Final Research Report
Agreement T4118, Task 91
Land Development Risks

LAND DEVELOPMENT RISKS
ALONG STATE TRANSPORTATION CORRIDORS

by

Anne Vernez Moudon, Professor
Amir Sheikh, GIS Analyst and Andy Kraus, Doctoral Research Assistant
Orion Stewart, MUP, Research Scientist
URBAN FORM LAB (UFL)
University of Washington, Box 354802
Seattle, Washington 98195

Mark E. Hallenbeck, Director
Washington State Transportation Center

Washington State Transportation Center (TRAC)
University of Washington, Box 354802
Seattle, Washington 98105-4631

Washington State Department of Transportation Technical Monitor
Karena Houser, Transportation Planning Specialist

Prepared for
The State of Washington
Department of Transportation
Lynn A. Peterson, Secretary

September 2013

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
WA-RD 805.1		

4. TITLE AND SUBTITLE	5. REPORT DATE
LAND DEVELOPMENT RISKS ALONG STATE TRANSPORTATION CORRIDORS	September 2013
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
Anne Vernez Moudon, Amir Sheikh, Orion Stewart, Andy Kraus, Mark E. Hallenbeck	
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. WORK UNIT NO.
Washington State Transportation Center (TRAC) University of Washington, Box 354802 University District Building; 1107 NE 45th Street, Suite 535 Seattle, Washington 98105-4631	11. CONTRACT OR GRANT NO. Agreement T4118 Task 91
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
Research Office Washington State Department of Transportation Transportation Building, MS 47372 Olympia, Washington 98504-7372 Project Manager: Kathy Lindquist, 360-705-7976	Final Research Report 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT:

Land development that is not coordinated with transportation planning can compromise the performance of Washington's state routes. Identifying land at risk for development along state routes can provide opportunities for proactive, collaborative planning to improve access, mobility, and safety while supporting economic development. This project, described in two parts, provides tools to help turn adverse risks of land development into opportunities to make route improvements.

In part one, systems for identifying land at risk for development were developed for the state and local levels from relevant literature and expert input. Risk factors for land development at the state level include historic population and job growth, population and job forecasts, and traffic conditions. Additional risk factors at the local level include regulatory constraints, critical areas, vacant and undeveloped lands, recent sales history, building permit history, and sewer and water utilities. The local level system was applied to three case study areas. Results generally agreed with local knowledge, yet the method offered an objective and systematic means for comparing corridors across the state fairly.

In part two, a menu of strategies for responsibly developing state routes was developed from current WSDOT practices, literature on standard approaches, and reports of novel solutions. Strategies were classified as planning and coordination activities, non-engineering and engineering strategies, and funding/enforcement strategies.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Land development, right of way, risk analysis, transportation planning, corridor planning, forecasting, land use, access management	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22616

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
None	None		

DISCLAIMER

CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

Land development that is not coordinated with transportation planning can lead to increased traffic congestion, decreased safety, and environmental degradation. These adverse risks of land development can compromise the performance of Washington's State Routes. Advance knowledge of where development is likely to occur can be used to facilitate collaborative planning processes. However, adverse risks can also become opportunities to improve access, mobility, and safety while supporting economic development. This project provides the Washington State Department of Transportation (WSDOT) with tools to help turn adverse risks of land development into opportunities for route improvements in two parts: (1) A replicable system to objectively evaluate where land development risk is likely to occur based on readily available data for estimating risk factors and (2) A menu of strategies to proactively mitigate adverse development risks.

The first part of the project consisted of developing systems to identify areas of land development risk at both the state and local levels. State-level risk factors were initially identified from the literature and refined on the basis of input from a round table of experts in the fields of land development and transportation. Local-level risk factors were based on the state-level risk factors but were also developed through three case study applications: The West Plains area of Spokane, the Three Creeks area of Vancouver, and Issaquah. The case studies provided valuable insight into existing local strategies for identifying areas at risk of development and the data available to do so in a systematic and objective manner. Part one resulted in five state-level risk factors and 12 local-level risk factors that can be used to identify areas at risk of land development (listed below). All factors are measured by using publically available data and are analyzed in a GIS by using spatial overlay techniques.

State-level risk factors

- Historic population and job growth (2 factors)
- Population and job forecasts (2 factors)
- Traffic conditions

Local risk factors

- Historic population and job growth (2 factors)
- Population and job forecasts (2 factors)
- Traffic conditions
- Regulatory constraints (zoning and urban growth boundaries)
- Critical Areas
- Vacant and undeveloped lands
- Recent sales history
- Building permit history
- Sewer and water utilities

The second part of this project identified ways in which WSDOT can collaboratively and proactively work with local agencies, developers, and other stakeholders to encourage responsible development along state routes. This menu of strategies was developed from current WSDOT practices, literature on standard approaches, and reports of novel solutions. Strategies were classified as planning and coordination activities, non-engineering and engineering strategies, and funding/enforcement strategies. The appropriate strategy will depend on the corridor and development characteristics as well as the available resources.

Feedback from transportation and land-use professionals indicated that the state and local factors for identifying development risk work well. Case study results generally agreed with local knowledge, yet the method offers an objective and systematic means for comparing corridors across the state fairly. Additional work is necessary to calibrate the risk factors to optimize the ability to predict where development will occur and to improve estimates of land development capacity to better estimate how much added demand on transportation facilities will result from development. These improvements would result in a powerful tool that could be used to strategically allocate resources where proactive planning could result in the best return on investment.

INTRODUCTION

Land development can compromise the performance of the state transportation system. Potential risks to the state transportation system from land development include increased traffic volumes; parking, loading, and turning impacts; safety issues; light, glare and other driver distractions; storm water runoff; increased right-of-way acquisition costs; and incompatible development. If these risks are realized, political pressure may mount to fund expensive retrofits or capacity improvements that impose both short-term and long-term social, environmental, and financial costs. Identifying the corridors most likely to be affected by development will help the Washington State Department of Transportation (WSDOT) strategically target its planning resources. WSDOT can then work more closely with local governments to develop and implement proactive strategies and lower-cost practical solutions for the transition of these state highway facilities to support more urban development, economic development opportunities, and community quality of life.

This short-term project had two goals:

1. **to develop a framework for a repeatable, data-driven method to identify and prioritize sections of state transportation infrastructure vulnerable to land development; the goal was to develop and test an evidence-based method that will enable state planners to compare, prioritize, and benchmark needs for risk management on state transportation corridors**
2. **to create a menu of appropriate collaborative strategies for managing adverse risks.**

SCOPE OF WORK AND PROCESS

Several questions were posed at the inception of this project that framed the approach to assessing the relative risk of land development along transportation corridors:

- What are the sources of land development risk to the transportation system?
- What are the relative likelihoods of development occurring along transportation corridors?
- Where are these risks most likely to occur?

- What are the potential consequences and horizons?
- What can WSDOT do to manage or mitigate the risks?
- What are the most effective strategies for balancing costs, benefits, and risks?
- How can WSDOT collaborate with local governments to implement these strategies proactively?

At its inception, the project was set up to address land development risk at the state and local levels. The state level would require a more general set of criteria and measures to assess risk than the local level. Also, different data would be available at these two levels. Three case studies were planned for the local level, with the goal of engaging local planners in the development of the framework for risk assessment.

A series of workshops were held with transportation and urban planning professionals as well as development stakeholders. First, a round table meeting was held on January 28, 2013, at the University of Washington, which gathered experts in the field of land development and transportation (see Appendix 1). These experts reviewed a preliminary list of factors to be considered in future work. Preliminary factors were presented by the research team along with data sources that were expected to be available for the study. A range of case studies was considered by the participants, and three cases were selected:

- West Plains, a case study featuring SR 2 as it passes through Airway Heights in Spokane County
- Three Creeks, a case study featuring land development near the I-5/I-205 interchange in Clark County, and
- Issaquah, for development north of I-90.

Second, the West Plains Workshop was held on May 20, 2013, at the offices of the Spokane Regional Transportation Council (SRTC). This meeting allowed the project team to physically tour one of the case study sites, listen to discussions about development potential from representatives of each of the jurisdictions and agencies actively involved in the West Plains study area, present the preliminary findings from the new risk identification tool, gain feedback on differences between what the tool identified and what the local planners expected, identify weaknesses in the tool, and gain insight into how the prototype risk identification tool could be improved.

A third and final workshop took place in Tumwater on June 10, 2013. At that workshop, the project team presented the findings of both the West Plains and Three Creeks case studies. Only partial findings could be presented on the Issaquah case study, as key data had yet to be obtained on that project. The workshop attendees were all WSDOT staff. The workshop attendees provided feedback on the usefulness of the risk identification tool, described where and when such a tool would be used and provided feedback to WSDOT's Headquarters Community Transportation Planning Office regarding the next steps for the project.

The project team used the results from these meetings and the lessons learned from performing the three case studies to refine the risk identification tool and to develop the recommendations for future WSDOT activities and follow-on work.

This report presents the results of this study in two parts. Part I, Risk Factors, presents a framework for a repeatable, data-driven method to identify and prioritize sections of state transportation infrastructure vulnerable to land development. And Part II, Collaborative Strategies for Managing Adverse Risks, presents approaches to managing risk through planning and coordination; reviews non-engineering (soft) and engineering (hard) mitigation strategies; and discusses funding and enforcement of mitigation strategies.

PART I: FACTORS USED TO IDENTIFY ADVERSE RISK

This section describes the development of a system to identify sections of Washington state routes that are at risk to the adverse effects of uncoordinated land development. First, the literature was reviewed for examples of similar efforts to forecast land development risk for transportation planning purposes. On the basis of the literature and expert input, factors that represented greater or lesser risk of land development were identified. Publically available data to measure these factors were collected and processed to produce two simple ranking systems for development risk. The first system was at the state level and the second system was at the local level. These two separate yet parallel systems were created because of the varying availability of data at the state and local levels and the necessity to use coarser geographic units of analysis at the state level and finer resolution geographic units of analysis at the local level. The statewide system was applied to Washington state, while the local system was developed and applied in conjunction with three case study areas: Spokane/West Plains, Issaquah, and a portion of the Three Creeks Special Planning Area in Clark County (including the Fairgrounds, Salmon Creek, and Pleasant Highlands subareas). Finally, this section discusses the strengths and limitations of the two systems for identifying land development risk and proposes next steps to make the system more useful for WSDOT corridor planning.

Literature Review

A growing number of initiatives call for the coordination and integration of both transportation and land-use planning (NCHRP, Partnership for Sustainable Communities HUD, DOT, EPA). Transportation agencies are seeking to implement strategies that help forecast land-use change and evaluate their effect on transportation corridors.

Factors used for identifying and assessing the risk of adjacent land development are numerous; they relate to the scope and objectives of the development, the scale of analysis, and the availability of data. Past studies have indicated that the following factors serve to evaluate land development risk: population and employment density, household demographic and socio-economic information, land use and zoning, vacant land, environmentally constrained land, underdeveloped land, improvement-to-land ratio, slope, proximity to existing development, undervalued land [2-5]. Additional factors include network distances to amenities, commute times, traffic capacity, and the profit ratio of parcels (method of incorporating land values vis-à-vis costs for development) [6-8].

How such factors are measured and eventually modeled requires a relatively sophisticated approach to corridor management. A risk-based framework to assess land development and to identify vulnerable locations along transportation corridors is needed. Table 1-1 presents examples of such approaches identified in a report of best practices of development forecasts for corridor management [9]. Best practices were obtained from interviews with various state DOT and MPO officials across the U.S. Many approaches used complex models of development and transportation outcomes based on numerous demographic and economic factors, with assumptions provided by analysts or through collaborative task forces. Agencies have voiced the need for tools that are automated, require minimal resources, and provide actionable results.

Table 1-1: Examples of Approaches to Identify Corridors Most At Risk for Development. Source: [9]

Strategy	Description	Source Agency
Virginia Land Development Forecasting and Prioritization System (**VLDFPS**)	Classifies segments into varying levels of risk based on several expert-elicited factors (demographic, economic, suitability for development) and rule-based modeling. Data obtained from public geospatial databases	Virginia DOT
Cube Land, an economic real estate model to identify where development pressure will occur	Used to prioritize ROW acquisition. Models interactions among demand, rent, and supply of land. Output is real estate units, land use, employees, and households per TAZ.	Minnesota DOT
Highway Economic Analysis Tool **(HEAT)**:	Economic model to estimate impacts of corridor improvements on roads and businesses in terms of attracting businesses. Used for economic development, but could be adapted to assessing development risk of various improvement scenarios.	Montana DOT
Activity based travel models	Models performance based on individual household decisions aggregated to various geographies. Can be used to assess changes in system performance based on development, as well as to forecast growth and assess capacity to handle growth under existing facilities and policies.	Caltrans and Sacramento Council of Governments
REMI county-level economic forecasting models (from regional economic models, inc., private business)	Provides county-level economic forecasts (gross domestic product, employment, etc.) that are often used in conjunction with other models. Could be used to forecast where development is likely to occur, but appears limited to the county level	Georgia DOT, Atlanta Regional Commission, Minnesota DOT, Montana DOT

The Virginia Land Development Forecasting and Prioritization System (VLDFPS) is a promising framework for identifying land development risk in a systematic manner using minimal resources. The State of Virginia developed it by using a risk-based approach following extensive research conducted by the Center for Risk Management of Engineering Systems at the University of Virginia [10-12]. The study used a comprehensive layering of factors that affect the risk of land development and devised several risk management strategies and land development models. The modeling layers consist of six steps: 1) the elicitation of factors most influencing land development, 2) setting logical combinations of factors influencing land development 3) measuring the potential for development, 4) assessing the sensitivity of results, 5) analyzing the transition of land from one state of development to another, and 6) determining strategic actions to minimize regret and prioritizing investment [11].

The Virginia work guided the present study, which is based on the first three steps noted above: the identification of factors influencing land development; the combination of these factors into a risk score to gage the level of development risk; measurement of the intensity of development. Also used in the present study was Virginia's reliance on expert elicitation to aid in deriving factors of influence. Expert elicitation facilitates gaining general knowledge and insights about the conditions that contribute to land development as well as the necessary local knowledge that can be obtained from planners and managers [11, 13]. Expert elicitation was also used to weigh the individual factors regarding how and to what degree they contribute to the potential of land development. Factors and criteria determined through the process used in the Virginia study are shown in Table 1-2.

Table 1-2: Weighting of Individual Risk Factors for Land Development (from University of Virginia, Center for Risk Management of Engineering Systems)

Perspective	Factor	Unit	High	M. High	Medium	Low
Economic	Job Housing Balance	Abs(# Jobs/ # Housing units)-1	<0.23	>=0.23 and <0.41	>=0.41 and <0.66	>=0.66
	Employment Forecast	People	>84503	<=84503 and >21448	<=21448 and >9801	<=9801
	HubZone	"1" if HubZone, "0" else	1			0
Demographic	Population Density	People per Square Km.	>2501	<=2501 and >485	<=485 and >62	<=62
	Population Projection	%	>53	<=53 and >21	<=21 and >1	<=1
	Unemployment	People	<976	>=976 and <2026	>=2026 and <5809	>=5809
Land Use	Home Value	Dollars	>289797	<=289797 and >199023	<=199023 and >138342	<=138342
	Suburban / Urban / Rural classification	"1" if Rural, "2" if Urban, "3" if Suburban	3		1	2

State-Level Risk Factors

A system for assessing the likelihood of land development along all Washington State Routes was developed by using a GIS- based analysis. Factors that contributed to risk of land development were evaluated through a series of spatial overlays. State-level factors were selected following the literature search and review by experts present at the January 28, 2013, roundtable.

