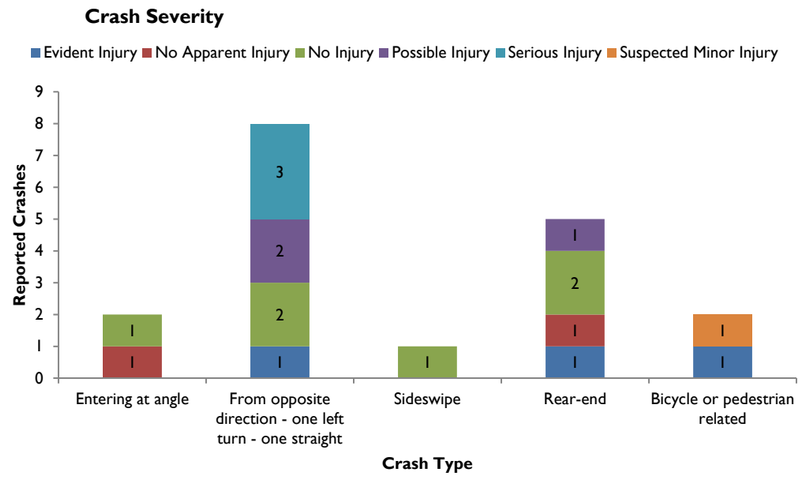


Exhibit I-1A Reported Crashes by Severity and Type

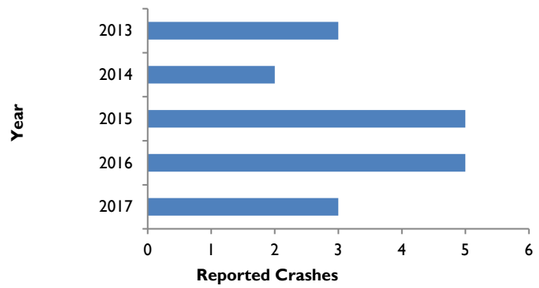


Exhibit I-1B Reported Crashes by Year

Site Photo

Photo I-IA Vegetation on south bound approach
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Change left-turn phase to protected phasing on one or more approaches
- Modify change plus clearance interval to ITE 1985 Proposed Recommended Practice

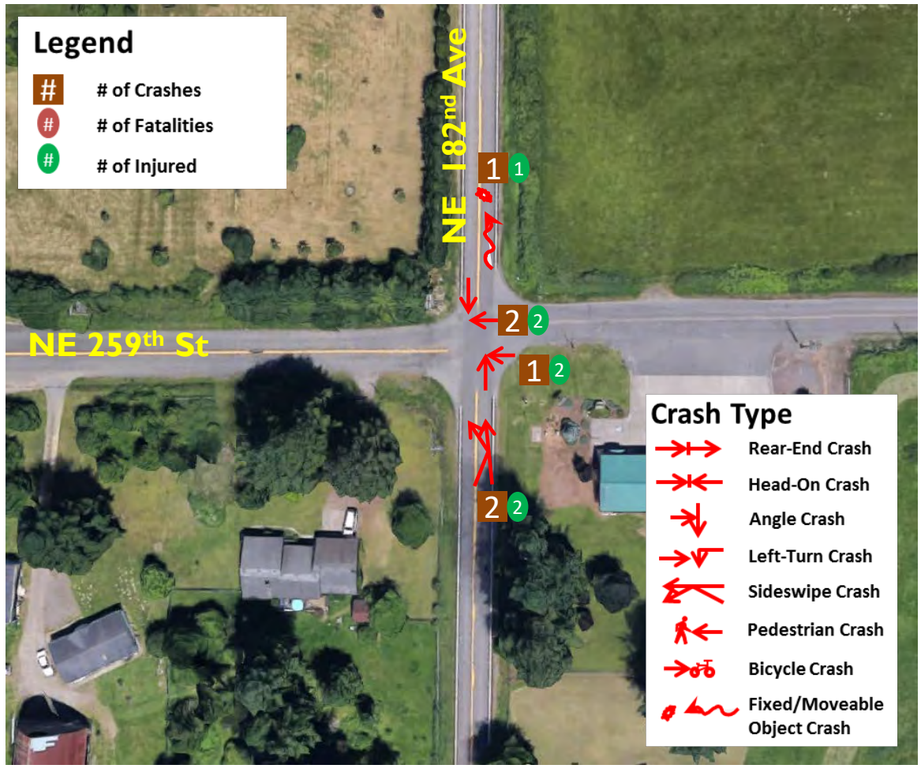
Intersection Performance Summary (2013-2017)

Table I-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#19** location countywide.
Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle crashes

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	1.89	0.99
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.26	0.75
Annual Equivalent Property Damage Only Score	68.9	0.98
Total		3.22



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 3 of the 7 crashes were angle crashes (Exhibit I-IA).
- 2 of the 7 crashes were fixed object crashes (Exhibit I-IA).
- The majority of the crashes resulted in injuries (Exhibit I-1A).

