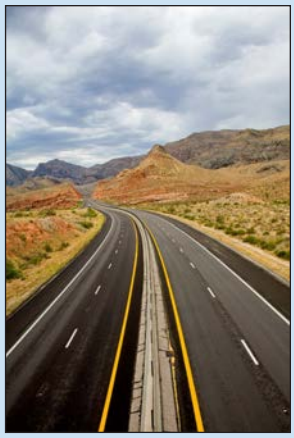
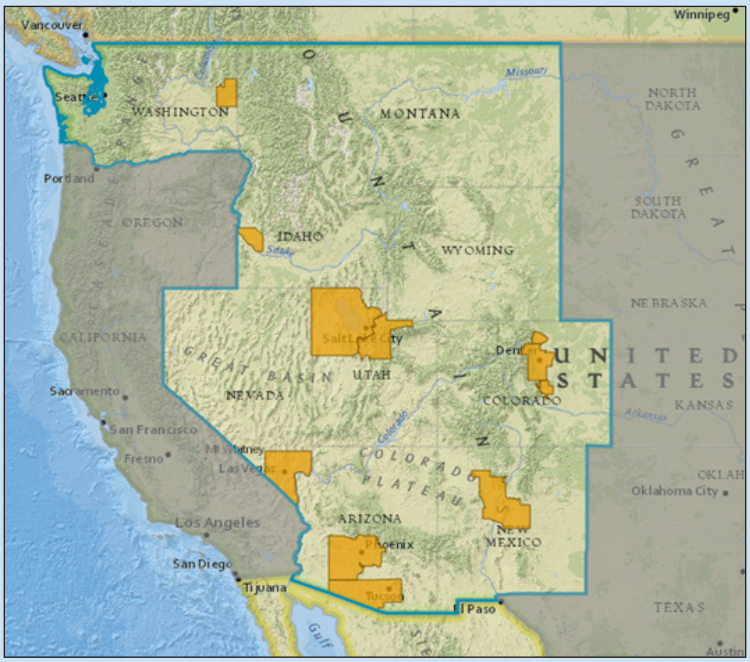
Expediting Project Delivery of Key Transportation Projects in the Intermountain West Region











Prepared by

MARICOPA ASSOCIATION of GOVERNMENTS

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Maricopa Association of Governments

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- A description of the alleged discriminatory act(s) in sufficient detail to enable the Title VI Coordinator to understand what occurred, when it occurred, and the basis of the alleged discrimination complaint (race, color, national origin, etc.)
- The letter must be signed and dated by the person filing the complaint or by someone authorized to do so on his or her behalf.

For more information, or to file a complaint, please contact the Title VI Coordinator at (602) 254-6300.

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List of Acronyms/Abbreviations

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ADOT	Arizona Department of Transportation
ASLD	Arizona State Land Department
ATRI	American Trucking Research Institute
BLM	Bureau of Land Management
BNSF	Burlington Northern and Santa Fe Railroad
CDOT	Colorado Department of Transportation
CHAT	Crucial Habitat Assessment Tool
COG	Council of Governments
COMPASS	Community Planning Association of Southwest Idaho
DoD	Department of Defense
DOT	Department of transportation
DRCOG	Denver Regional Council of Governments
EDC	Every Day Counts
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAF	Freight Analysis Framework
FAST Act	Fixing America's Surface Transportation Act
FASTLANE	Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies
FHWA	Federal Highway Administration
FTP	File Transfer Protocol
GDC	Geospatial Data Collaboration
GIS	Geographic Information System
I-11	Interstate 11
IMW	Intermountain West
ISTEA	Intermodal Surface Transportation Efficiency Act
IWCS	Intermountain West Corridor Study
LEHD	Longitudinal Employer-Household Dynamics
LODES	Longitudinal Origin-Destination Employment Statistics
MAG	Maricopa Association of Governments (in most places; disambiguate Mountainland Association of Governments in part of Section 7 and in *Appendix O*)
MAG	Mountainland Association of Governments (in parts of Section 7 and *Appendix O* only)
MAP-21	Moving Ahead for Progress in the 21st Century Act
MPO	Metropolitan Planning Organization
MRCOG	Mid-Region Council of Governments
MRLC	Multi-Resolution Land Characteristics
NAFTA	North American Free Trade Agreement

List of Acronyms/Abbreviations (continued)