Data

Five factors were initially selected for analysis. Socioeconomic factors included historical population and job growth, and population and job projections, for which data were available at the census tract and county levels. Traffic condition factors were based on traffic data on state routes. WSDOT provided data on volume over capacity (V/C) ratios along each segment of the state routes. Table 1-3 summarizes the data sets and their sources; the spatial unit and year for which they are available, and the year used for the present analyses

Table 1-3: Statewide Factors and Data Sets

Factor	Dataset	Spatial Unit	Dates available	Years of analysis
Historical Population Growth	Small Area Estimates Program (OFM-WA)	Census Tract	Yearly	2000 -2010
Historical Job Growth	Census Bureau's Longitudinal Employment Household Dynamics (LEHD) Program - On The Map	Census Tract	Yearly	2002 - 2010
Population Projections	Washington State Growth Management Population Projections (OFM-WA)	County	2010 to 2040	2010-2015
Job Projections	Employment Security Department - WA	County and County aggregations (Workforce Development Councils)	2014, 2019	2009-2014
V/C ratio on State Routes	WSDOT	SR segments	2011	

Analyses

Socioeconomic Factors

Each factor was measured as the change in both the absolute and relative (percentage) values by using the range of years available for the given data set. Table 1-4 provides the descriptive statistics of these factors.

Table 1-4: Descriptive Statistics of Statewide Analysis

Factor	count	min	max	mean	std. dev.	1st-quartile	median	3rd-quartile
By census tract, 2000 – 2010 change								
population (absolute change)	1446	-3195	8526	574.29	913.22	59	313.5	813.88
population (percent change)	1446	-100	15715	33.912	432.57	1.5785	8.043	19.92
employment (absolute change)	1446	-12002	30808	319.01	1408	-38	108.5	468
employment (percent change)	1446	-90.128	4546.2	28.387	153.55	-5.102	10.713	32.669
By county, 2010 – 2015 change								
population projections (absolute change)	39	-60	81531	7632.3	15191	288	1677	9421.5
population projections (percent change)	39	-1.2357	12.272	3.1857	2.7024	1.1559	2.8706	4.5705
By county or county aggregations, 2009 – 2014 change								
employment projections (absolute change)	12	5959	86498	19676	21943	7453	13575	21049
employment projections (percent change)	12	5.2797	11.319	7.4577	1.7968	6.2053	7.002	8.3785

In a first step, census tracts that fell within the upper quartile of *both* absolute and percentage change were further considered for analysis (figures 1-1 to 1-4). These census tracts represent those with significant amount of change on these selected indicators.

In a second step, the factors were combined for each census tract into one score that rated the relative risk of change in population and jobs. Census tracts that were in the upper quartile for both absolute and percentage population and employment change (historical and projected) were given a weight of 1 (all other tracts had a value of zero). Values assigned to the census tracts were then added together through a spatial overlay process. A new layer of census tracts was produced, with a numerical score of 1 through 4 denoting how many of the factors contributed to a specific census tract's likelihood of development.

Table 1-5 lists the number of census tracts by county and by risk score, and the corresponding map is shown in Figure 1-5.

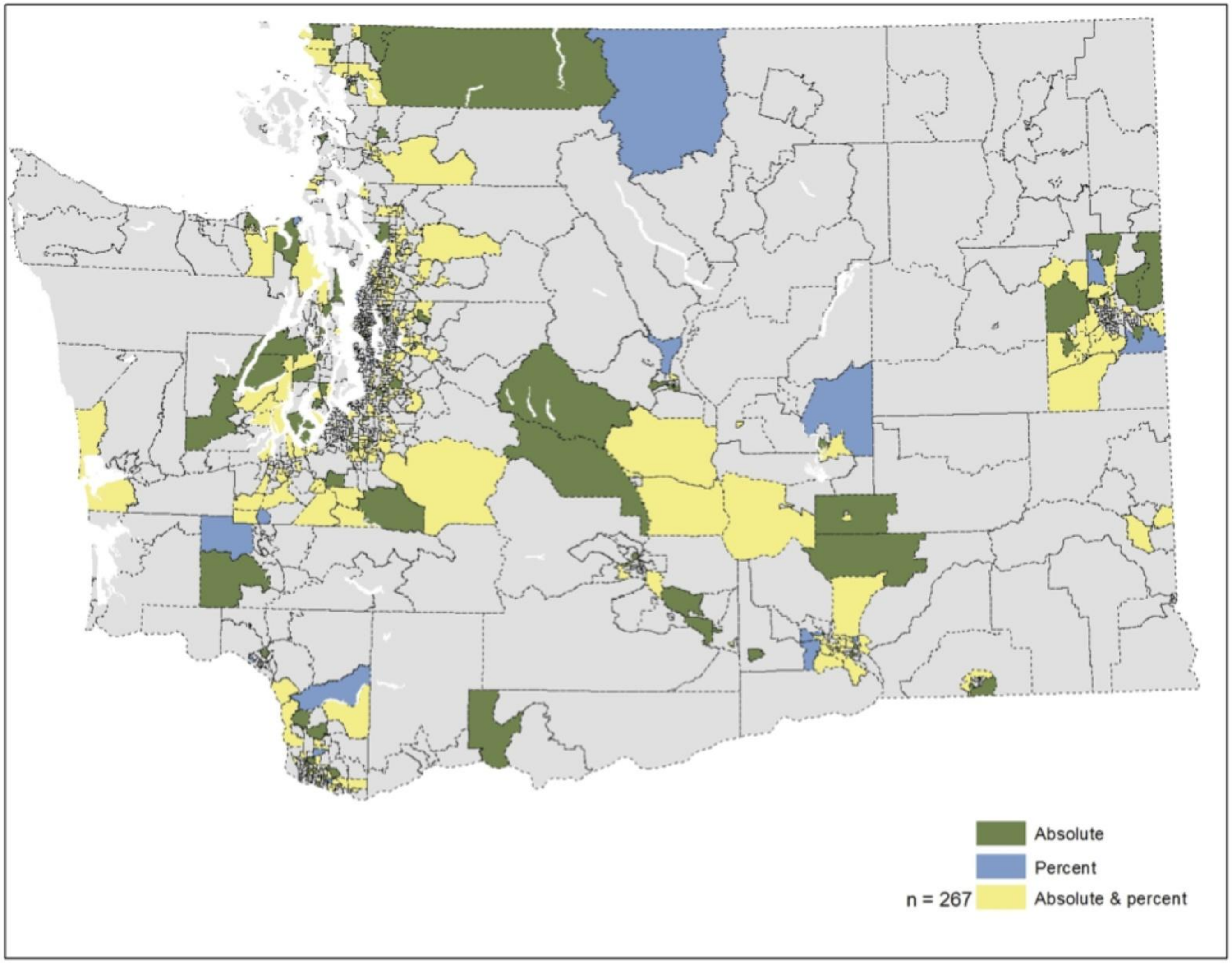

Figure 1-1: Census Tracts That Fall within the Upper Quartile of Absolute and Percentage of Population Change

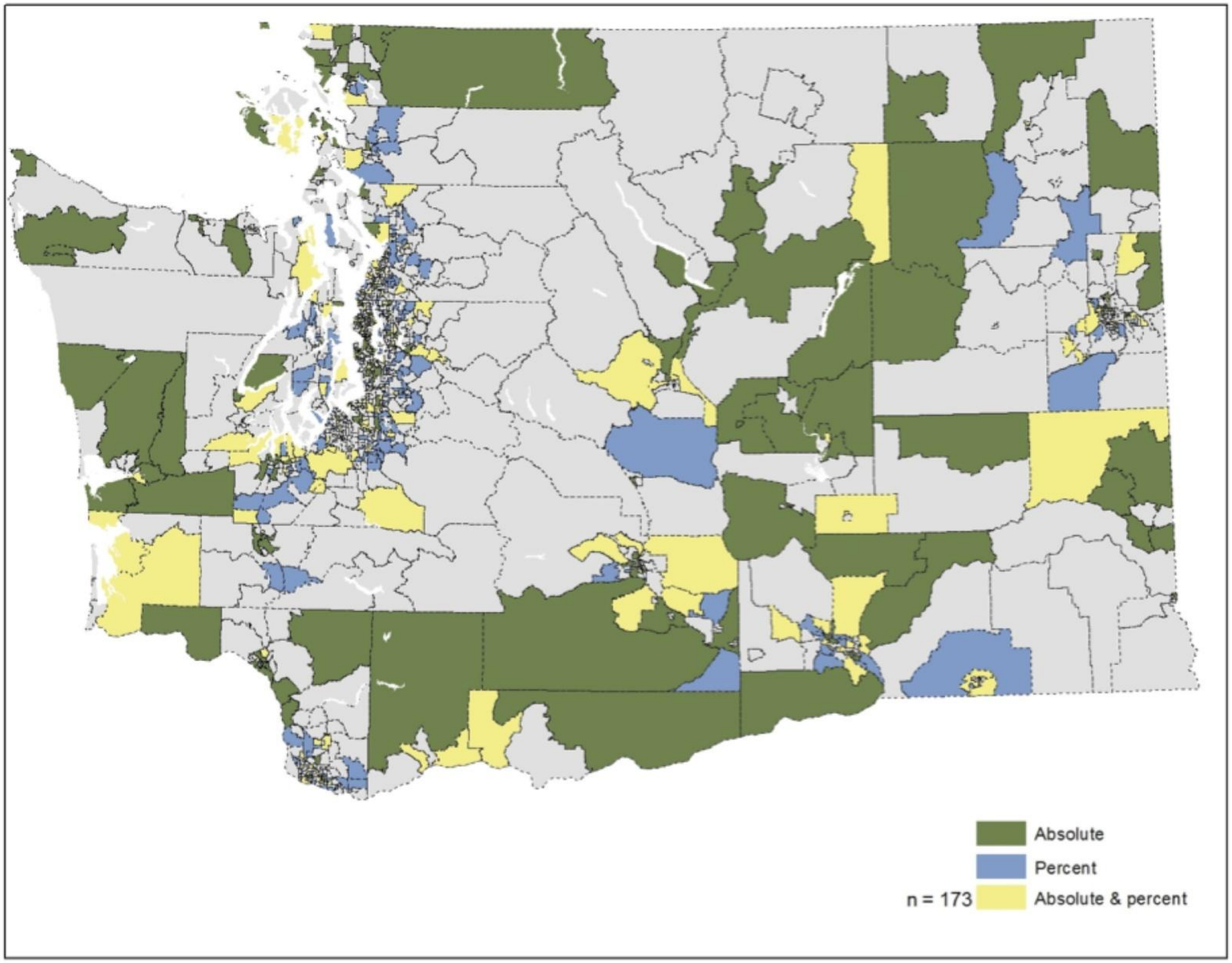

Figure 1-2: Census Tracts That Fall within the Upper Quartile of Absolute and Percentage of Job Change

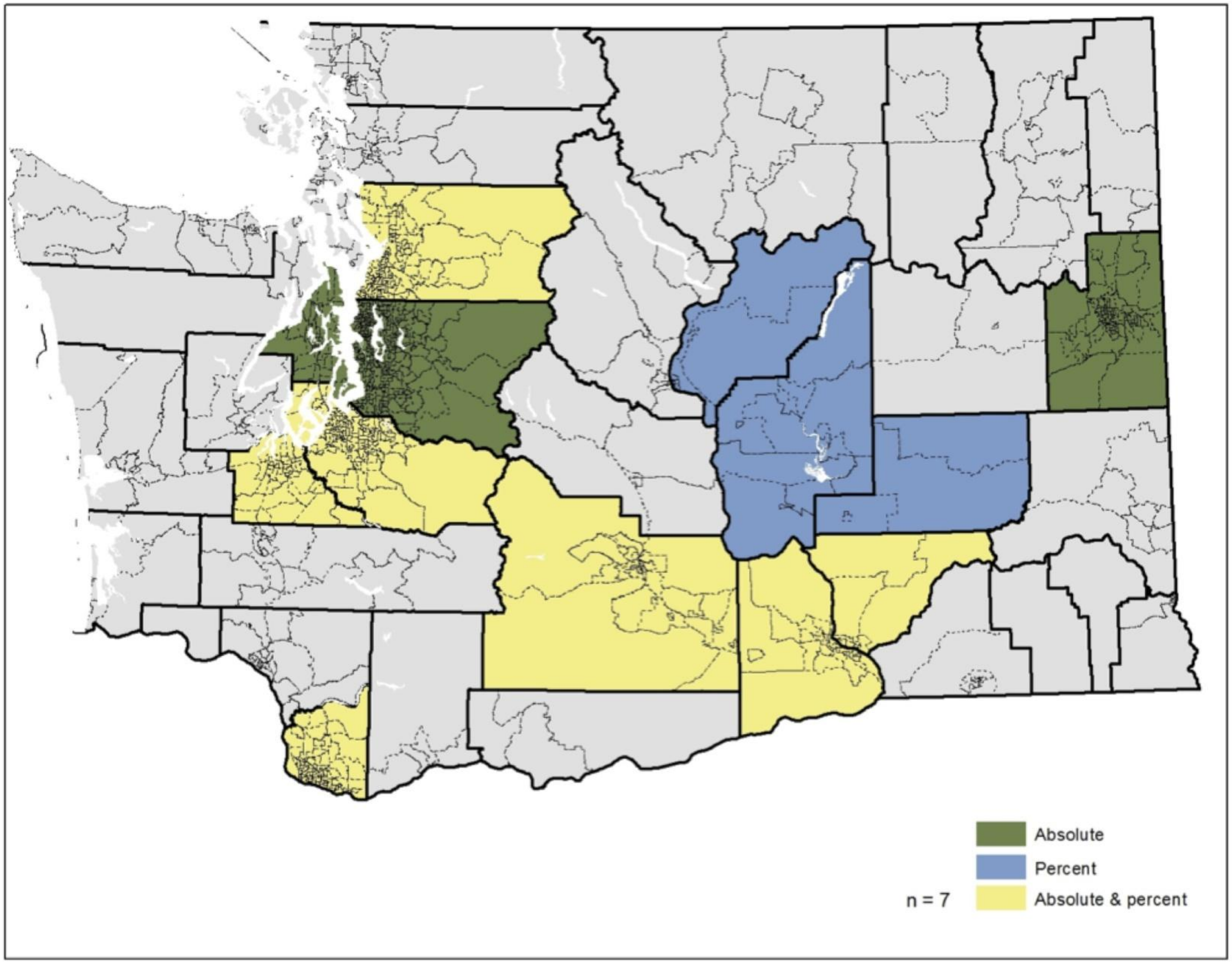

Figure 1-3: Counties That Fall within the Upper Quartile of Absolute and Percentage of Projected Population Change