Field Review Observations

- Offset intersection
- Driveway next to the intersection on the minor road
- Limited sight distance on northwest corner due to vegetation (Photo 1-IA)

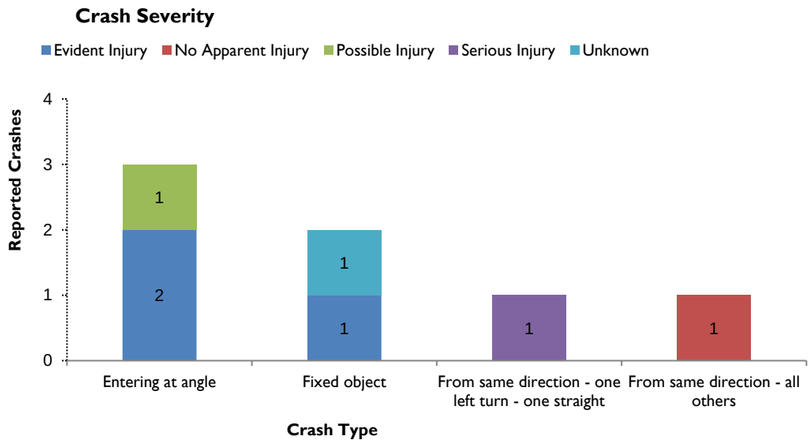


Exhibit 1-1A Reported Crashes by Severity and Type

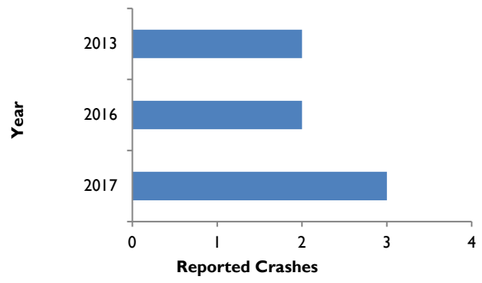


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Limited intersection sight distance
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Convert minor-road stop control to all-way stop control
- Provide a left-turn lane on both major-road approaches
- Provide triangle sight distance

Intersection Performance Summary (2013-2017)

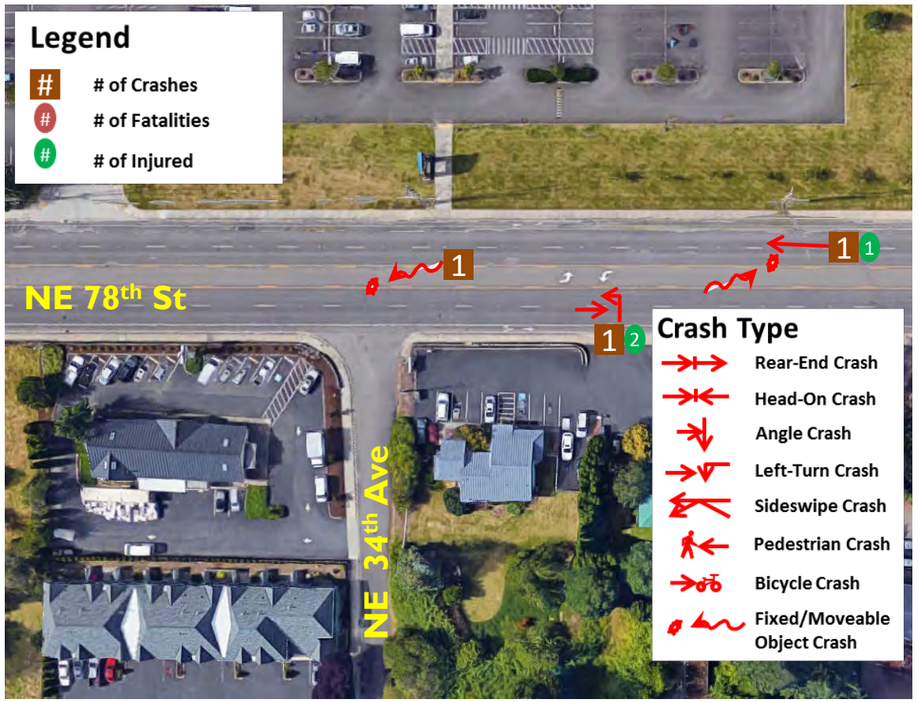
Table I-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#20** location countywide.