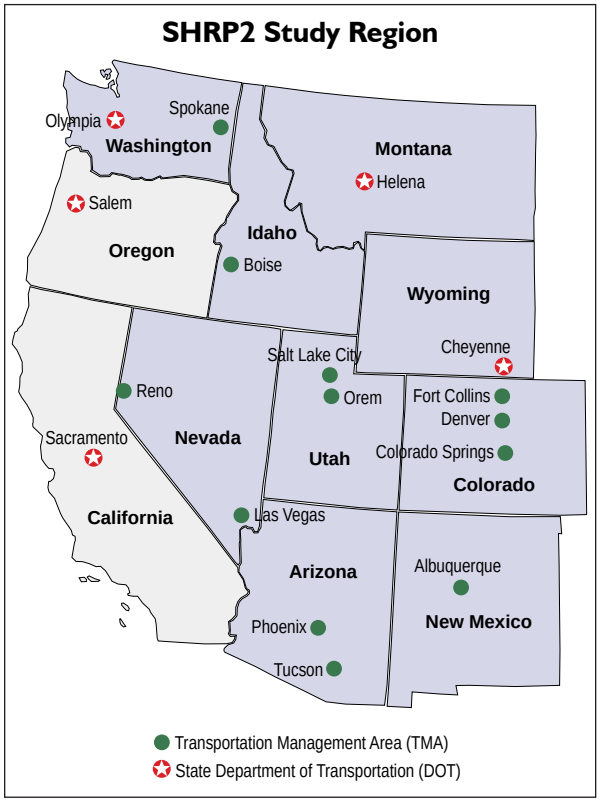
NEPA	National Environmental Policy Act
NFRMPO	North Front Range Metropolitan Planning Organization
NHS	National Highway System
NLCD	National Land Cover Database
NWSA	Northwest Seaport Alliance
PPACG	Pikes Peak Area Council of Governments
ROW	Right-of-Way
RTC	Regional Transportation Commission of Southern Nevada
SHRP2	Strategic Highway Research Program
SRTC	Spokane Regional Transportation Council
TEA-21	Transportation Equity Act for the 21st Century
TIGER	Transportation Investment Generating Economic Recovery
TMA	Transportation Management Areas
UDOT	Utah Department of Transportation
UP	Union Pacific Railroad
WECC	Western Electricity Coordinating Council
WFRC	Wasatch Front Regional Council
WGA	Western Governors' Association
WRA	Western Regional Alliance
WRP	Western Regional Partnership

1. Executive Summary

This report constitutes the summary of efforts by the Maricopa Association of Governments (MAG), the Western Regional Alliance (WRA) and transportation management areas in the Intermountain West region, regarding the Strategic Highway Research Program (SHRP2) Solution C19, Expediting Delivery of Transportation Projects grant received by MAG. It details the activities undertaken by MAG and others under the grant and conclusions and recommendations resulting from those activities.

Importance of the Intermountain West Region

The Intermountain West (IMW) region consists of the states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Washington and Wyoming. Although it is a large area with numerous political jurisdictions, the area is relatively homogeneous. It contains vast stretches of open lands, including deserts in the south, forests in the north and mountains throughout.



The region has much more federal, state and tribal land than the rest of the continental United States. Development in the IMW took place much later than in the Eastern United States and along the West Coast. Given these factors, the area has a great deal of the population concentrated in a fairly small number of large cities.

While the region's population grew slowly in the past, in recent years it has experienced significant population growth exceeding most of the country.

The IMW's transportation infrastructure needs additional capacity improvements to accommodate the economy and movement of people and goods. Because transportation funding formulas tend to use older population estimates, when population increases quickly in an area, funding does not keep up. Thus, the IMW is constantly trying to build and maintain infrastructure consistent with the rapid population growth. Given the vastness of the IMW, transportation planners find themselves continually challenged to find sufficient resources to address the transportation needs of each community and region.

On December 4, 2015, the President signed into law the Fixing America's Surface Transportation Act (FAST Act)[1] regarding surface transportation infrastructure planning and investment. The FAST Act continues funding allocation formulas from existing surface transportation legislation, the Moving Ahead for Progress in the 21st Century Act (MAP-21.)[2]

These formulas, which allocate based on outdated population figures, have a cumulative, negative impact on the IMW region because of its rapid population growth relative to other areas of the country. Federal legislation should reflect current population and other conditions and respond to the demands placed on the region's infrastructure as its population grows and economic opportunities improve with the ultimate goal of improving the quality of life of its residents.

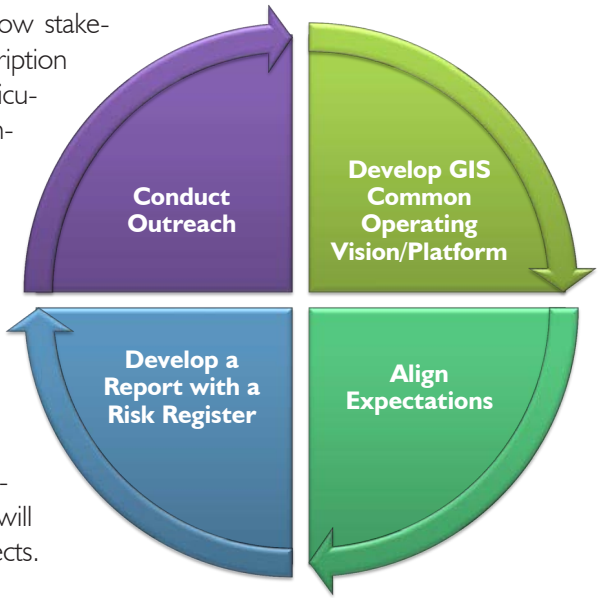
For these reasons, the IMW must not only use transportation dollars efficiently but also expedite the build-out of new, or enhancement of existing, transportation infrastructure. These goals may stand at cross purposes to one another; therefore, efficiencies across the planning and development process are crucial to continued development of robust transportation infrastructure in the IMW.