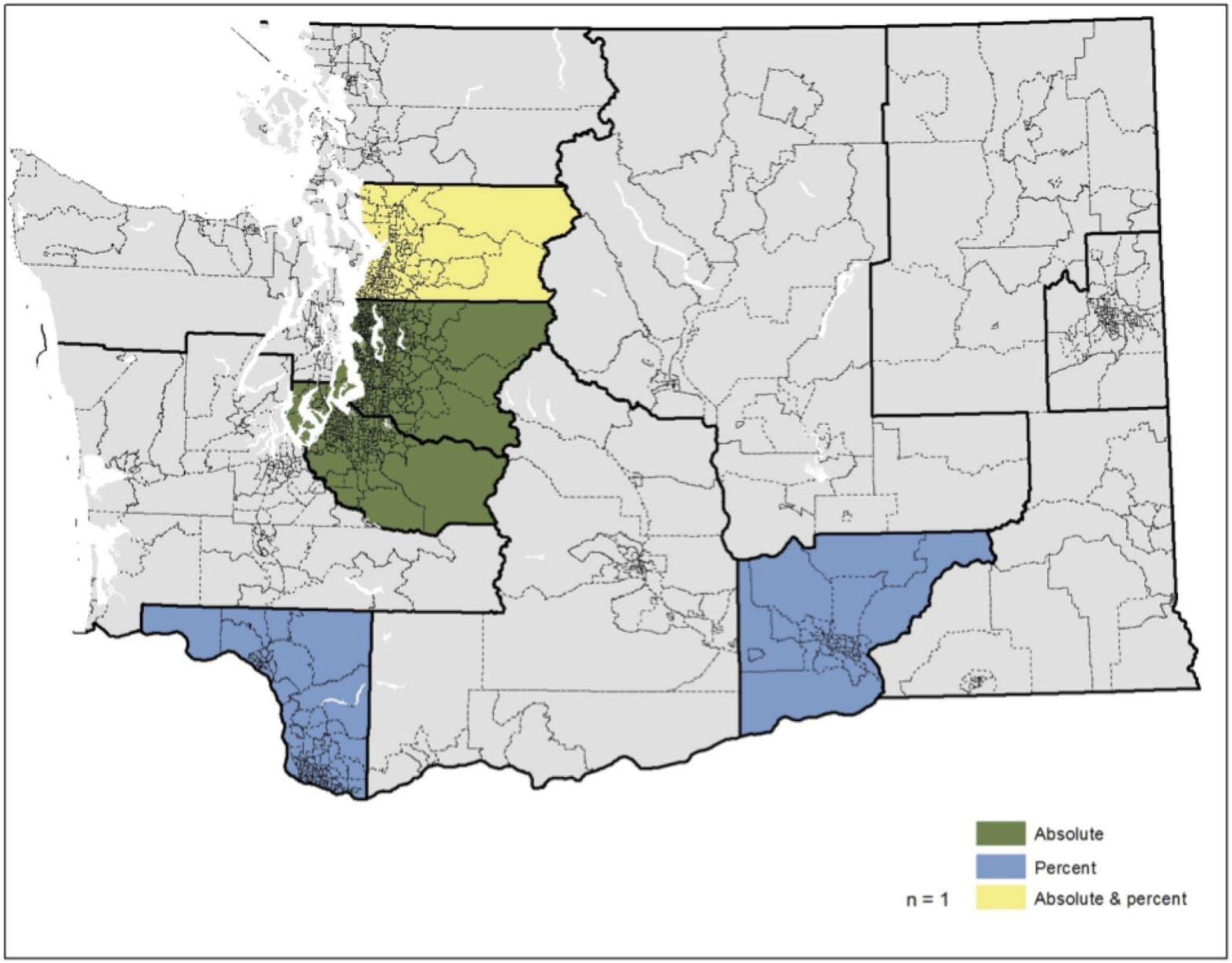

Figure 1-4: County and County Aggregations That Fall within the Upper Quartile of Absolute and Percentage of Projected Employment Change

Table 1- 5: Number of Scored Census Tracts by County

	Factor score			
County	1	2	3	4
Adams	3			
Asotin	1			
Benton		10	3	
Chelan	2			
Clallam	4			
Clark		31	5	
Cowlitz	4			
Douglas	1	1		
Franklin		4	3	
Grant	5			
Grays Harbor	3			
Island	2			
Jefferson	1	1		
King	87	7		
Kitsap	8			
Kittitas	4			
Klickitat	1			
Mason	4	1		
Okanogan	1			
Pacific	2			
Pierce		46	3	
San Juan	1			
Skagit	6			
Skamania	2			
Snohomish			52	5
Spokane	25	5		
Stevens	2			
Thurston		17	6	
Walla Walla	2	1		
Whatcom	14			
Whitman	4			
Yakima		9		

A weight of 1 was assigned to each factor for the initial exploration of this method. However, any weight could be used in future analyses, related to the degree to which an individual factor was deemed to contribute to land development. Weights could be refined with input from experts and local knowledge of trends.

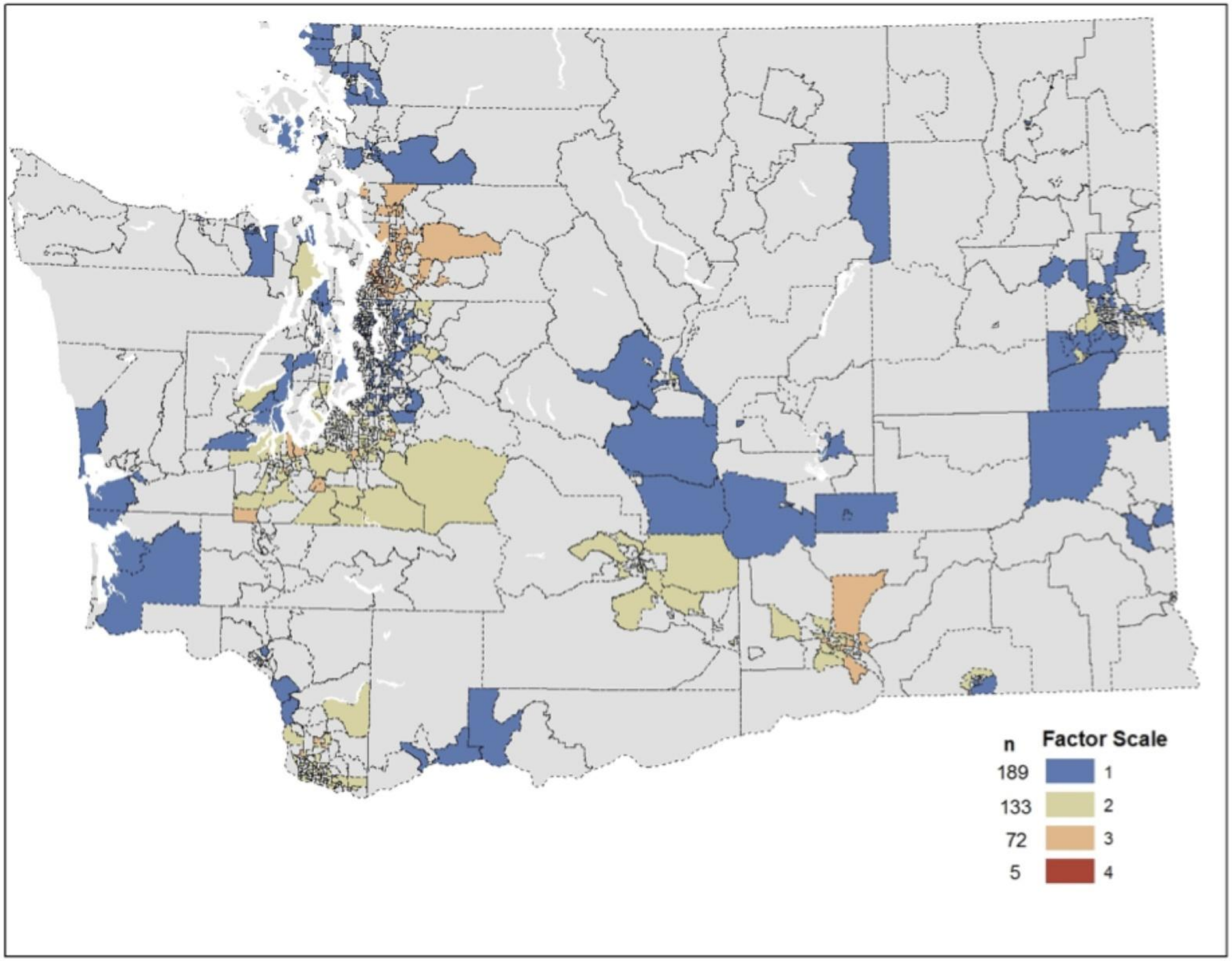

Figure 1-5: Factor Scaling for Census Tracts (Combination of Statewide Factors Given Equal Weights)

Traffic Conditions

In a third step, two thresholds of volume over capacity (V/C) values were used in the analysis: ≥ 0.7 and ≥ 1. A 0.5-mile buffer was used along all segments to (1) better display the segments in the maps and (2) with GIS, capture the values of the census tract along the segments (see "composite risk score" section).

In a fourth step of this analysis, state route segments with V/C values of ≥ 0.7 but < 1 were given a weight of 1, and segments with V/C values ≥ 1 were given a weight of 2.

Composite Risk Score

In a fifth step, a composite score of socio-economic and traffic conditions factors was calculated. Factor scores for census tracts on the two sides of road segments (calculated in step two) were then assigned to the closest state route segment. Of all the adjoining census tracts along a particular segment, the value of that with the highest factor score was assigned to the segment. To calculate the Composite Risk Score, the census tract factor score was simply added to the score of the segment by using a spatial overlay function.

In a sixth and final step, a line density calculation was used to average the Composite Risk Score within a 0.5-mile radius of the segments by using a 100-m grid (figures 1-6 and 1-7). Census tract factor scores and segment scores were then calculated as follows:

Risk Score = length of segment that is ≥ .7 V/C * the combined census tract and segment score that fall with a 0.5-mile radius/ divided by the area of the circle within 0.5 miles from a tract.

This final step served two purposes: (1) to better display the results on a map—it translated the segment polylines into buffered areas that display "thicker" segments; and (2) to "smooth" the Composite Risk Score values between segments—by averaging the segment values along a "moving window" at 100-foot intervals and within a 0.5-mile radius, adjacent segments with different values could be read and measured as being continuous, an important consideration, especially at road intersections.

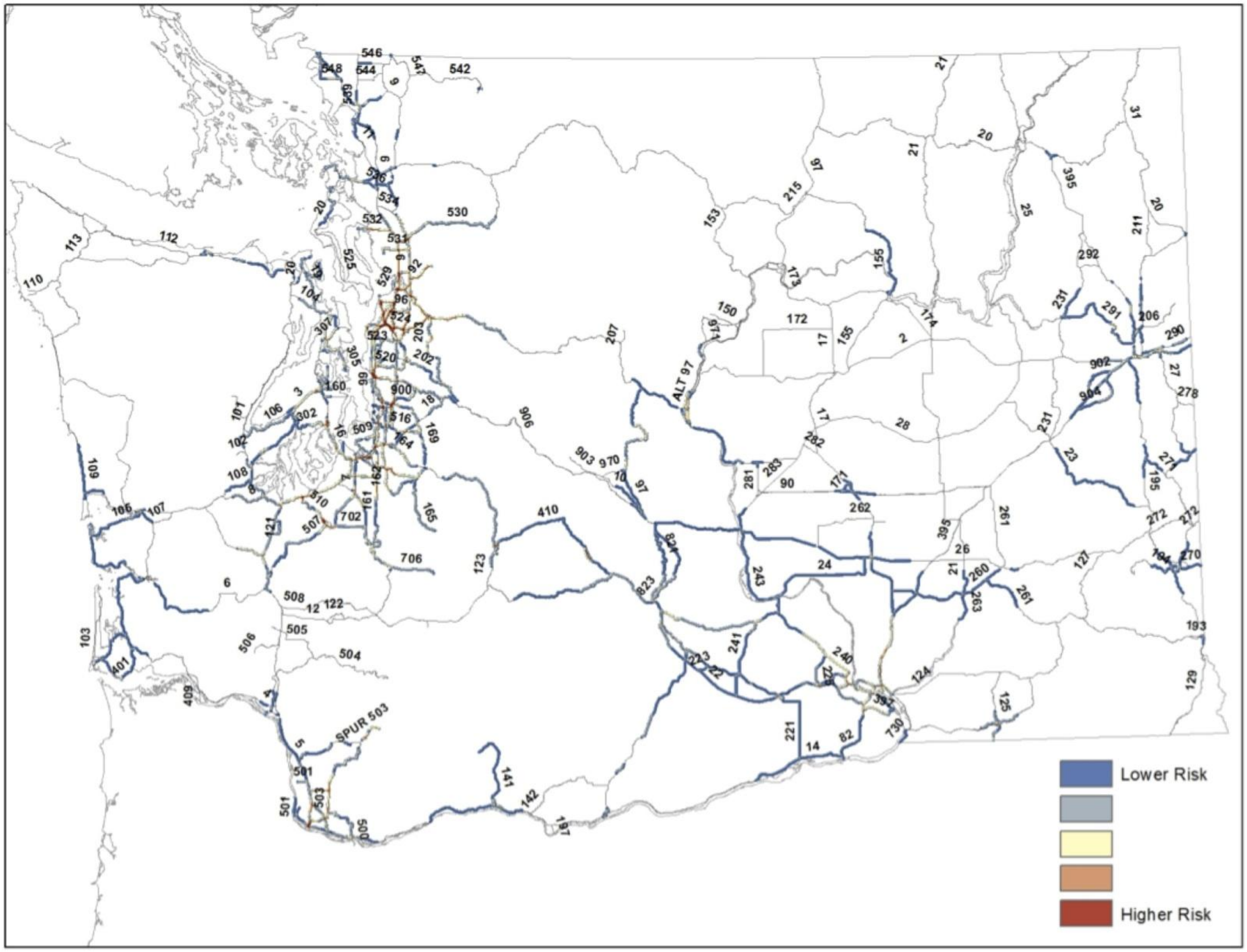

Figure 1-6: Line Density of Composite Risk Score within 0.5-Mile Buffer (Statewide)