Key reasons the intersection was selected for further review include:

- The crash frequency and severity
- The high proportion of angle, opposite direction, and fixed object crashes

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	0.24	0.51
Number of Fatal & Severe Injuries	1	0.50
Excess Proportion of Angle Crash Type	0.10	0.75
Excess Proportion of Opposite Direction Crash Type	0.24	0.25
Excess Proportion of Fixed Object Crash Type	0.19	0.25
Annual Equivalent Property Damage Only Score	59.4	0.95
Total		3.21



Source: Google Earth, 2020.

Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 1 of the 3 crashes were angle crashes (Exhibit I-IA).
- 1 of the 3 crashes were fixed object crashes (Exhibit I-IA).
- 2 of the 3 crashes resulted in injuries (Exhibit I-1A).

Field Review Observations

- Approach from minor road is on a crest curve (Photo 1-IA)

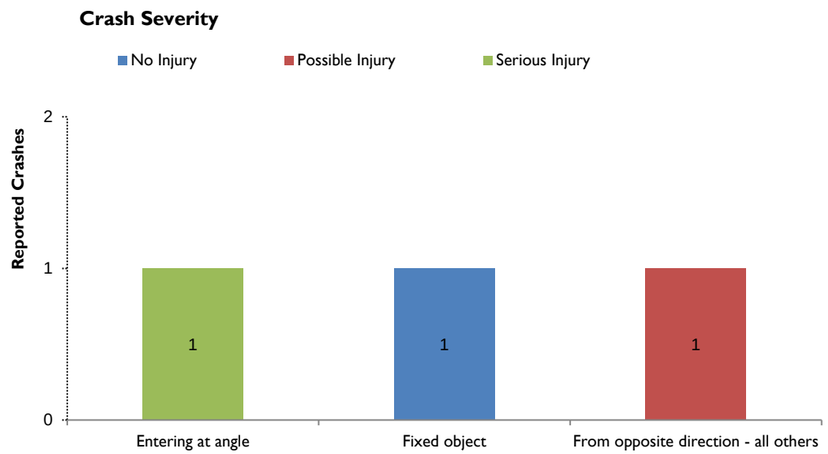


Exhibit 1-1A Reported Crashes by Severity and Type

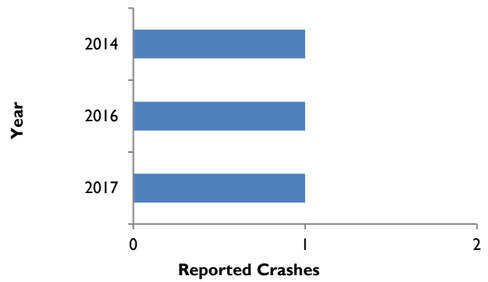


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Intersection on crest curve
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- None, no observed trends to rectify