The recent designation of the Interstate 11 (I-11) corridor through Arizona makes it even more imperative that time be used wisely to provide the best environment for that project and others to move forward. However, the sheer size of the I-11 project suggests that some new ideas in collaboration and cooperation may be the best way to achieve efficiencies.

Western Regional Alliance

It is for these reasons that the Maricopa Association of Governments (MAG) applied for a Strategic Highway Research Program (SHRP2) grant, specifically in solution C19, Expediting Delivery of Transportation Projects. MAG recognized the need to work across political boundaries, particularly with the Western Regional Alliance, to develop a policy network to collaborate and leverage efforts. MAG determined to focus this project on four themes: conducting outreach to engage our stakeholders and identity needs and gaps, developing a common GIS data sharing platform, developing a report with a risk register, and aligning expectations across the region for a broad IMW transportation vision. These components build on each other to assist in future partnering and planning of transportation projects throughout the IMW.

This report details the activities of MAG and its fellow stakeholders throughout this project. It begins with a description of the IMW—physically, economically, and most particularly, its transportation assets. The economic and environmental impacts of transportation infrastructure are considered, and the process used in this project is comprehensively addressed. With that background and through this process, the development of three important tools followed: identification of IMW transportation- and GIS-related resources; the IMW Story Map, an interactive tool for transportation planners having numerous data layers that a planner needs in addressing a transportation project of any scale; and a model risk register that a planner can adapt for their particular project. These tools will assist in the expedited delivery of transportation projects.



The report details the work on the four themes identified by MAG as key to this project.

[1] Public Law 114-94.
[2] Public Law 112-141.

Conducting Outreach Throughout the IMW to Identify Needs and Gaps

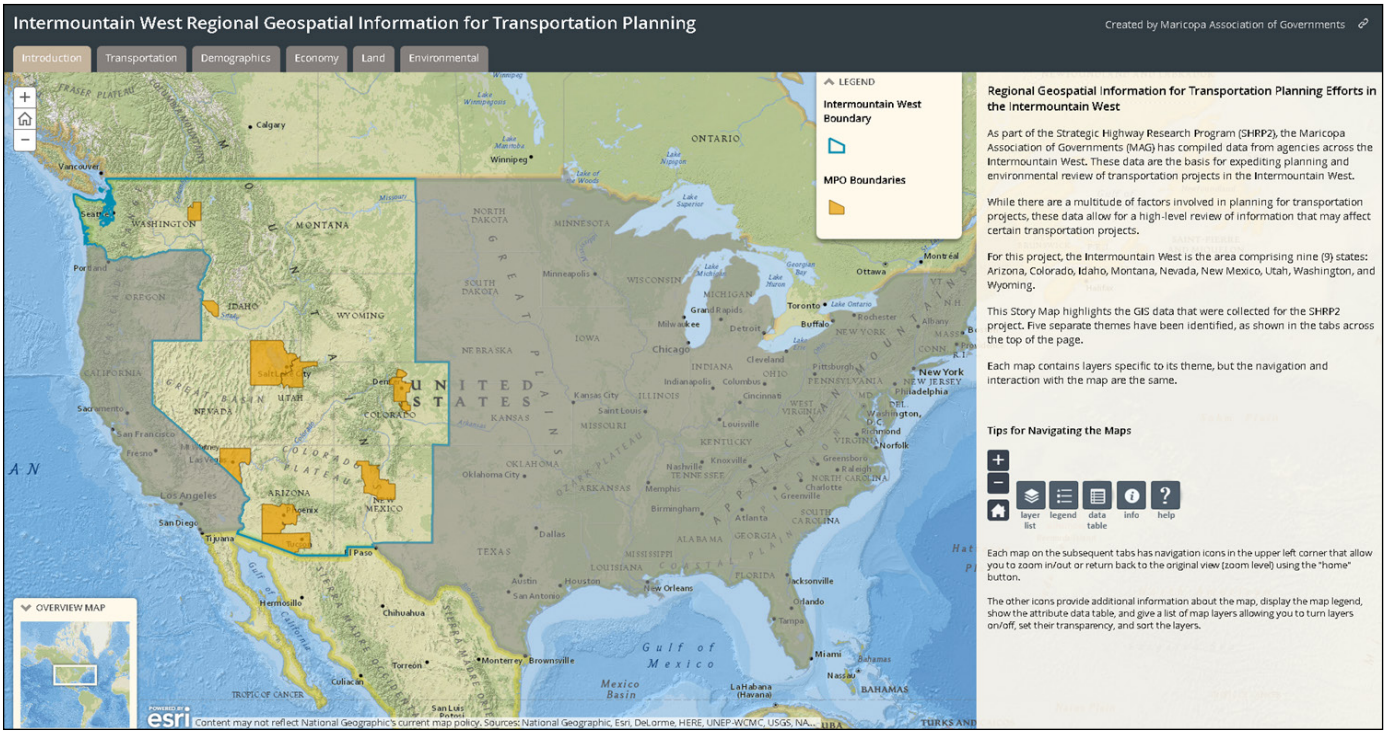
The most critical phase of the project was conducting outreach to the metropolitan planning organizations (MPOs), transportation management areas (TMAs), state departments of transportation (DOTs), and other key stakeholders. These agencies identified needs and potential gaps related to transportation and data resources. Fundamental goals of this project included building new relationships, strengthening existing ones, and creating awareness among these stakeholders to expedite planning and environmental review of key transportation projects within the IMW.