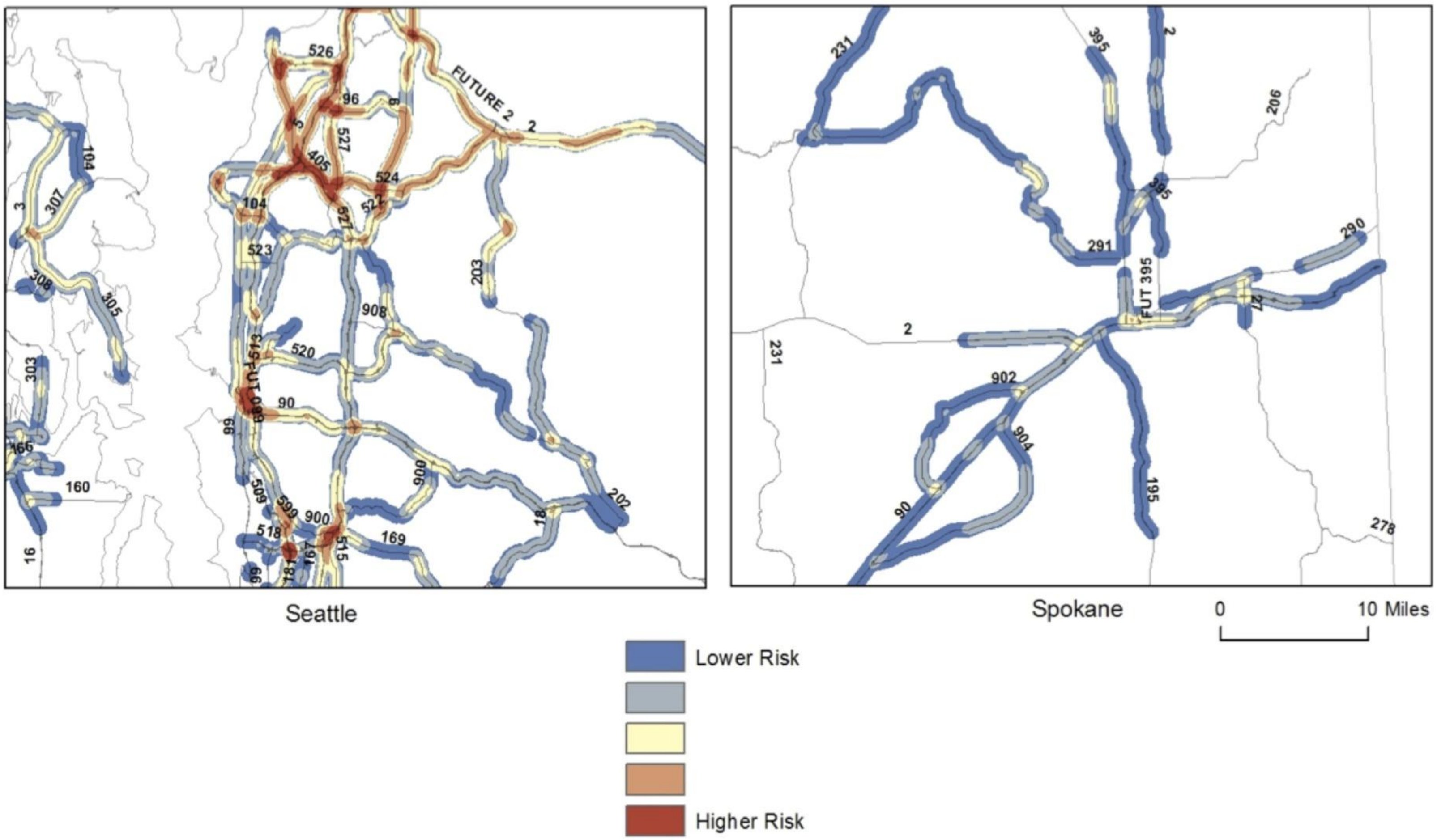

Figure 1-7: Line Density of Composite Risk Score within 0.5-Mile Buffer

Summary

The method used in this preliminary analysis is flexible. It can accommodate the same type of data found at other scales where available. Other factors can be added or substituted as deemed appropriate. For example, job forecast data were readily available at the aggregate county scale. However, where available (Table 1-3), finer scale data could be incorporated for analysis. Also, indicators other than volume/capacity ratios, such as percentage of posted speed, could be substituted for traffic data. Finally, each factor can be given a weight that is proportional to how that specific factor is known to contribute toward land development. The specific weights given to the individual factors and the resolution of the data used will influence the Composite Risk Score.

Local-Level Risk Factors

The state-level system for identifying land development risk can highlight corridors that should be prioritized for proactive planning and eventual risk mitigation efforts. Once such corridors have been identified, however, a more refined system is necessary to confirm that the corridors are indeed of high risk and to pinpoint precisely which areas or parcels are at greatest risk for land development. This will help planners understand the specific potential impacts on the corridor and engage the appropriate development stakeholders. To develop this local system for assessing risk along state corridors, three case studies were selected during the Land Development Risk roundtable held on January 28, 2013, at the University of Washington with members of the UW Urban Form Lab (UFL)/TRAC, WSDOT, and other invited parties. The case studies were 1) West Plains, City of Airway Heights area just west of Spokane, 2) Three Creeks Special Planning Area north of the Vancouver area, and 3) the area around the City of Issaquah in King County.

Case Study Area Determination

With the exception of the Three Creeks Area, specific study area boundaries were not discussed at the initial project meeting. The boundaries for the three case studies were determined as follows (Figure 1-8).

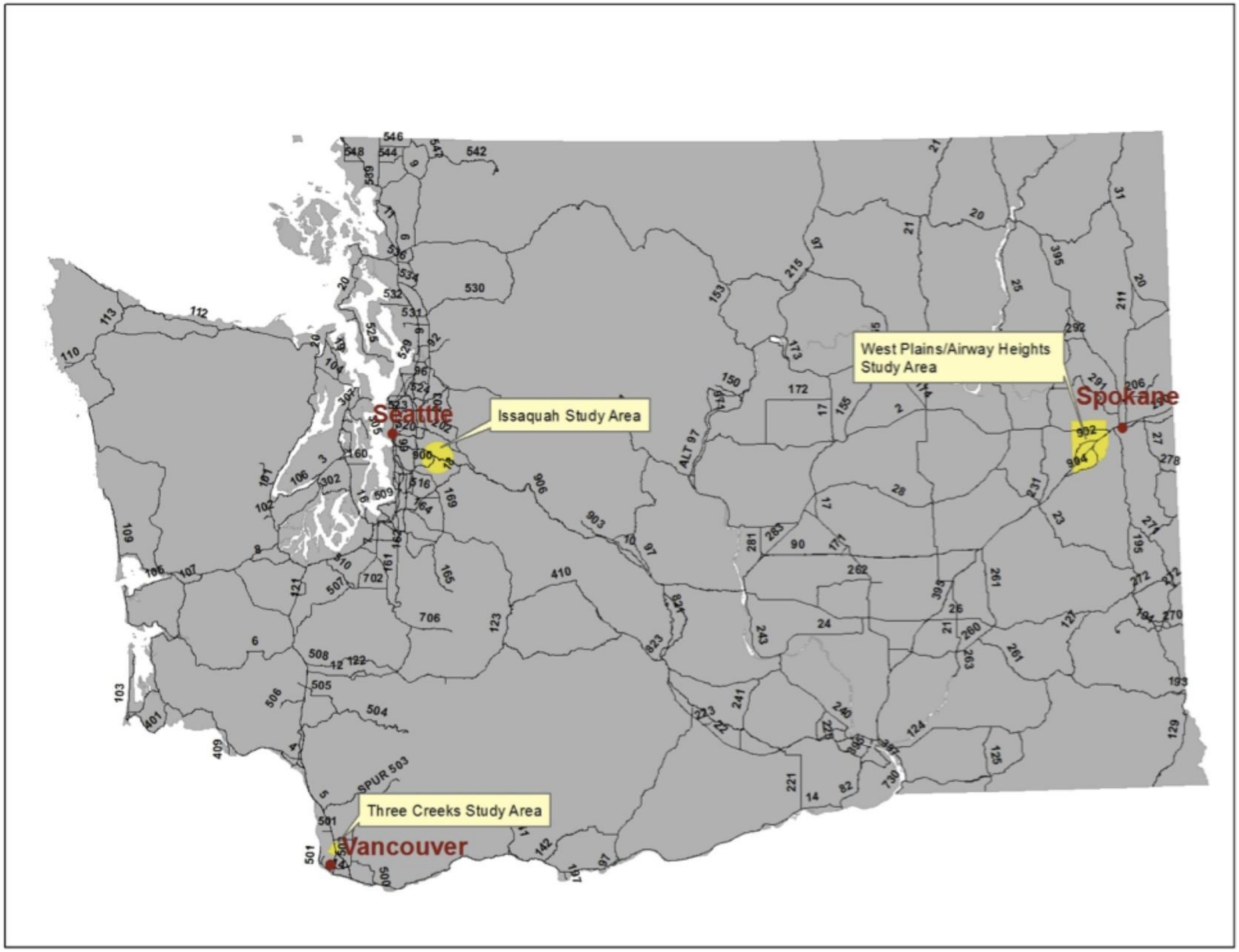

Figure 1-8: Land Development Risk Case Study Areas

Spokane/West Plains

In a document provided to the UFL [14], WSDOT initially identified a number of intersections along U.S. Highway 2 and Interstate-90 that had peak hour volumes at or greater than 90 percent. To capture all of these areas, we drew the study boundary as a wedge-shaped polygon roughly bounded by the intersection of Hwy 2 and I-90 in the east; Cheney-Spokane Road in the south; Espanola Road in the west; and a parallel line three miles north of Hwy 2 in the north. The rationale for this particular set of boundaries was to capture the area in which development might occur that would reasonably affect the intersections described in the WSDOT document [14]. This study area was divided into two sub-areas: 1) a north area surrounding Hwy 2; and 2) a south area surrounding Interstate-90.

Issaquah

The Issaquah case study was not originally included in the WSDOT document presented at the roundtable meeting, and as a result, little guidance was provided regarding the desired geographic scope of this case study. We applied a 5-mile buffer from the intersection of Interstate-90 and Front Street to serve as our study area. We chose a 5-mile buffer on the basis of a number of travel shed calculations made internally, as well as judgments based on the existing and potential development patterns in the area. While far from perfect, this 5-mile radius contained most of the development areas likely to affect the WSDOT-managed transportation network within and around Issaquah.

Three Creeks Special Planning Area: Clark County (including the Fairgrounds, Salmon Creek, and Pleasant Highlands Subareas)

The initial case studies document presented the larger Three Creeks area as a potential study area but also offered the smaller Discovery/Fairgrounds, Salmon Creek/University District, and Pleasant Highlands sub-areas as being of particular interest to future transportation planning efforts. We used these three smaller areas as our study area boundary for this analysis.

Local-Level Factors

Factors identified for analysis at the case study level included the socioeconomic factors selected for the statewide analyses. Census blocks were used rather than census tracts to provide finer-grained spatial information. Factors relating to land use and regulations and economic activity were added, with the following factors being included in the analyses of all three case studies:

- historical population and job growth

- population and job projections
- vacant parcels
- zoning
- recent real estate sales
- urban growth boundaries
- traffic volume and capacity on state and main routes.

Additional data were obtained, but because of time pressures, they were not used in all of the analyses.

- Building permit data from Clark County were used in the Three Creeks analysis, but we did not obtain these data for the other two case studies.
- Critical areas layers were not used because more detailed local knowledge was needed to use them appropriately (i.e., various critical areas are developable to certain degrees, and particular criteria determine the developability of the areas).
- Data on utilities, such as sewer and water lines, were added after receiving feedback on our initial findings at the Spokane workshop. These data were deemed to be primary indicators of risk of development. The absence of sewers, for example, would hold or at least slow development. Although not incorporated into the actual final analysis, utilities data were overlaid for visualization purposes.
- Historical parcel data were also acquired for future research, as they could calibrate relationships between the variables and development outcomes (see future research section: *Calibrate Model with Historic Data*).

The various data sources are outlined in Table 1-6.

Table 1-6: Case Study Data

Dataset	Spatial unit	Clark		Spokane		Issaquah	
		Source	Notes	Source	Notes	Source	Notes
Historical Population Growth	Census block	U.S. Census		U.S. Census		U.S. Census	
Historical Job Growth	Census block	U.S. Census		U.S. Census		U.S. Census	
Population & job forecast	TAZ	Southwest Regional Transportation Council		Spokane Regional Transportation Council		Puget Sound Regional Council	(not received)
Traffic Data	SR segment statewide	WSDOT		WSDOT		WSDOT	
Regulatory frameworks (Zoning and Urban Growth Boundary)	Clark	Clark County GIS		Spokane County GIS		King County , City of Issaquah, City of Sammamish, some zoning information incomplete	
Critical areas	County wide	Clark County GIS	critical areas, floodplain	Spokane County GIS		King County (WAGDA)	
Vacant / underdeveloped lands	parcel	Clark County GIS	parcels, buildable lands model	Spokane County GIS	parcels	King County Assessor	parcels
Sales	parcel	Clark County Assessor	Back to 1995	Spokane Regional Transportation Council	1999, 2001, 2004 (2004 with complete data)	King County Assessor/WAGDA/Map Library	Back to 1999 (no 2002)
Building Permits	parcel	Clark County GIS		Spokane County Assessor	Back to 1996	King County Assessor	Back to 1996
Sewer/water utilities	county	Clark County GIS		City of Spokane			

Data

Historical population and employment data came from the U.S. Census and Census Bureau's Longitudinal Employment Household Dynamics (LEHD) Program, available online at the US census website. Future population and employment forecasts were readily available for Transportation Analysis Zones (TAZ) from the regional transportation planning authorities (Note: During the course of this seven month study we were not able to obtain forecast data for the Issaquah study area. This points out one limitation in this methodology, the data described are generally available, but sometimes require active cooperation from local agencies that may be busy with other tasks. Lack of active cooperation can delay the desired analysis.) Zoning data were gathered from counties and municipalities. Real estate data, which included both property characteristics information and sales transactions, came from the three counties hosting the case study areas (see Appendix 2: Real Estate Data Overview, for further discussion on Real Estate Data). Assessor data, including both property characteristics and transactional information (real estate sales data) for Spokane and King counties, were downloaded from the respective assessors' websites free of charge. These data files are updated weekly and posted to the websites for dissemination. We purchased the Clark County data directly from the contacts at the county. Data for all three counties appeared to be up-to-date, high quality, and complete, with the necessary data fields to conduct development risk analyses.

Data Cleaning/Processing

Most of the data required minimal processing for use in the analyses. The historical census data required the use of Census block relationship files to account for the change of geographies between the 2000 and 2010 census. Assessor data, like most secondary data sources, often require considerable cleaning and transformation to suit the individual purposes of any empirical research in which they may be used. However, the property characteristics data required much less cleaning than the sales transaction data.

County sales transactions, a product of the county's recorder's office, generally include all transactions of property, regardless of whether or not it is a true "market transaction." [1] For the purposes of analyzing real estate markets, it is necessary to first remove any and all "non-arm's length" transactions from the data: those include foreclosure and sheriff's deeds, easement

[1] Meaning a transaction representative of a willing exchange between two market place participants.

recordings, and other instruments that change the title to property (such as a quit claim deed). Fortunately, all three counties provided one or more fields in their sales data to indicate whether or not the assessor's (and/or recorder's) office believed each individual transaction to be a "true" market-based transaction. For each county, we removed all transactions believed to be non-arm's length.

Data Preparation and Development

Data preparation and development is typically time-consuming. This document presents an overview of the general process used to aggregate the various data from the three counties. While the specific operations may have varied slightly by county, the general structure of the preparation and development process was similar for the three counties.[2]

- *Clip Parcel, Census Tract Data, and TAZ Layers to Study Area Extent.* We began by limiting the GIS parcel layers gathered from each county to the extent of the study area by using the GIS clipping function. Since some boundaries may not have lined up perfectly with the study area boundary, we included any and all parcels, census blocks, and TAZs that intersected the study area boundary.
- *Attach Property Characteristic Data to Parcel*. Next, we joined the property characteristics data—specifically property use type, structural year built and structure size—to the study area parcels. The required level of preparation varied by county. The Clark County parcel layer had this information already attached, while in Spokane we had to combine information from the residential and commercial building tables to append this information. In King County, information from five different relational database tables was necessary to add these data to the parcel file.
- *Extract Most Recent Sale*. The sale transaction data for each county are stored in a large file containing all transactions for approximately 15 years. For purposes of this analysis, we eliminated all sales except the most recent sale of each parcel in the study area. In addition, we added the three most recent sales to the Spokane parcel to illustrate how historical sales data could also be applied in this type of analysis.
- *Attach Sales Information to Parcel.* Finally, we attached the most recent, valid sale from the previous step to the parcels in the study area. Note that many parcels will

[2] In counties with vastly different data quality or quantity, a different set of processes may be required.

have no recent sale information. The data fields attached included sale date and sale price.