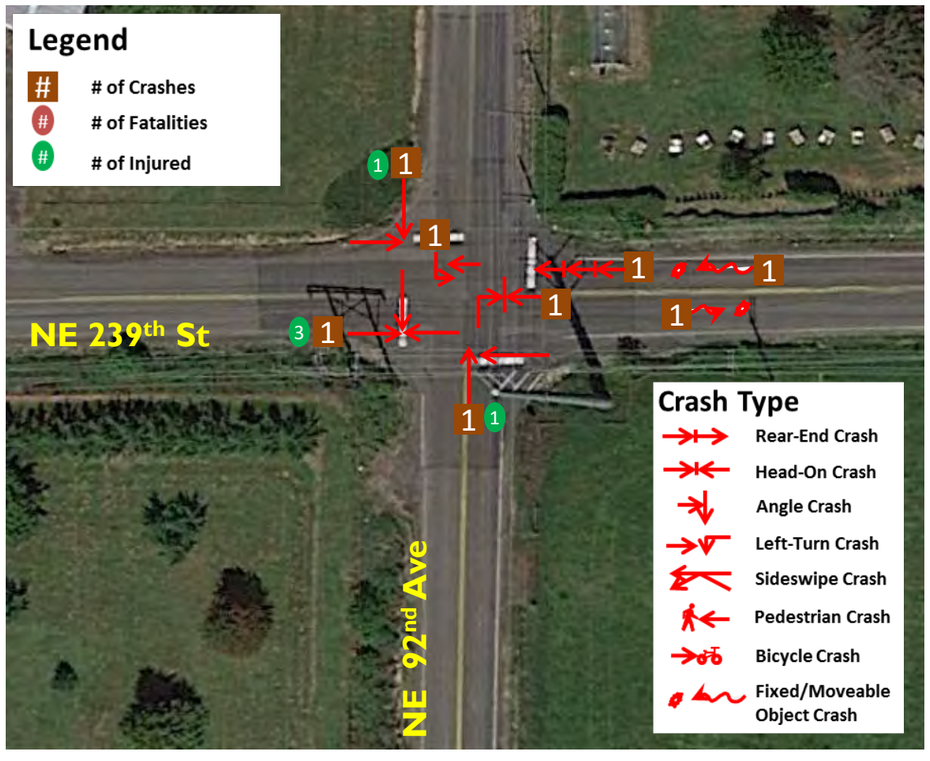
Intersection Performance Summary (2013-2017)

Table 1-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#22** location countywide.
Key reasons the intersection was selected for further review include:

- The crash frequency
- The high proportion of angle, fixed object and alcohol impaired crashes

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	1.18	0.97
Number of Fatal & Severe Injuries	0.00	0.00
Excess Proportion of Angle Crash Type	0.49	0.75
Excess Proportion of Fixed Object Crash Type	0.12	0.25
Excess Proportion of Alcohol Impaired Crashes	0.07	0.25
Annual Equivalent Property Damage Only Score	6.50	0.96
Total		3.18



Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 5 of the 8 crashes were angle crashes (Exhibit I-IA).
- 2 of the 8 crashes were fixed object crashes (Exhibit I-IA).
- 3 of the 8 crashes resulted in injuries (Exhibit I-1A).
- 1 of the 8 crashes was related to alcohol impairment.

Field Review Observations

- All way stop controlled intersection could use enhanced signing and striping for additional warning to the driver (Photo 1-IA)

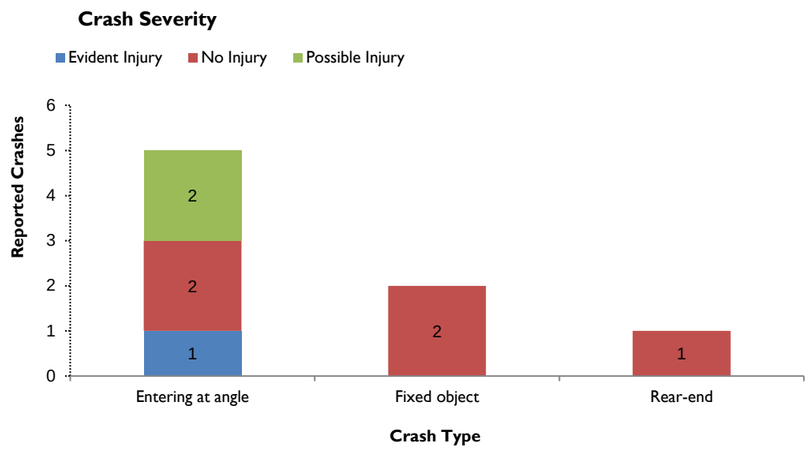


Exhibit 1-1A Reported Crashes by Severity and Type

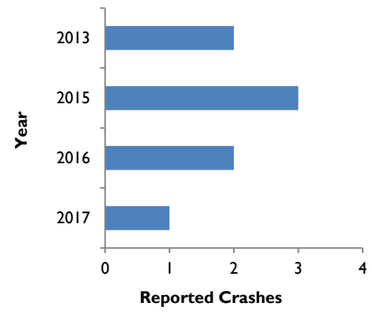


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Intersection signing and striping
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Provide intersection illumination
- Signing and striping improvements
- Widen shoulders around intersection

Intersection Performance Summary (2013-2017)