The first task of the project was to contact the other planning agencies to seek their input and to ascertain that the universe of stakeholders was considered broadly and comprehensively. Given the large footprint of the IMW, as a matter of efficiency, meetings were generally conducted by teleconference or webinar. However, one important stage of the project was the two-day meeting of 26 technical staff from 14 agencies in August 2015. Significant progress was made at that meeting that would be of vital importance to the direction and results of the project.

Leading up to and following on that two-day meeting, there have been several other meetings in the region to incorporate further input from the agencies involved. Numerous informative presentations by the stakeholders and others have thoroughly informed this process throughout.

Development of an IMW Common Geographic Information System (GIS) Operating Vision/Platform to Better Support Planning Efforts

This effort provided key technical input to develop a common data sharing platform, a GIS resource with great potential to streamline data sharing between and among planning agencies, making it easier for regions and states to work on projects more efficiently, especially those that cross geopolitical boundaries or involve multiple planning areas. GIS and data analysis are critical transportation planning tools. Quality regional data made available through a common operating system would provide decision makers with better awareness of the region and enable them to make more fully-informed decisions.



Recognizing the significance of this, the project team conducted two detailed surveys of those datasets and analyses the parties already used, with a special focus on GIS assets. The project team also further analyzed the existing data and analyses. This report documents the extensive GIS resources in the IMW as presented by each agency.

The surveys revealed the diversity of data in use across the IMW as well as data gaps. Major metropolitan areas tend to have more comprehensive data libraries compared to rural areas. IMW agencies have existing tools in place that work in their region.

The stakeholders' discussions about building a common GIS platform revealed two key concerns:

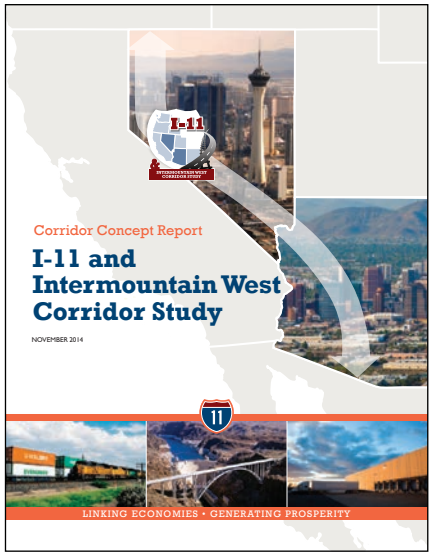
- The need to clarify the intended audience
- The platform must not conflict with existing resources and tools

The project team determined that a phased approach would best meet current needs while building a foundation to address these concerns. The phased approach includes:

- Develop documentation on the data collected for the IMW region
- Create look-up tables so that the data are consistent across the IMW
- Continue to build relationships and partner with regional and local agencies throughout the IMW
- Build an online interactive Story Map to display and distribute the data

Risk Register to Serve as a Proof of Concept

The other significant tool for planners that this project created was the risk register. This tool is designed as proof of concept for a model that other planners could use. The risks and considerations in any given project will differ, but the general process developed in the risk register will be useful as a means of informing planners and expediting the delivery of projects.