GIS Processing

- *Historical population and employment change* were calculated at the census block level. Census blocks that fell within the upper quartile of both absolute and percentage change were further considered for analysis.
- *Population and employment forecast change* were calculated at the TAZ level. TAZs that fell within the upper quartile of both absolute and percentage change were further considered for analysis.
- *Vacant parcels* were selected for further analysis
- *Current zoning* data were added to the parcels. In some cases this information was tabular (King and Clark Counties) and in others it had to be spatially joined (Spokane County).
- *Recent Sales* information was added to the parcels. Economic reality can differ greatly from the planning and zoning entitlements in place. Real estate data, in the form of sales transactions, can help planning agencies better understand the movements of the markets. Specifically, in regard to land development risk, sales of large, vacant land parcels may be an indicator of future development action. To incorporate this information, we added the most recent sale transaction data to each parcel in the three case study areas.
- *Urban Growth Areas (UGA)* were overlaid with the parcels. Parcels within Urban Growth Boundaries are more likely to be at risk of development.
- *Building permit information* can provide insight into development trends in an area. Although development at the permit stage may be far ahead of implementation or completion and somewhat unhelpful in long-range planning, certain land-use types—such as large industrial developments and master planned communities—may be subjected to a multi-year permitting process. In these cases, planning efforts, even those of mid- to long-range, can benefit from current permit information. We only received building permit data for the Three Creeks Special Planning Area from Clark County.

Analyses

The greater West Plains/Airway Heights study area is used to illustrate the results of these preliminary local-level analyses. Also for these preliminary analyses, each one of the factors was given an equal weight of 1. The values were assigned to the specific parcels and then added together through a spatial overlay process (Figure 1-9). Zoning data were assigned weights according to the assumed impacts of different zoning designations on the likelihood of land development (Figure 1-10). Future analyses could be based on different weights related to the degree to which the individual factors illustrated in Figure 1-9 were expected to contribute to land development. Figure 1-11 illustrates the weighted score for risk of development within the delineated greater West Plains/Airway Heights study area.

To identify high risk parcels in relation to existing traffic conditions, available local traffic data of intersections and road segments with $V/C > 0.8$ were overlaid with the land development risk indicators (Figure 1-12.) Finally, incorporating water and sewer utilities into the analysis refined the outcome of the likelihood of development of parcels. Parcels that did not have sewer and water line access would be downgraded in their ranking of risk for development (Figure 1-13).

Similar analyses were undertaken for the Three Creeks Planning Area (see summary map, Figure 1-14). Note that as with West Plains analysis outcomes, the relative risk of development in different parcels that is depicted in Figure 1-14 will change if weights other than uniform weights (i.e., 1) were assigned to different risk of development criteria. Additional detailed statistical analysis is needed to determine the relative importance of the various criteria explored in this project. Changing these weights will change the expected risk of development for any given analysis. It is also likely that some risk factors work in different time frames than others. Variables such as more recently issued building permits are more likely to be good predictors of near term development, while larger growth patterns combined with land availability might be a more reliable predictor of long term development pressure. Gaining insight into the relative contribution of these variables to the risk of development as well as the development time frame in which each variable is most relevant could be a valuable outcome of additional analysis and model development. With that more detailed understanding of risk factors, the risk development analysis might use different input variables depending on the time frame within which WSDOT wishes to examine the risk of development.

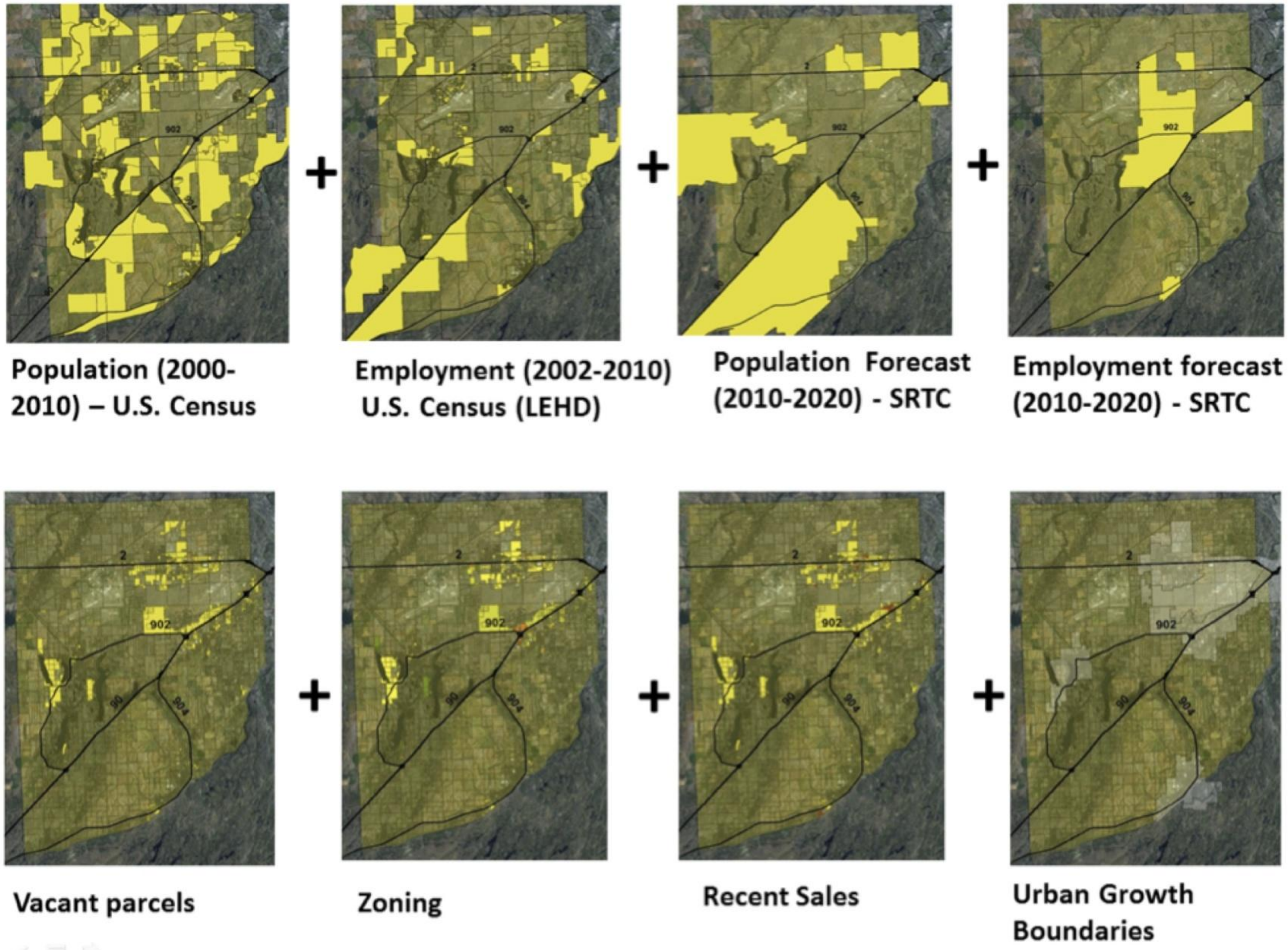

Figure 1-9: West Plains Area, Factors Used for Likelihood of Development for the Case Studies

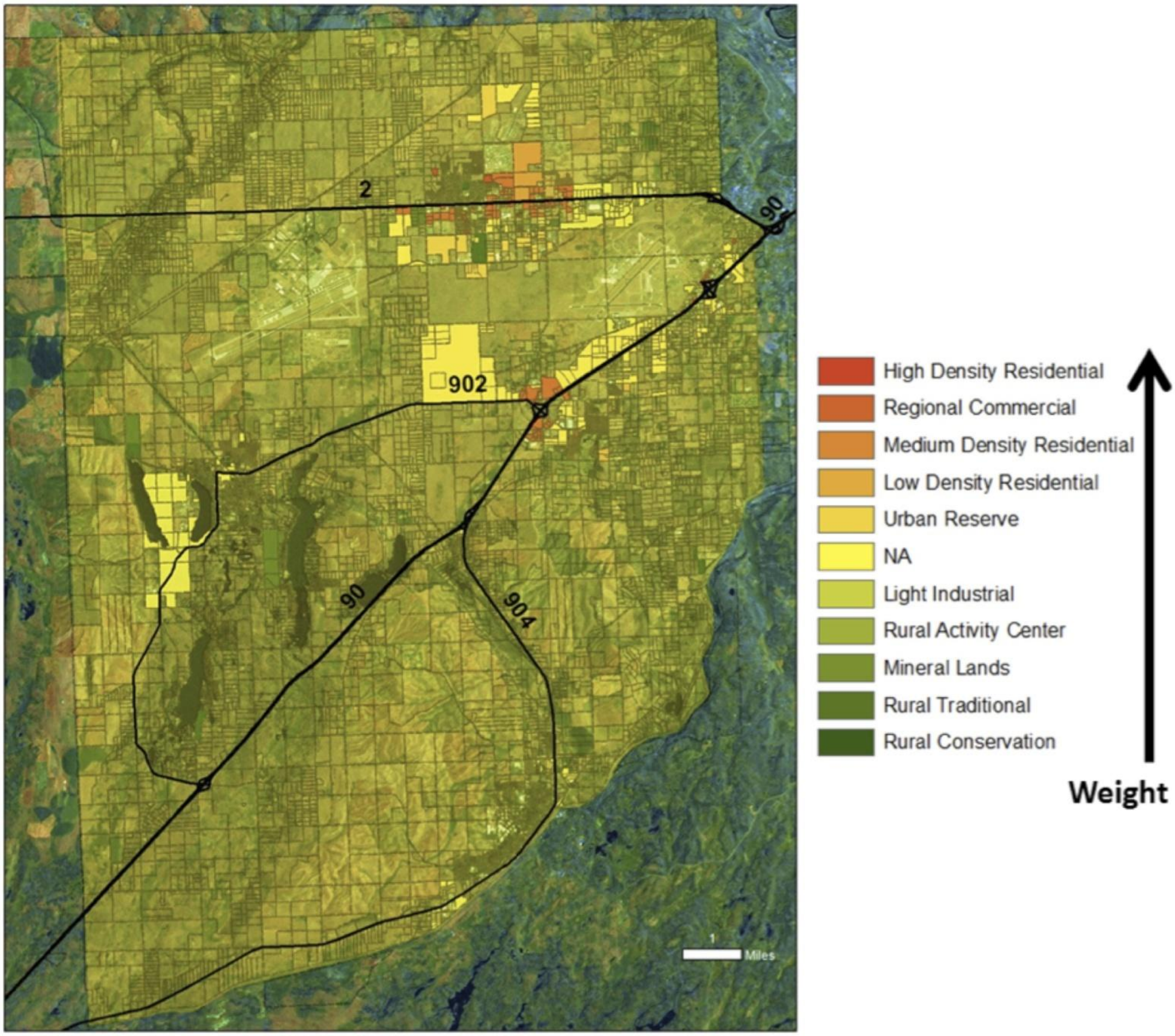

Figure 1-10: West Plains Area, Zoning Data with Weights Added According to Specific Zoning Designations for the Likelihood of Land Development

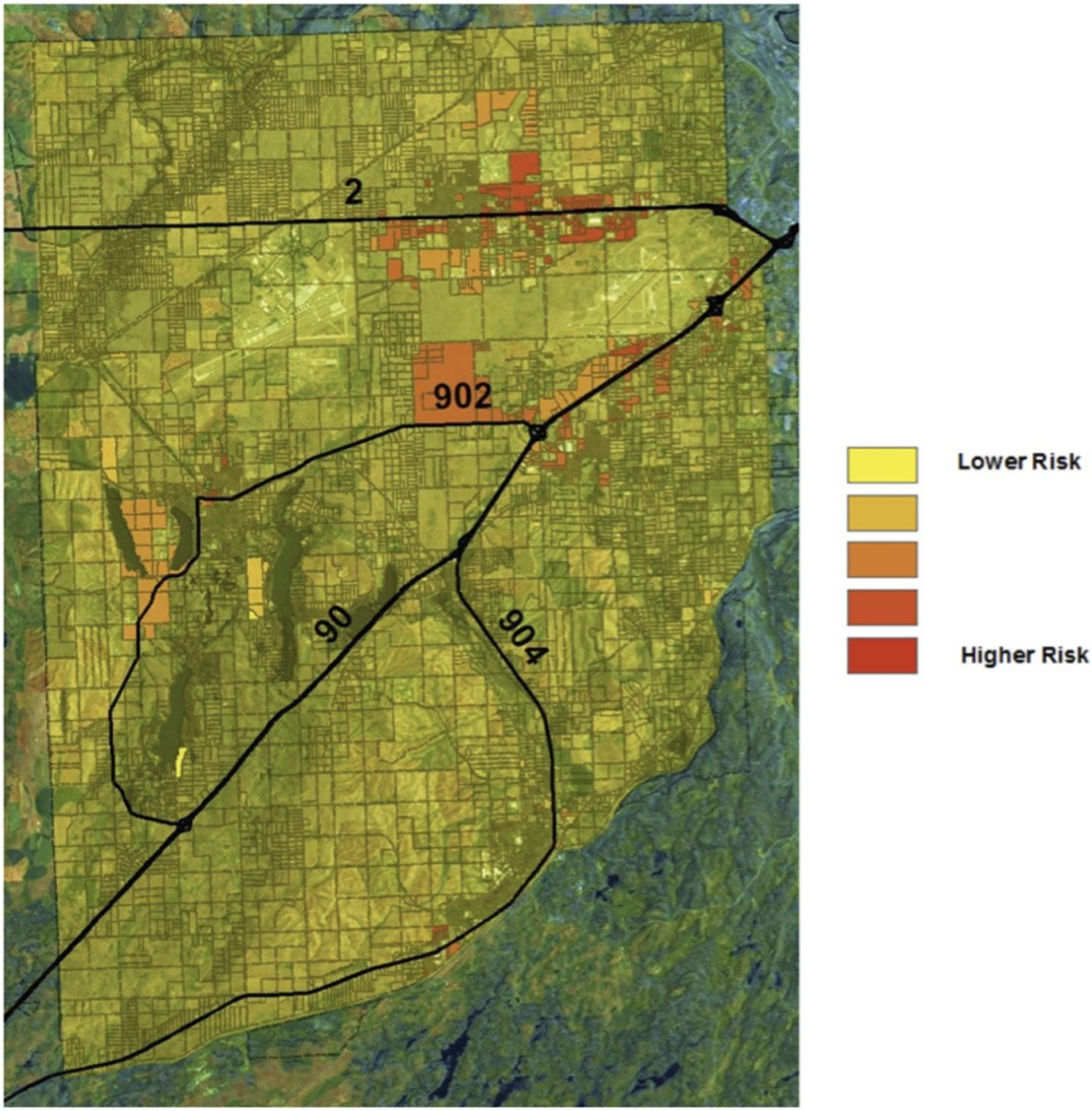

Figure 1-11: Development Risk Per Parcel for the Greater West Plains/Airway Heights Study Area