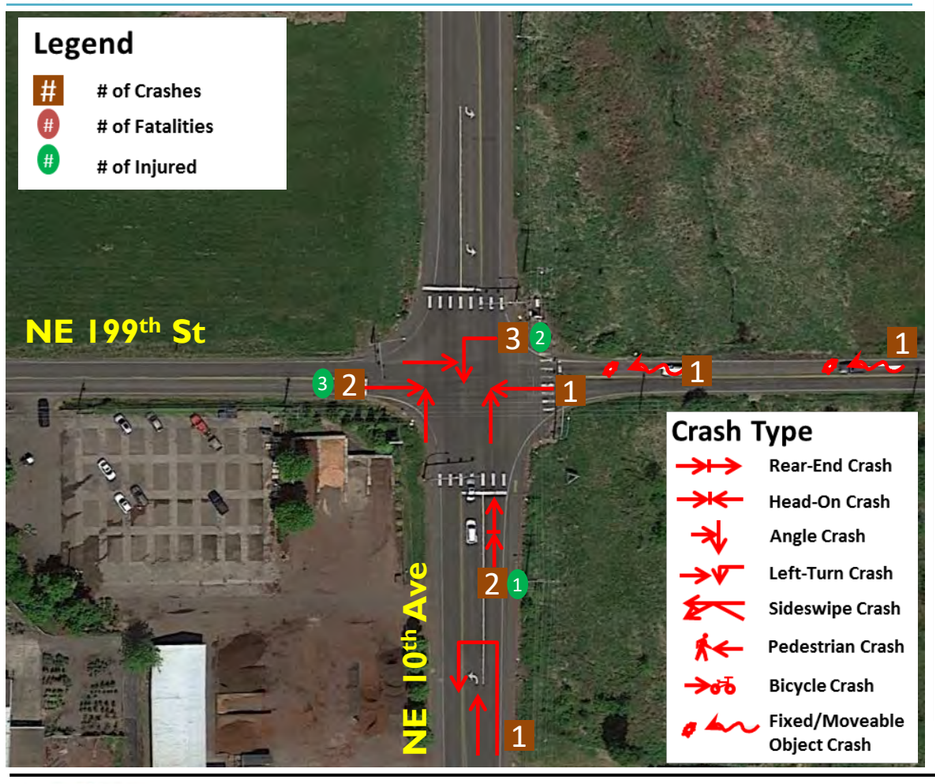
Table 1-1A provides the intersection's performance scores and rankings from the Transportation Safety Management Plan's network screening performance evaluation. This intersection is the **#23** location countywide.

Key reasons the intersection was selected for further review include:

- The crash frequency
- The high proportion of angle, opposite direction, and fixed object crashes

Table 1-1A Performance Measure Results

Performance Measure	Value	Score
Critical Crash Rate Ratio	1.04	0.96
Number of Fatal & Severe Injuries	0.00	0.00
Excess Proportion of Angle Crash Type	0.14	0.75
Excess Proportion of Opposite Direction Crash Type	0.21	0.25
Excess Proportion of Fixed Object Crash Type	0.05	0.25
Annual Equivalent Property Damage Only Score	8.10	0.96
Total		3.17



Crash Analysis and Field Review Summary

The crash diagram within the aerial in the bottom left highlights the type and location of crashes. Relevant crash trends and field review observations are highlighted below.

Identified Crash Trends

- 6 of the 11 crashes were angle or turning crashes (Exhibit 1-IA).
- 2 of the 11 crashes were fixed object crashes (Exhibit 1-IA).
- 3 of the 11 crashes were rear-end crashes (Exhibit 1-IA).
- 4 of the 11 crashes resulted in injuries (Exhibit 1-1A).

Field Review Observations

- Lack of left turn lanes on NE 199th Street (Photo 1-IA)