The risk register identifies potential risks to transportation projects in the initial focus region outlined in the I-11 and Intermountain West Corridor Study (IWCS) (Nogales to Las Vegas via Phoenix.) At the time this SHRP2 proposal was approved and awarded funding, the I-11 Tier 1 Environmental Impact Statement (EIS) had not been started; it is now in its initial phase. Given the breadth and scope of the I-11 Tier 1 EIS, and the immense size of the IWCS preferred corridor alignment area, the risk register was drafted as a high-level tool providing an overview and qualitative measure of the risks to ensure no efforts are pre-decisional or impact I-11 Tier 1 EIS Study efforts. The risk register was tailored to gather relevant information, provide awareness at a very broad scale of the potential constraints and opportunities, and improve communication. Further information on the limitations of the risk register may be found in Section 10.

The risk register was created specifically for the proposed Arizona portion of I-11. Still, this was no small project; the preferred corridor alignment area in Arizona is approximately 450 miles in length and up to 25 miles wide.

Despite limiting the risk register to a high level proof of concept, it will prove to be a useful starting point for future transportation projects throughout the IMW, whether improving existing multimodal transportation or developing new transportation projects.

Align Expectations

Collaboration among the various stakeholders on this project has proved that it is both possible and mutually beneficial to engage in dialog to align expectations of the transportation network throughout the IMW. This project examined and developed a regional transportation vision, aligning expectations to focus on the movement of people and freight, provide decision makers with better situational awareness of the region, and build upon existing collaborative efforts to best leverage resources and eliminate redundancies.

Environmental issues are certain to be encountered in a project of any size given the considerable open space in the IMW. However, by aligning the vision within the region, mitigation efforts also may be more effectively planned. Habitats have no regard for jurisdictional lines, and it is critical for planners to be able to know about mitigation opportunities outside their own planning region.

By knowing which agencies use which resources, it may, over time, lead to cooperative purchasing or movement toward more consistent and compatible platforms that may make further expedition of transportation projects possible. All agencies are resource constrained, but by aligning a transportation plan in the region those resources may be used most efficiently.

Most importantly, the IMW region cannot see transportation as an end in itself, but as a means of better connecting the region to the national and world economy. The IMW is already an economy of considerable significance, but enhancing its connections to ports, both in and outside the region, will enhance its prospects of developing its economy further, which in turn will create resources to invest in additional transportation projects. In order to obtain a fuller appreciation of the economic impacts of transportation infrastructure on economies, MAG commissioned an economic impact report, detailed in this report, describing the benefits of a cohesive, rational growth pattern to the region and to individual stakeholders.

This may be enhanced by the recent federal action to encourage multi-jurisdictional collaboration through the Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies (FASTLANE) grant program. The IMW is a natural for multi-jurisdictional, large-scale projects; collaboration on those grants would help feed the opportunities generated by expediting delivery of transportation projects that the tools created by this project will augment.

Future Developments

All the people involved in this project related their individual experiences and perspectives on transportation planning in the region. From that exchange, a number of lessons were learned and best practices shared. An important part of this report is collecting those lessons and practices to better inform planners of future transportation projects.

In addition, the project team recommends specific actions be taken in order to expedite the delivery of transportation infrastructure, not just highways, but all modes of transport in the region. Subsequent to this project, if funding is available, the next phases could include:

- Developing a proof of concept tool to serve as a common GIS platform
- Gathering feedback and input from stakeholders on the proof of concept
- Determining next steps

Perhaps the most important recommendation is the commitment of the stakeholders to continue the collaborative process started with this SHRP2 grant.

Conclusion

MAG undertook this project to enhance the ability to provide timely transportation projects in the IMW through collaboration with peers in the region. The generous contributions of these peers have allowed MAG to meet the goals of this project. The population and transportation assets of the IMW are now much better understood, and a way to bring those things to bear on improving the economic prospects for the region has been developed. The outreach and collaborative effort among the agencies in the region led to three important resources for transportation planning in the IMW:

- Inventory of IMW transportation- and GIS-related resources (to assist with this project and other collaborative IMW efforts)
- The IMW Story Map (an interactive tool for transportation planners having numerous data layers that a planner needs in addressing a transportation project of any scale) and
- The risk register (that a planner can adapt for their particular project, depending on scale and scope).

Another important outcome was in the development of a technical team from agencies throughout the IMW who will now be able to work more collaboratively on projects in the entire region. This report details the considerable progress MAG and its project partners made to better understand economic and environmental considerations for future transportation planning decisions and makes recommendations for future action to further that understanding with the ultimate goal of expediting transportation projects in the IMW to positively impact the economic climate of the region.

Detailed information regarding this SHRP2 Expediting Project Delivery (C19) Grant can be found here: *http://www.azmag.gov/information_services/shrp2-expediting-project-delivery-grant.asp*

2. Introduction to the Intermountain West Region and the SHRP2 Project

Purpose

The Intermountain West (IMW) region[3] is significant to the nation's long-term economic vitality. Nationally significant transportation corridors within the IMW, once fully developed, strategically would enhance the east-west and north-south movements of people and freight to, from and through the IMW. Now is the critical time to address the transportation network and other infrastructure in the region, enhancing global competitiveness and improving the economies of both the region and the nation. Expanding and enhancing the transportation infrastructure of the region is not an end in itself; rather, improving the movement of people and goods enhances economic opportunity for the IMW and the nation.