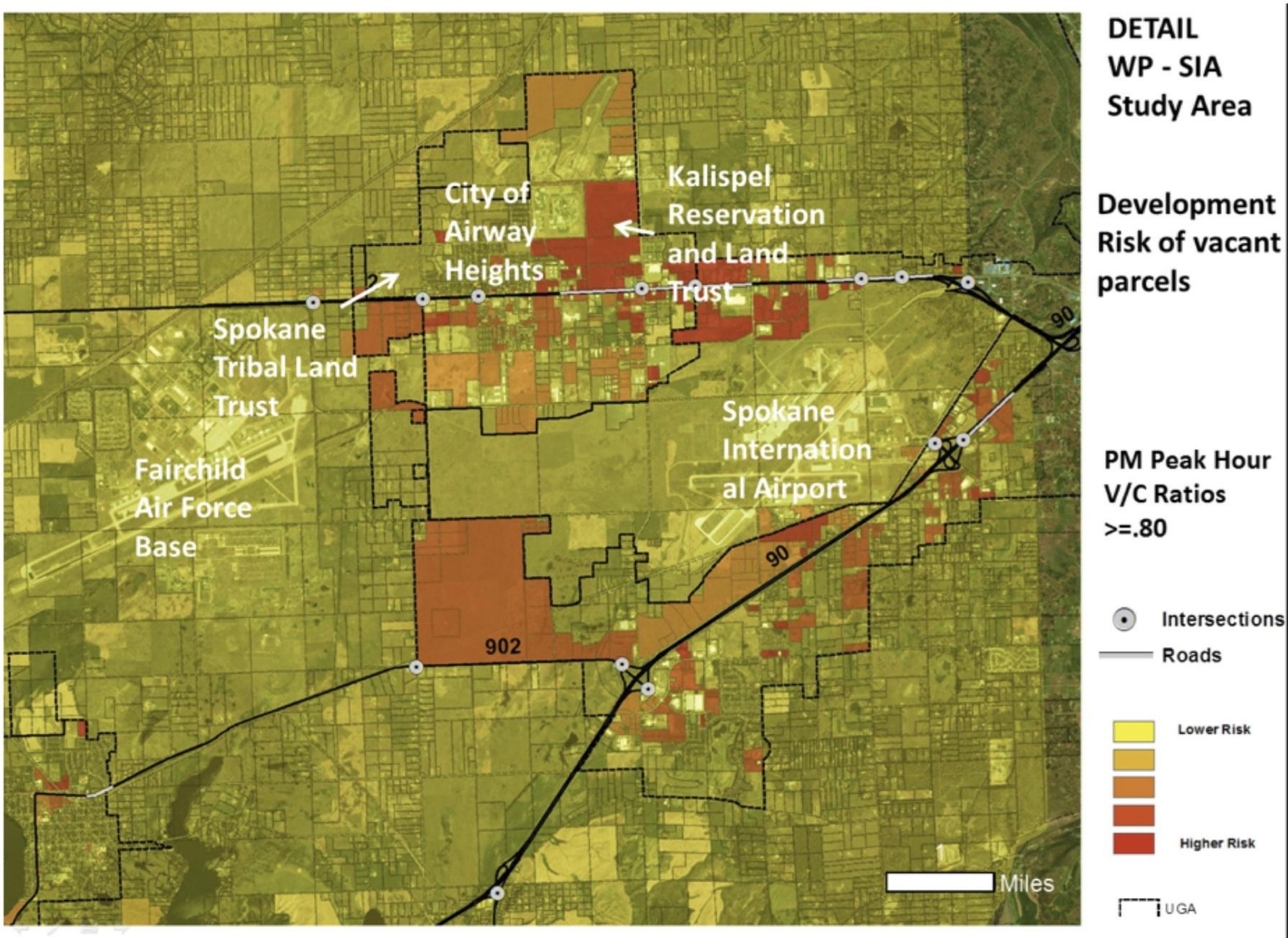

Figure 1-12: Detail of Development Risk of Vacant Parcels for the West Plains Airway Heights, and Spokane International Airport Study Area

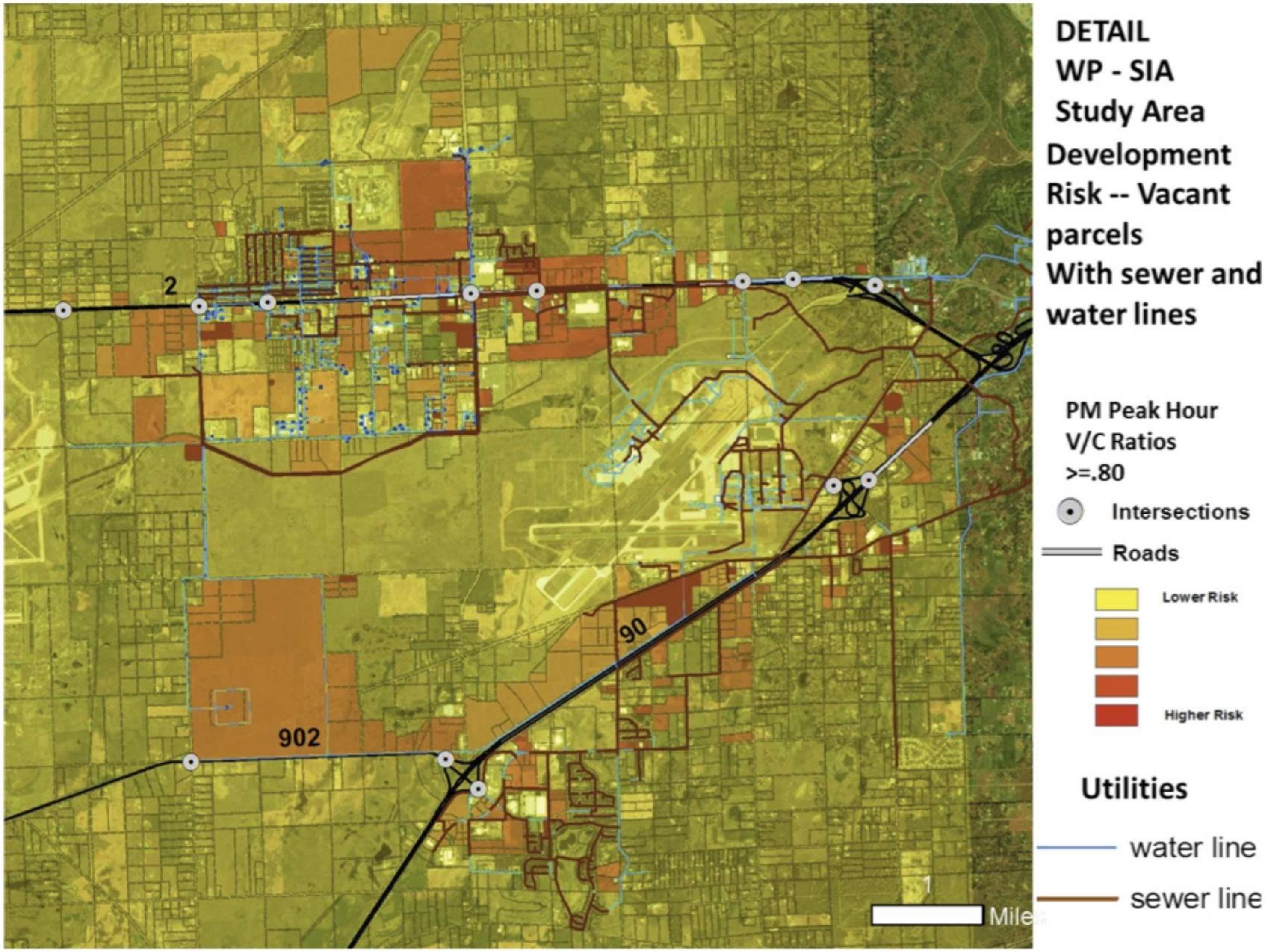

Figure 1-13: West Plains Area, Risk of Development with Sewer and Water Utilities Overlaid

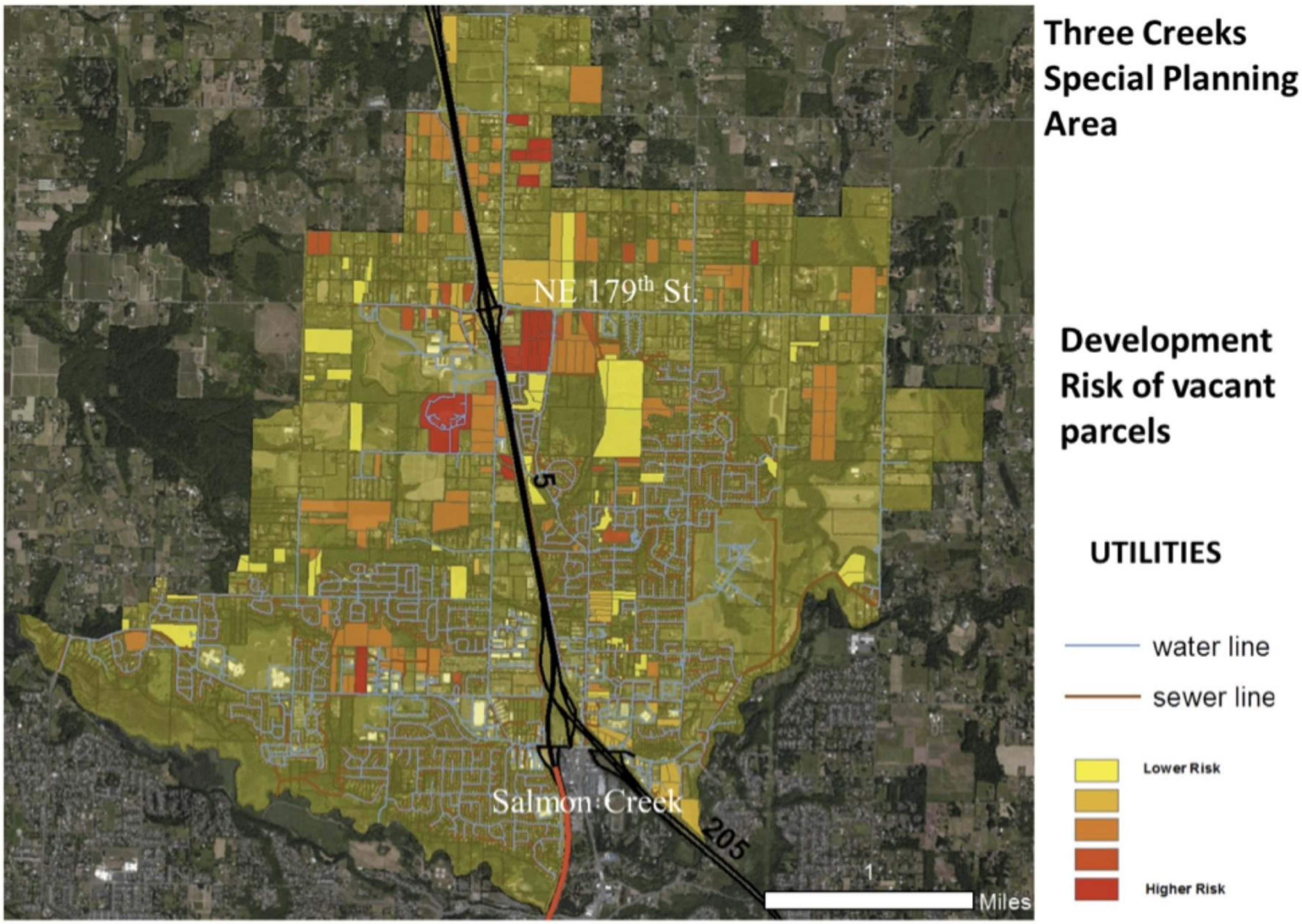

Figure 1-14: Three Creeks Area, Development Risk of Parcels

For Issaquah, analyses remain incomplete, as we did not obtain population and employment forecast data, and we lacked consistent zoning information

Further Explorations of Underdeveloped and Re-developable Lands

Underdeveloped land presents challenges in assessing risk of future development. In many cases, developed properties (i.e., property where the land is not vacant) do not contain improvements that are the “highest and best use” allowed by zoning, meaning that redevelopment might be economically desirable. Land monitoring efforts typically use ratios of assessed improvement values to land value to identify those properties with a ratio below a defined threshold as “re-developable.” The interpretation of results from such analyses necessarily takes into account specific locations because the pressure for development can vary greatly among areas—as they would, for instance, between the area of South Lake Union of Seattle and that of Medical Lake outside of Spokane.

A simple analysis of the West Plains area was undertaken to investigate potentially underdeveloped land by focusing on parcels that were currently in single family use and greater than 2 acres. In urbanizing areas, these are parcels that are likely to be subdivided into smaller lots. The same analysis and weighting process as described above was carried out for these parcels (Figure 1-15). This quick and simple assessment of underdeveloped land was done for illustrative purposes. It should be noted that many of the parcels highlighted in Figure 1-15 would be at lower risk because of the lack of utility connections.

Another means for assessing underdeveloped lands is to leverage the Buildable Lands analyses that urban counties periodically undertake. Buildable Lands assessments have the benefit of directly addressing the issues of land development potential. We received a buildable land data set from Clark County but did not have a chance to integrate the data into our risk analysis.

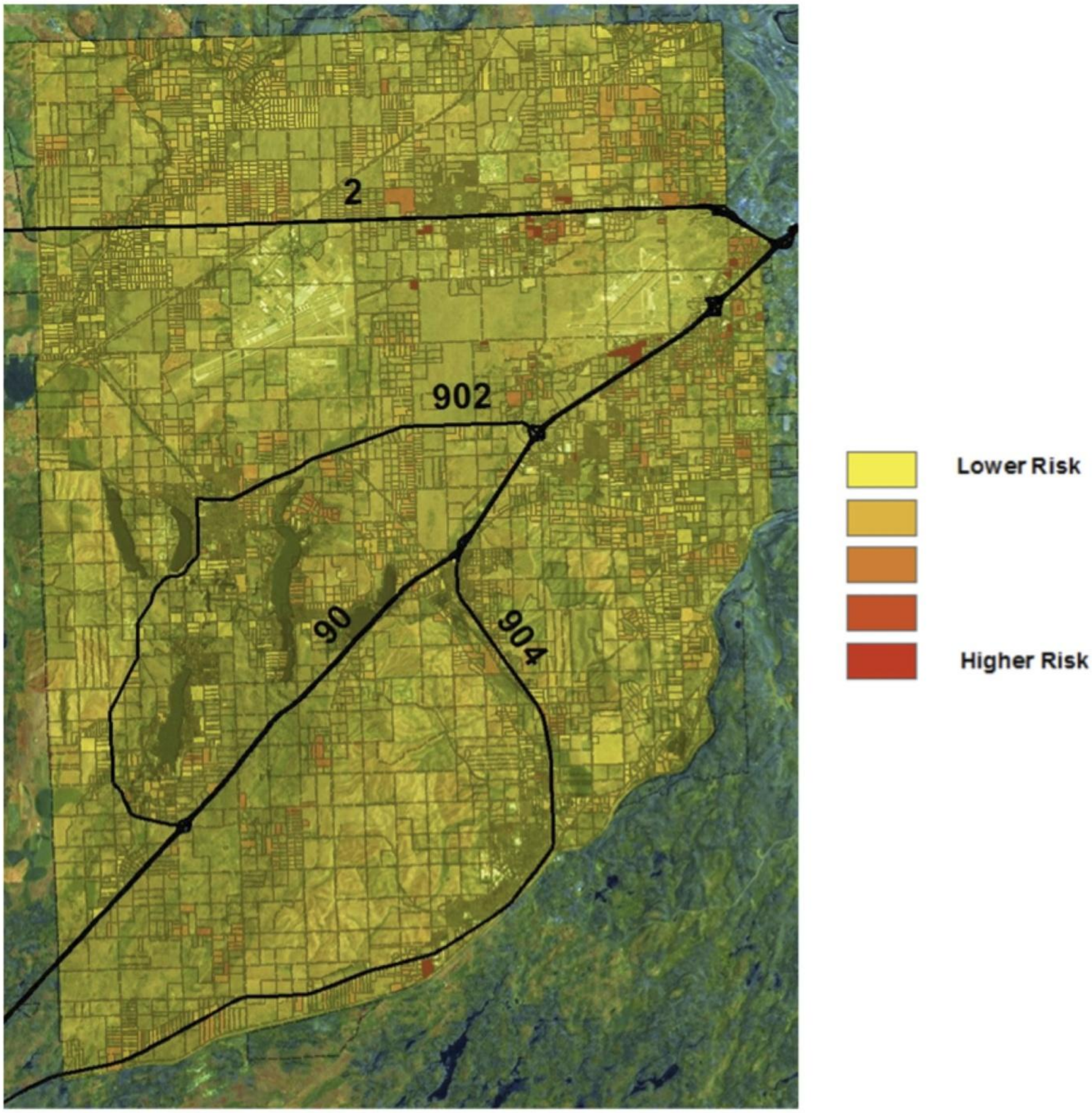

Figure 1-15: Risk of Development for Underdeveloped Land for the Greater West Plains Study Area

Summary

As noted in the statewide analysis, this method is flexible and can accommodate additional data, including those found at other scales where available. Factors can be added or substituted as deemed appropriate. Discussions with regional WSDOT staff and local government planning staff indicated that these initial analyses came adequately close to real world conditions for assessing land development risk. Although, in the West Plains area, local planning staff noted that land belonging to the airport, the military, and the tribes were not identified as at risk for development, when in fact they are likely to experience more intensive uses in the future. This was a result of how those lands were treated within the data sets used to track historic changes in development and estimate future growth. For example, the areas of Fairchild Air Force base and Spokane International Airport did not have data readily available from our sources in Spokane County or the City of Spokane. Thus, these areas need to be treated as distinct planning entities, and engaged individually for obtaining data and determining future projections.