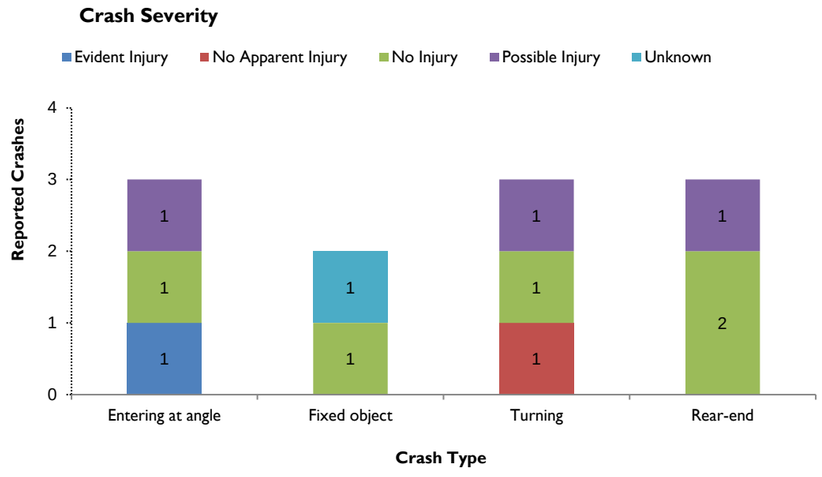


Exhibit 1-1A Reported Crashes by Severity and Type

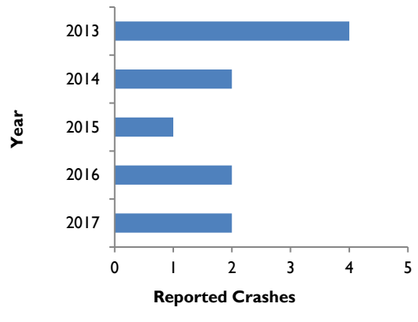


Exhibit 1-1B Reported Crashes by Year

Site Photo

Photo 1-IA Lack of left turn lanes on west and east legs of intersection
Source: Google Earth, 2020.

Countermeasures Selection

The following countermeasures are suggested based on the observed crash trends and field reviews to help reduce crash frequency and severity at the intersection.

Suggested Countermeasures

- Installation of left turn lanes on NE 199th Street
- Convert signalized intersection to modern roundabout

Third Party Cyber Security Questionnaire

This questionnaire is used to assess the control environment of a third party that may handle, store or process sensitive data provided to them by Clark County. This questionnaire is one component of Clark County's ongoing due diligence and risk management process. This review will evaluate if proper information security controls are in place at the third party location in order to protect the confidentiality, integrity and availability of data.

INSTRUCTIONS

1) Complete the "Business Information" tab.
2) Answer all questions on the "Cyber Security Questions" tab.
3) If applicable, answer all questions on the "Data center" tab.

All answers and supporting documentation will be reviewed by Clark County's Security Committee, who may request further clarification. If Clark County enters into an agreement with you, some or all of the information provided in response to these questions may be incorporated into the agreement. The agreement will also contain a representation by you that all such information is accurate and complete as of the date you are signing the agreement and that no changes are planned as of such date except as specifically set forth in the agreement.

Business Information

Responders Name	
Responders Job Title	
Date of Response	
Clark County may have follow up questions to your responses. Please provide the name, email and phone of the person we should contact for more information.	
Company Profile	
Company name	
Location of data	
Location(s) where scoped systems and data is stored	
Name of third party data center, if applicable	
Provide location	
Name of any other location(s) where scoped system and data is stored	

ISO 27002:2013 Control Family	Questions	Responses
Physical and Environmental Security	Describe what physical security controls are deployed to protect your corporate and data center operation facilities.	
Physical and Environmental Security	Describe the organization's approach to ensuring storage media is wiped and/or destroyed prior to disposal and/or reuse.	
Physical and Environmental Security	Describe policies and controls in place for securing and protecting unattended infrastructure devices and network connections.	
Ops Security	How are the development, test, and production environments separated?	
	What is the process for introducing changes to the environment? Please address how changes are planned and tested; this should include hardware, software, and configuration changes.	
Ops Security	What controls are in place to prevent malicious code from executing on information systems? Describe the approach to both prevention and detection of successful execution.	
Ops Security	Describe your organization's service and data backup strategy? When was your last successful test recovery of that environment?	
Ops Security	What kind of audit and event logs are being stored and reviewed? In your answer please address: What constitutes an event What systems are included	
	How are audit logs protected and stored? Do they include authorization and access authentication logs?	
Ops Security	What tampering prevention and detection controls are in place over log collection systems?	
Ops Security	How are SysAdmin/operator actions and sessions monitored and reviewed on a regular basis?	
Ops Security	What are the controls in place to control and manage the installation and modification of installed software?	
Ops Security	Describe the process in place to handle vulnerability discovery and management? Please be sure to include how endpoint or "client-side" vulnerabilities are included in the process.	
Ops Security	What policies exist governing the installation of software by non-admin users on company assets? For this question, please focus on local administration privileges on end-user devices and software.	