Moreover, the development of megaregions such as the IMW has shown promise in:

- Increasing alignment between federal, state, regional and local agencies.
- Leveraging federal funding and resources.
- Harnessing the nation's top regional metro economies for global competition through linked transportation planning, infrastructure and economic development investment.[4]

To make this a reality, various affected entities in the IMW need to make a robust, cooperative, multiphase effort. To that end, this project intends to provide tools and information to assist planners, engineers, developers, and other stakeholders with both maintaining, expanding and improving the system to not only keep up with the growth that the IMW has experienced and will continue to experience if nothing is done, but also to enhance economic opportunities beyond that trend line.

This SHRP2 grant gives impetus to that effort.

The Project Goals

The Maricopa Association of Governments applied for a SHRP2 grant from the U.S. Department of Transportation to expand its existing cooperative efforts with various agents throughout the IMW region and advance the deployment of solutions that expedite transportation project delivery across the region by working with key stakeholders through:

- Outreach to identify needs and potential gaps related to transportation and data resources
- Developing a Common Operating Vision/Platform for GIS to enhance data sharing
- Aligning expectations for a long-range vision to move people and goods in the region
- Developing a report with risk register

[3] For the purposes of this report, the IMW Region consists of the geographic area defined by the States of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Washington and Wyoming.

[4] Maricopa Association of Governments, "Harnessing the Power of U.S. Megaregions: The Next Frontier for Transportation Planning, Economic Prosperity and Global Competitiveness."

Throughout the project, as much as possible, efforts built upon existing collaboration to best leverage resources and eliminate redundancies. Care was taken to respect everyone's time and use resources efficiently. The robust cooperation among various entities made this project successful.

This report details the project's success with outreach, enhanced GIS sharing, and development of a transportation vision for the IMW region. Additionally, the report includes a risk register as a proof of concept for addressing corridor-wide preplanning elements along a vast area. For purposes of this report, the risk register addresses that portion of the potential I-11 corridor from the international border crossing at Nogales, Arizona, through Phoenix, Arizona, to Las Vegas, Nevada. At the time this proposal was awarded of SHRP2 funding, the I-11 environmental impact statement (EIS) had not been started. It is now in its initial phase. Consequently, the risk register has been drafted at a high level to ensure no efforts of this project are considered pre-decisional or impact I-11 project efforts. Substantial research of risk registers demonstrated that no single form of risk register applies to all projects. Typically, risk registers help bridge the gap between design and construction. Given the I-11 corridor's size, that it is still under review, and that only portions of it have been designated, the risk register was tailored to gather relevant information to provide awareness at a very broad scale of the potential constraints and opportunities, improve communication, and develop relevant information.

Project Study Area—The Intermountain West Region

The IMW region is highlighted in *Figure 1*.[5] The study area extends from the Canadian border on the north to the Mexican border on the south, and includes the states of Arizona, Colorado, Idaho, Nevada, New Mexico, Montana, Utah, Washington, and Wyoming. The IMW includes some of the nation's most scenic national parks, a high percentage of federally-owned land, many cultures, and diverse terrains, from the low-lying deserts to towering, snow-covered peaks in the Rocky Mountains. As beautiful and majestic as this region is, the movement of people and freight between major metropolitan areas and from the West Coast deep water ports can be challenging. At present, transportation corridors are relatively few, focusing on high capacity corridors that run east-west (coast-to-coast) and north-south between Mexico and Canada along the CANAMEX trade corridor. The CANAMEX Trade Corridor was defined by Congress in the 1995 National Highway Systems Designation Act[6] as a High Priority Corridor, from Nogales to Las Vegas.

Figure 1 SHRP2 Study Region

Population in the IMW is dispersed, with a small number of densely populated metropolitan areas and vast amounts of rural lands. *Figure 2* depicts population concentration in 2010 according to the most recent U.S. Census Bureau's decennial census; *Figure 3*[7] depicts the projected growth in the IMW to 2050 according to the 2016 Maricopa Association of Governments Socioeconomic Projections.