Discussion and Conclusions

The exploratory nature of this project produced a wealth of readily available data and an underlying structure to create a workable land development risk analysis for use by WSDOT planners. As noted, additional and different factors can be used in future risk analyses. Also, and perhaps more important, the weights given to the factors used in the Composite Risk Score need to be assessed and defined. Multivariate analyses with different travel outcomes can help measure the relative influence of the factors on the desired outcome. Furthermore, land development prospects can be better understood and eventually measured with more refined analyses of historical data on land development and sales, along with more precise assessments of the relationship between zoning regulations and land development. The land development risk of institutional, military, tribally owned, or other lands where development activity may not routinely be incorporated into the county/regional assessor and land sale databases, or that represent jurisdictional entities that may not be fully integrated with the MPO planning process should also be further explored. The following sections expand on the first two points.

Calibrating the Risk Analysis with Historical Data

The relationship between development and the numerous data that we collected varies by location. In other words, the development process is different in Issaquah than in the Salmon Creek area of Clark County. If the present analyses were expanded to include more highly developed urban areas or more sparsely developed rural areas, these differences would be even greater. To address these spatial heterogeneities, future research could calibrate the relationships between the variables and development outcomes for each area by using historical data. The sales information that we collected included transactions for 15 years. We also gathered at least one historical parcel shapefile from each of the three counties in our case studies. Acquiring historical data on property characteristics, zoning regulations, etc., could prove more difficult, though direct cooperation by the county should be helpful.

One of the difficulties in such an approach is the fact that large properties are often subdivided for development purposes and, therefore, can be difficult to track within historical databases. By comparing parcel layers over time within a GIS framework, this issue can be potentially overcome.

Improving Estimates of Development Capacity

The development capacity of any given parcel may be estimated by comparing its legal entitlements to its physical attributes. A cursory analysis such as this has a number of problems.

First, planning and zoning regulations are not always simple enough to apply a basic multiplier to the lot size. In the case of single family residential subdivisions, dividing the total land area by the minimum lot size (minus right-of-ways) may provide an accurate estimate of development potential. But for commercial zoning and other higher density residential uses, this exercise becomes more complex and the outcome less certain.

Second, planning and zoning entitlements do not necessarily mean that a given use is economically viable and likely to be developed. Further complicating the process is the fact that it is difficult to forecast what may be economically viable 15 to 20 years in the future.

Finally, planning and zoning regulations change, and they do not always do so in predictable ways. Within Urban Growth Boundaries, vacant lands with large lot zoning today can become tomorrow's densely developed Planned Urban Development. Ongoing contact with local planners and public officials can provide much needed information on the likely changes to public policy in the near term.

For the purposes of this exploratory analysis, we did not attempt to estimate specific development capacity but rather focused on identifying properties with potential for development. As noted, determining development capacity is a difficult process. Ideally, future developers of this risk analysis would solicit input from local planners in the specific areas being analyzed. Avoiding errors deriving from the inherent uncertainty of future economic conditions is perhaps the most challenging aspect of forecasting land development risk. We suggest producing a range of outcome scenarios (rather than a single output), as well as employing a process that continually updates these models at given points in the future to stay abreast of any changes to the market.

Determining the Study Areas Is an Incomplete Science

Finally, we suggest that more research into local travel patterns will provide more reliable estimates of how new growth on any given parcel is likely to influence traffic patterns.

In conclusion, the analyses presented outlines a system to objectively evaluate where land development risk is likely to occur near state facilities. Based on readily available data, the analyses are replicable and offer a tool that WSDOT can use to assess future changes in travel on state routes at a statewide level. Statewide land development risk analyses can help WSDOT to compare, prioritize, and benchmark high risk areas. The identification of high land development risk in specific areas of the state can be followed by further analyses at the local level. Anticipating land development objectively, and over the long term, can help turn adverse risk of land development into opportunities for route improvements.

PART II: COLLABORATIVE STRATEGIES FOR MANAGING ADVERSE RISK

Once specific corridors and/or road segments have been identified as being at risk from likely real estate development, WSDOT can allocate resources to those potential problem locations. Additional planning resources will allow the Department to work collaboratively with the local jurisdictions to help ensure that the expected new development—and the location's current residents, employers, and stores—can be effectively served by available, sustainable transportation options, and that as development occurs, the collaboratively adopted plans will describe how those transportation options should expand to meet the new travel demand.

This section of the report describes a variety of ways in which the WSDOT can contribute to this collaborative process. It also provides advice on when to use each of the identified techniques. Given the limited scope of this project, and because much has been written elsewhere on these techniques, this discussion is brief. References are provided to direct WSDOT staff to more detailed documentation on each of the techniques discussed.

Overview of the Risk Mitigation Approach

The recommended approach for mitigating risk to state transportation facilities attributable to development is structured in five steps. These steps are as follows:

Step 1: Identify corridors most at risk for development

Step 2: Manage risk through planning and coordination

Step 3: Identify specific non-engineering mitigation strategies

Step 4: Identify specific engineering mitigation strategies

Step 5: Fund and/or enforce mitigation strategies.

The first of these steps is covered in Part 1 of this report. The remaining four steps are briefly discussed below.

Part II of this document introduces the goals of the activities to be performed in steps 2 through 4, explains the intended results from each activity, and provides a set of strategies identified in the literature that transportation agencies have successfully undertaken to accomplish those goals. For each step, a summary table of strategies is provided. For each strategy in each table, the following information is provided:

- Strategy name and brief description ("Strategy" column)
- Additional details and a brief assessment of the strategy's usefulness ("details/assessment" column)
- Locations where the strategy has been implemented ("applied" column)
- An estimate of the time frame over which the strategy takes effect ("Time frame" column)
- A rough estimate of the ease of implementing the strategy ("Ease" column)
- The literature source from which the strategy was identified ("Reference" column)

While these activities are discussed as separate steps, they actually take place in parallel with considerable interaction. For example, establishing the availability of funding—including identifying possible funding sources, and determining how the funding will be generated and when it will become available in the land development cycle—plays a key role in identifying which engineering and non-engineering mitigation efforts are affordable, can therefore be implemented, and should therefore be part of a corridor or sub-area plan. Similarly, when no funding for transportation improvements is available, local jurisdictions need to carefully consider their permitting process and development code.

Setting up the jurisdictional cooperation needed to select the best/most appropriate mitigation approaches, identifying and obtaining the funding needed to implement those solutions, and then actually supplying those transportation services are tasks that must be done within the context of the region. Thus, while the four steps below can be discussed independently of each other, the actual risk management effort must treat them holistically.

Step 2: Manage Risk through Planning and Coordination

In many respects, "Planning and Coordination" is the key to mitigating the risk from real estate development activity. The ideal outcome of the planning and coordination step is for the affected partners (jurisdictions and transportation agencies) to agree on a practical vision for the corridor/subarea and to set the stage for implementing that vision as the expected growth occurs. That vision includes a shared understanding of roughly where the development is going to occur, the characteristics of that development, how the transportation system in the area can most effectively grow to provide the transportation services needed to meet the expected growth, and how the funding needed for those improvements can be generated. That shared vision also needs the flexibility to adjust to changing development interests while maintaining an overriding connection to the transportation services that can realistically be provided to support that growth.

In this step of the risk mitigation process, knowing the specific details of the size and timing of new developments is not crucial. What is important is developing a broader agreement on the overall size of the development expected; the nature, size, and location of the transportation facilities needed to serve that growth; the funding needed to supply those new transportation services; and an understanding of—and agreement on—the actions required from each of the partners to achieve that vision. That is, comprehensive growth plans and transportation plans need to be effectively synchronized across jurisdictions, with funding for transportation system expansion being linked to expected growth.

The state of Washington has existing transportation concurrency legislation that requests just this sort of coordinated response to planning for and implementing growth and transportation system expansion. The concurrency legislation creates one set of tools that local governments can use to work together successfully. While the concurrency legislation provides for considerable flexibility in the design and implementation of transportation concurrency [15], not all local jurisdictions are comfortable using the state's concurrency rules as a way to encourage cooperative, coordinated planning. Additionally, local governments are not required to and seldom do include state transportation facilities in their concurrency programs. In addition, many local agencies have adopted concurrency regulations that are not sensitive to the impacts of those regulations across jurisdictional lines. When developed with a shared jurisdictional vision of desired outcomes, concurrency can be a useful tool for achieving that shared vision. When developed independently and without that shared jurisdictional vision, it is far less effective. [15] Luckily, many other strategies can be successfully used to effectively plan and implement the transportation facilities needed to foster and support growth. Table 2-1 lists a number of the strategies that can help multiple jurisdictions work effectively together to plan for expected growth.

Ideas like signing a memorandum of understanding (MOU) between jurisdictions with shared interests can serve many purposes. For example, some Washington jurisdictions have used MOUs to codify agreements with neighboring jurisdictions so that each jurisdiction collects and shares multi-jurisdictional transportation impact fees for developments whose impacts cross jurisdictional boundaries. Such MOUs help jurisdictions act for their common good by limiting the ability of developers to play one jurisdiction off against the other.

While congestion on routes of statewide significance can not be used under the Concurrency regulations to limit development when local agencies wish to allow that development, local agencies are allowed to generate funds from both development and local sources that can be used to help pay for improvements on state routes and they can enter into agreements with the state with respect to those improvements. The exact nature of the relationship between the state (WSDOT) and local jurisdictions, as well as the nature and size of the funds to be generated locally, will change from location to location. The key to all of these inter-jurisdictional arrangements is the ability for all participating agencies and jurisdictions to come to a shared vision of the desired outcomes, and agree on the roles and capabilities of each agency in achieving that vision. Getting to a shared vision, and adopting effective, realistic plans for achieving that vision are important outcomes of the on-going planning process.

Table 2-1: Strategies for Planning and Coordination

Strategy	Details / Assessment	Applied	Time Frame	Ease	Reference
Memorandum of Understanding (**MOU**) to define agency roles in corridor planning and property/ improvement negotiations	Important for inter-agency cooperation	WA, MT, NC, FL	Med to long	Med	[9]
Interagency task forces to establish policy standards, guidelines, data sharing agreements, modeling standards, etc.	Could be effective for setting up framework for sustained interagency cooperation	FL	Short	Med	[9]
Technical assistance via handbooks, joint training, municipal outreach, engagement of associations, workshops, model regulations, webinars, online tools	Effectiveness likely depends on delivery and how well assistance is received	PA	Short set up; mid to long delivery	Easy	[9, 16]
Acquire ROW property or development rights in high risk areas in advance of development	Requires a fairly high level of certainty of where growth will occur	Many places	Short	Med	[9, 16, 17]
Access management plans	Often standard practice. In WA local jurisdictions are access permitting authorities when managed access state facilities are within their boundary, which makes plans difficult to enforce. Also difficult to alter pre-existing non-conforming access points.	Many places	Med to long	Easy	[9]
State DOT competitive **grant program for funding transportation investments linked with land-use planning** to support livability and non-motorized transportation	Such a program would incentivize local jurisdictions to proactively mitigate development impacts where development is likely to occur	PA, OR, LA, GA, MN, CA	Med	Med	[9]
Sharing of **standardized land-use and transportation data** across agencies	May work best when integrated with sharing of plan and project documents fed by the data	WA, LA, OR, GA, MN	Long	Med	[9]
System for providing **electronic project or planning documentation** that all stakeholders can access and review concurrently	Electronic process also facilitates record keeping and documentation of process	FL, OR	Short	Med	[9]
Least Cost Planning Tool (LCPT), a regional level tool to compare multiple actions across multiple corridors for performance indicators such accessibility and quality of life	LCP is a method of comparing costs and benefits of potential TDM and capacity options (i.e., all mitigation strategies) with the help of public input. Oregon tool in development.	OR	Short	Med	[9, 18]

Similarly, actively sharing data and creating task forces to develop mutually beneficial growth and transportation plans helps neighboring jurisdictions and the state develop plans and implementation strategies that benefit from the synergy of multiple jurisdictions working together. These joint planning efforts generally result in better outcomes than when individual jurisdictions work independently, looking out only for their own benefit.

The timing of these planning efforts is important. Understanding the likely growth potential for a corridor/subarea and the transportation options needed within a corridor/subarea as "build-out" of that area continues allows the affected jurisdictions, and often the region as a whole, to plan for the deployment of the necessary transportation options before growth has forestalled those options. If effective planning for growth occurs early, it is possible for the local jurisdictions to either help developers plan for alternative transportation modes as part of the design for their developments (for example, building infrastructure that makes it easy to provide transit service, or providing safe, well connected biking and walking paths as ways to make their developments attractive) or help construct the well-connected roadway systems that are necessary to provide the mobility that will attract residents, employers, and stores to that new development.

For example, if it is understood that an existing roadway will need additional lanes as an area grows, the right-of-way for those lanes can be purchased, reserved, or otherwise maintained as growth begins in the corridor, even if that capacity is not needed at the time of that early growth. This can only be done with the cooperation of the jurisdictions through which that road travels and that control the development rules for parcels along that corridor. By starting well before expansion becomes a requirement, the affected local jurisdictions can adopt the policies necessary to minimize the cost, effectively share that cost, and maximize the benefit obtained from that right of way.