Communication Security	Please describe control and monitoring systems in place to protect the information residing within your system. Scope should include mechanisms such as IDS and IPS systems.	
Communication Security	What controls are in place to ensure confidentiality and availability of inbound and outbound data?	
Communication Security	Describe how systems, applications and processes are segregated from each other to ensure data integrity and confidentiality.	
System Acquisition, Development, and Management	How are modifications to installed systems and software monitored, restricted, and controlled?	
System Acquisition, Development, and	Please indicate whether or not an Enterprise Information Security Policy exists within the organization and what frameworks went into the development?	
System Acquisition, Development, and Management	How is security testing conducted during the development of an application or piece of software?	
Information Security Incident Management	Describe your organization's approach how information security incidents/events are reported.	
Information Security Incident Management	Describe the incident response plan's process flow from initial incident reporting to closure.	
Human Resource Security	Describe your organization's background screening process as it pertains to employees, contractors, consultants, etc. .	
Human Resource Security	Describe the organization's approach to providing information security awareness training to all users of their corporate network (employees, contractors, consultants etc.)	
Asset Management	Describe how the organization maintains an hardware inventory of all the devices on the network.	
	Describe how the organization maintains an software inventory of all the software that is allowed for use on the network.	
Asset Management	Describe how the organization controls and manages the use of removable media on the network.	
Access Control	Describe how the organization's Access Control policy is utilized in the provisioning and de-provisioning of access to their information systems.	
Access Control	Describe how the organization establishes the appropriate levels of access for its users.	
Access Control	Describe the approval process for granting privileged access.	
Access Control	Describe the organization's password reset procedures.	
Access Control	Describe the organization's approach to user access reviews.	
Access Control	Describe the organization's termination and/or role change process as it pertains to access control.	
Access Control	Describe what guidance is given users in regards to managing their authentication credentials.	

Access Control	Describe the authentication mechanisms used in order for a user to log onto the organization's network (locally and remotely).	
	Describe the authentication mechanisms in which privileged users log onto the organization's network (locally and remotely).	
	Describe the organization's approach to handling session inactivity.	
Access Control	Describe the organization's password management system: Number of characters? Complexity? History/Reuse? Frequency of change? Visible when enter? Encrypted in storage? Encrypted in transit?	
Access Control	How is access to program source code controlled/restricted?	
	Is that access logged?	
Supplier Relationships	Describe what security controls are in place for suppliers/vendors/consultants who will have access to information systems that contain data	
Information Security Aspects of Business Continuity Management	Describe what processes, procedures and controls your organization will leverage during a disaster recovery/business continuity event in order to safeguard data and resume their contracted support services.	
Information Security Aspects of Business Continuity Management	Describe how your organization will review and tests processes, procedures and controls leveraged to safeguard data during a disaster recovery/business continuity event.	

Questions	Responses
Data Center Network Security:	
Are up to date network diagrams maintained? If so, how is access to them restricted	
How is access to network devices (routers, hubs, etc.) controlled	
Do situations exist where the User ID and password are shared between individuals? If so, provide your controls.	
Do formal documented, detailed procedures for handling security incidents exist?	
Are established, documented, procedures in place for patching against vulnerabilities	
Are security violation events logged, monitored/reviewed/reported and followed up on	
How many security violations were investigated in the last 12 months	
Briefly explain the procedures used to perform vulnerability assessments.	
Are external penetration/vulnerability tests performed internally or by a third party on a regular basis?	
Are automatic alerts generated when critical systems reach specific thresholds (for instance, a sustained and unexpected spike in traffic)	
What solutions are used to provide remote access to your network? Please provide details.	
Are the security services that provide protection from the Internet owned and administered by your company?	
Please describe the solution used to protect servers and workstations from viruses.	
Are procedures in place to facilitate configuration change management? If yes, please explain.	
Data Center Physical Security:	
Please provide the address for all locations where Clark County data will reside if a contract is entered into with your company. Then answer the following questions as they pertain to those locations.	
How is physical access to rooms and buildings controlled	
How is physical access to network devices and systems controlled	
Is disk storage media ever sent offsite for any reason? If so, state each reason or circumstance for which such media may be sent offsite (such as for repairs) and state what precautions are taken to protect information contained on such media.	
Are visitors required to sign guest logs indicating purpose of visit and arrival/departure times	
Are visitors escorted at all times by authorized security personnel	
Do other tenants reside in your building? If so, what physical security separates the tenants	