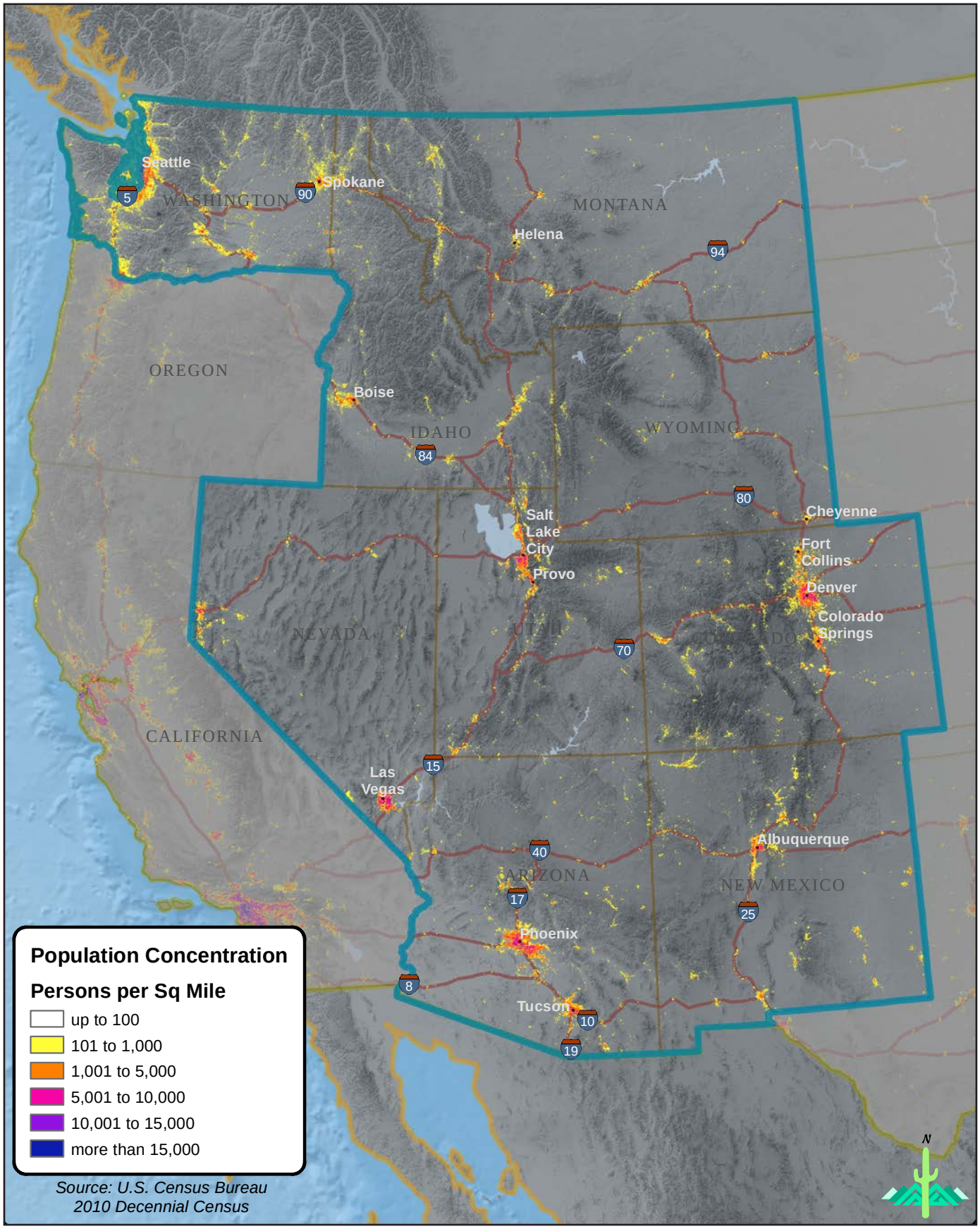
[5] Source: Maricopa Association of Governments

[6] Public Law 104-59.

[7] Figure 2 and Figure 3 maps prepared by Maricopa Association of Governments; Data sources: U.S. Census Bureau and *(for Figure 3)* population projections from respective state agencies.