Similarly, if it is clear that key roads cannot, or will not, be expanded to handle foreseeable traffic volumes, by starting early, the affected jurisdictions can design alternative routes to carry some of the expected traffic load and/or adopt the policies that help encourage travel demand to occur in ways that require less road space (e.g., making sure transit can operate efficiently, or that safe, direct, non-motorized travel paths are constructed as part of the new development to encourage lower levels of vehicular traffic). If these modes of travel are only considered "after the fact," then the adopted land uses and land forms may prohibit their effective use as alternatives to the car, forcing the jurisdiction to accept significant traffic congestion as the cost of permitting additional development.

Finally, one of the key findings from the case studies for this project was that the act of having WSDOT participate with local jurisdictions in planning for future growth of areas that the data suggested were at high risk of development frequently led to valuable discussions about other potential growth areas. Those additional development concerns were often driven by specific developers (e.g., military bases or local tribes) that expected to serve the new travel demand exclusively through expansion of existing state routes. The WSDOT was able to indicate that the funding needed to build/expand those state routes was unlikely. This, in turn started a valuable set of planning discussions about good alternatives and the requirements to implement them.

The resulting discussions highlighted the need for the local jurisdictions to start planning now for alternatives to serving their planned developments, as the lack of increased state route capacity was likely to hinder the economic attractiveness of the planned developments without the availability of alternative capacity. These results are great examples of collaborative planning at its best.

Step 3: Identify Specific Non-Engineering Mitigation Strategies

As part of the collaborative planning process, it is important for the participating jurisdictions to consider a variety of strategies for mitigating the increased travel demand occurring as a result of new development. It is always important for the planning process to start by considering non-engineering (i.e., "soft" or non-infrastructure) solutions to mitigating the new demand expected from land development. Many non-engineering solutions not only provide low cost, sustainable travel alternatives, they can also decrease the need and cost of parking, improve safety, decrease the amount of stormwater runoff, and improve the overall attractiveness of land. Finding ways to limit growth in traffic demand and thus avoid the need to expand roadways also removes the cost of expanding road capacity and is especially critical when expanding the right of way is infeasible.

Unfortunately, many non-engineering strategies are effective only in specific land-use conditions or when applied to specific types of land forms. Therefore, to gain the desired benefits, these "soft" approaches must be selected carefully so that they fit their environment.

For example, pricing parking is an excellent way of reducing traffic volumes to an area. But when the strategy is implemented in a low density area, it simply tends to drive away residents, employers, and retail stores. Establishing parking pricing, without harming the economic activity of an area, is possible only when market conditions are correct. This usually means dense urban settings where land prices make parking spaces expensive to provide, where activity levels are high enough to attract trips despite the cost of parking, and where the density of activities allows for other effective and efficient travel services such as transit. Similarly, ridesharing programs—both as part of or external to Commute Trip Reduction programs—require sufficient trip making density to be successful.

Other non-engineering strategies need to be part of larger coordinated land-use and transportation plans. For example, strategies such as Transit Oriented Developments (TOD) are successful only when a number of factors, such as good transit service and high levels of accessibility to services and other travel destinations, exist within easy reach of the proposed TOD. These factors may be already present, but frequently regions need to plan for future TOD early in the development of the corridor to ensure that other supportive land uses exist near the TOD, that the early developers within the corridor design their developments in ways that support later TOD development, and that the early developments also gain from the benefits associated with the extra activity levels from the TOD development.

Table 2-2 summarizes many of the strategies available for mitigating traffic demand from new land development without increasing roadway capacity. The strategies presented are intended to serve as discussion points for the partner jurisdictions responding to development risk. Working together, these partners can determine which of these strategies are likely to be effective within the context of the study corridor and the expected development.

Table 2-2: Non-engineering Mitigation Strategies

Strategy	Details / Assessment	Applied	Time Frame	Ease	Reference
Context Sensitive Solutions (**CSS**), a collaborative approach to plan for a transportation facility appropriate for its setting. Can result in designs that encourage less vehicle miles traveled.	More of a planning process than a specific strategy. Requires "careful, imaginative, and early planning, and continuous community involvement."	Many places	Short	Med	[9]
Encourage **mixed use development**	Internal trip capture will reduce trip generation. Integrates land-use and corridor planning, which should happen before development is proposed.	Many places	Long	Med	[9]
Transit improvements and TOD (additional service, new routes, Bus Rapid Transit, circulator routes, park-and-rides, signal prioritization, trip planning tools, etc.)	Requires that transit agencies be part of corridor planning process.	Many places	Short to long	Easy to hard	[9, 19]
Route abandonment, changing jurisdictional ownership/control arterial type streets to jurisdictions if they will fall below acceptable LOS standards	Under state concurrency rules, this places what were state routes back within the local concurrency regulations, giving additional power over development to local agencies	CA	Short	Easy to hard	[20]
Parking management and pricing	Applicable mostly where heavy congestion and alternate transportation modes exist	Many places	Short to long	Easy to hard	[18, 19]
Commute Trip Reduction (**CTR**), employer-based program to encourage commuting by transit, non-motorized, ridesharing (subsidized transit pass; encouragement programs; bike storage and showers; workplace travel plans; flexible work hours; telecommuting; guaranteed ride home; parking cash out)	May work best in areas where there are just a few large employers. See TMA strategy for places where many small employers are located.	WA, CA	Med	Med	[18, 19]
Transportation Management Association (**TMA**), non-profit, member-controlled organizations that provide transportation services in an area, such as a commercial district	Essentially an efficient way to provide an extensive CTR program for many smaller businesses	WA, CA, OR	Med	Med	[18, 19]
Intelligent Transportation systems (**ITS),** traveler information, signalization, incident response	Most appropriate for areas with heavy traffic	Many places	Med	Med	[19]

Table 2-2 (cont): Non-engineering Mitigation Strategies

Strategy	Details / Assessment	Applied	Time Frame	Ease	Reference
Tolls, HOT lanes, managed lanes, and congestion pricing	Added benefit of providing funding, difficult to implement except where funds are needed for improvements and few alternate routes exist.	Many places	Med	Med	[19]
Adjusted trip generation estimates based on existing urban form	Good way to encourage infill development and efficient use of land in partially developed areas	Many places	Short	Easy	[20]
Public education campaign	Probably most effective when paired with physical transportation improvements	Many places	Short	Easy	[19, 20]
Rideshare matching programs outside of CTR program	Most appropriate for areas with heavy traffic congestion and strong commuting patterns	Many places	Med	Med	[19, 20]
Freight delivery management, including time-of-day restrictions	Can move freight travel out of congested time periods, freeing up roadway space for other vehicles, and more efficiently utilizing available roadway capacity	Many places	Med	Med	[19, 20]
Introduce or expand **car or bike share program**	Most appropriate for dense, mixed use areas	Many places	Med	Med	[19, 20]

Step 4: Identify Specific Engineering Mitigation Strategies

The most common development mitigation response is to add roadway capacity or other new infrastructure to serve the additional traffic demand from new development. "Engineering improvements" can take many forms, from new travel lanes, to major changes in streetscapes such as limiting access to neighboring land parcels via more controlled turning movements and driveways, to a variety of more modest intersection improvements (e.g., new channelization, better signalization).

Unfortunately, there are difficulties with relying on engineering mitigation. Two of the most common problems include 1) a lack of funding to pay for that mitigation, and 2) an inability to physically add the capacity needed to meet the demand expected, either now or in the future as growth continues in the corridor. Many suburban and exurban cities have built land forms that rely on roadway capacity for access but lack the funding and/or right-of-way to build that capacity as the fraction of developed land increases along a corridor. The result is either limitations in desired development or unwanted levels of congestion. Thus, while engineering solutions are important, the collaborative planning process needs to consider longer range growth scenarios and plan ahead for the travel mitigation required for those later stages of development.

Table 2-3 describes many of the more common engineering approaches to mitigating new travel demand from growing land development.

Table 2-3: Engineering Mitigation Strategies

Strategy	Details / Assessment	Applied	Time Frame	Ease	Reference
Add roadway capacity	A common default strategy – if space and money exists or can be made available	Many places	Long	Hard	[9]
Alternative Analysis Research Tool (**AART**) to identify and prioritize new facility alignments	Only relevant for building entirely new roads as a mitigation strategy. GIS tool. May be overly complicated.	FL	Short	Med	[9]
Developer provisions of ROW, development rights, or infrastructure	Subject to availability of ROW not within the bounds of the development	Many places	Long	Med	[9]
Access management, including shared driveways and frontage roads	Based on access management plans and enforced through the permitting process.	Many places	Short	Med	[16, 22]
Corridor Traffic Simulation Model to evaluate impact of access points along a corridor	Tool to assist with access management (http://mctrans.ce.ufl.edu/featured/tsis/)	GA	Short	Med	[9]
Landscaping (trees, noise barriers, screening, grade separations, etc.) to integrate additional traffic with adjacent land uses better	When used in concert with higher levels of access management can provide significant safety benefits as well as attractive development	Many places	Long	Med	[17]
Operational improvements: metered on-ramps, access management, advanced signal systems, signal re-timing, reversible lanes, parking restrictions, variable speed limits, etc.	For use in urban areas where capacity cannot be added. Choice of strategies will depend greatly on context.	Many places	Med to long	Med	[20]
Non-motorized transportation improvements: sidewalks, bike lanes, multi-use paths, pedestrian-oriented design	Requires appropriate urban form (larger non-motorized network and nearby density) for these improvements to be fully functional.	Many places	Long	Med	[9]
Grade separated **links across facility**	Important for local access. Also implies that a dense street network adjacent to state facilities will relieve traffic on state facilities.	Many places	Long	Hard	[17]
Traffic calming (road diets, raised crosswalks, tighter corner radii, medians, street trees, perceptual design features)	May add to travel time, but has potential to greatly increase safety, reduce traffic volumes and increase non-motorized mode split.	Many places	Long	Med	[18, 22]
Other geometric capacity improvements: Channelization, roundabouts, signalization, etc.	Typical improvements made as a result of development review and concurrency analysis. Can be good in the short term, but limited in the long term.	Many places	Short	Easy	

Step 5: Fund and/or Enforce Mitigation Strategies

This final step, in many ways, controls all of the other steps. At one extreme, with enough money, anything is possible. At the other extreme, with no money, only “free” alternatives can be implemented. No matter how well made, plans cannot be implemented without funding. Understanding what funding is available and how it will be obtained allows for the development of realistic plans. Understanding where funding shortfalls exist given the transportation needs of expected development tells a region when it needs to become more creative with its approach to funding or to reevaluate where and how development will occur. Similarly, a well formed transportation plan whose implementation is clearly vital to making an area attractive to development is key in bringing together local officials in order to develop the funding options to deliver those transportation options. Bringing the elected officials into the planning discussion so that they understand the value of the selected transportation options, the need for funding to implement those plans, and the consequences of <u>not</u> funding those plans is a key part of the collaborative planning process. Table 2-4 lists a number of different mechanisms that can be considered when additional funding is required to meet increased travel demand.

Table 2-4: Fund and/or Enforce Mitigation Strategies

Strategy	Details / Assessment	Applied	Time Frame	Ease	Reference
Taxing districts, created by developers or local governments to fund infrastructure costs for improved mobility	Seems like a good idea, More difficult to apply in WA state	GA	Med	Med	[9]
Require local jurisdictions to **condition development permits on delivery of DOT mitigation requests** or impact fees	If done right can make the process more consistent for developers, if not done correctly can stifle development and strain relations with local jurisdictions	Idea for WA	Short	Med	[16]
DOT directly assess and collect impact fees	Gives WSDOT a more direct role in review process, could result in consistent and predictable impact fees	Idea for WA	Short	Med	[16]
Private/public partnerships between DOT and developer (and perhaps other local jurisdiction) to deliver infrastructure	May only work for very large planned communities or other large developments.	NV	Short	Med	[20]
Multi-jurisdiction fee programs based on joint power of authority (JPA) agreements, used when development impacts affect facilities owned by multiple jurisdictions	Good because developers can avoid dealing with each jurisdiction separately (e.g., environmental impact reports for each individual jurisdiction)	WA, CA	Med	Med	[20, 21]
Organizational structure to quickly and efficiently **implement low-cost, short-term improvements**	Currently difficult for WSDOT process to handle small projects	Idea for WA	Short	Med	[20]

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APPENDIX 1: EXPERTS WHO PARTICIPATED IN THE ROUNDTABLE

Invited Guests

- Charles R. Wolfe, Land-use lawyer and UW Affiliate Associate Professor of Urban Design and Planning
- Ben Bakkenta, AICP, Program Manager, Puget Sound Regional Council, PSRC
- Joe Tovar, consultant, former planning director for the City of Shoreline; served on the Central Puget Sound Growth Management Hearings Board from 1992 to 2004

UW Runstad Center

- Glenn E. Crellin, Associate Director of Research, Runstad Center for Real Estate Studies
- Andy Krause, doctoral student, UW Interdisciplinary Program in Urban Design and Planning, working with Runstad Center data

UW TRAC/UFL

- Mark Hallenbeck, Director, UW TRAC
- Anne Vernez Moudon, Professor of Urban Design and Planning, Director UW UFL
- Amir Sheikh, Research Scientist UW UFL
- Orion Stewart, Research Scientist UW UFL

Washington Department of Commerce

- Leonard Bauer, Managing Director, Growth Management Services

WSDOT

- Brian Smith, Strategic Planning Director
- Elizabeth Robbins, Community Transportation Planning Manager
- Karena Houser, Transportation Planning Specialist

APPENDIX 2: REAL ESTATE DATA OVERVIEW

Real estate data can be broken into two subsets. The first subset is information regarding the current physical state of real property. This includes detailed records of the type, condition, size and other characteristics of the structure (s) existing on an individual property as well as information regarding the components of the land portion of the property such as size of lot, zoning, etc. Data regarding real property characteristics is generally available at the parcel (or lot) level. The most common source for this type of data is the county assessor's office. A number of third party data providers (such as CoStar and LoopNet) and real estate information services (Zillow, Trulia, etc) may also offer this information, sometimes at significant cost. The information available from third party providers may be limited to properties currently for sale or lease or only for properties of a given property use. In many cases, data from these services is gathered, in large part, from the county assessors themselves.

A second set of real estate data involves information on sales and leasing transactions. Much like the characteristics data, sales information is often available from county assessors and/or county recorders offices. Leasing information, on the other hand, is generally only available from specialized private sector firms.

From a land development perspective, both types of data are important. Property characteristics data can be used to determine vacant and underdeveloped land that has potential for development/redevelopment. Market transactions information is useful to pin point particular parcels that have recently undergone a change of ownership and are more likely to see a future change in use. When combined with other data, such as planning and zoning information, topographic maps and transportation network files, etc., real estate data can provide insight into the market fundamentals that drive private sector development.

An important consideration regarding real estate data is that it is likely to vary by location. Data is generally collected at the county level. Within the State of Washington, there is no central data collection agency for real estate data.[3] As a result, each individual county is likely to have data at varying degrees of quantity and quality. More populous counties such as King, Pierce and Spokane offer historical sales information back at least a decade as well as sophisticated land-use classification systems and property characteristics data. In less populous counties, data is often less accurate and less available from a historical context. In developing a

[3] See Maryland and Florida for good examples of a statewide data collection efforts

land development risk model aimed at operating throughout the entire state, these variations in real estate data quantity and quality by county need to be considered.