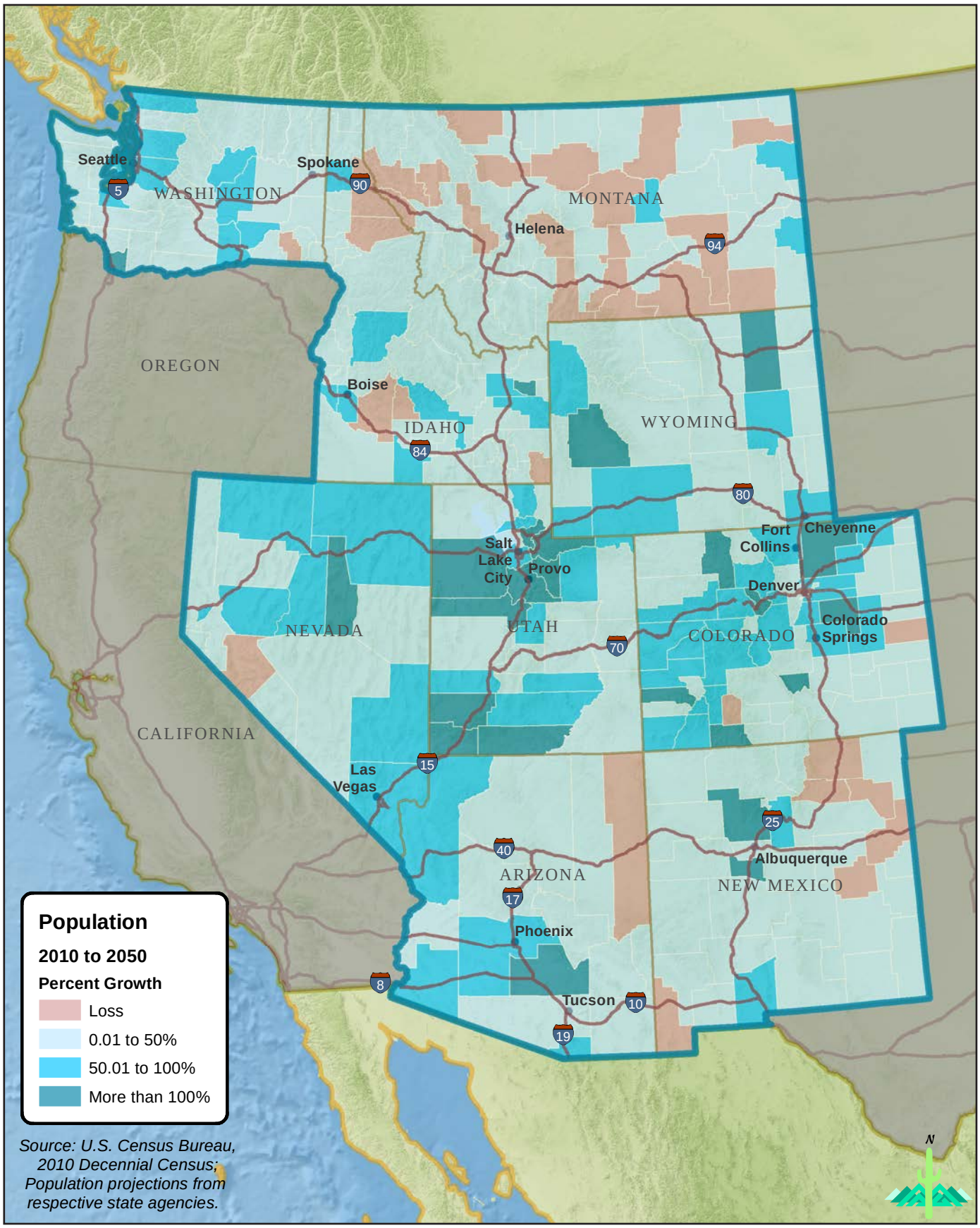
Figure 2

Population Concentration in the Intermountain West—2010



Source: U.S. Census Bureau
2010 Decennial Census

Figure 3
The Intermountain West Region County Population Growth 2010 to 2050



Source: U.S. Census Bureau, 2010 Decennial Census; Population projections from respective state agencies.

The nine states in the IMW region, all of which are in the top 18 by land mass of the 50 states, (see *Tables 1 and 2*), comprise 934,916 square miles, 26 percent of the total land mass of the United States.[8] The states all have significant amounts of federally managed lands, ranging from 28 percent to 85 percent. Of the entire region, 46.4 percent is federally managed. The region's 30 million people are 9.5 percent of the U.S. population.[9] About one-third—10.5 million—are employed, more than 380,000 in transportation-related jobs. The region has 545,000 miles of public roads, representing 13.3 percent of the nation's public roads. There are more than 21 million licensed drivers and 26 million registered vehicles. The region also has more than 18,500 miles of freight railroad, over 46,000 bridges, 37 border ports of entry and 91 major airports with over 106 million air carrier enplanements. There are many government planning bodies within this region, including 48 MPOs.[10]

Table 1
The Intermountain West States by Size (Area), Population and Employment

State	Area (sq.mi.)	State Ranking by Size	Population	Drivers	Employment	Transportation industry jobs
Arizona	114,006	6	6,600,000	4,800,000	2,200,000	81,274
Colorado	104,100	8	5,300,000	3,800,000	2,100,000	63,219
Idaho	83,574	14	1,600,000	1,100,000	510,000	16,858
Montana	147,046	4	1,000,000	766,700	350,200	12,387
Nevada	110,567	7	2,800,000	1,800,000	1,000,000	46,119
New Mexico	121,598	5	2,100,000	1,500,000	606,000	17,620
Utah	84,904	13	2,900,000	1,700,000	1,100,000	47,856
Washington	71,303	18	7,000,000	5,300,000	2,400,000	86,375
Wyoming	97,818	10	583,200	421,500	212,600	9,935
TOTAL	**934,916**		**29,883,200**	**21,188,200**	**10,478,800**	**381,643**

Table 2
The Intermountain West States, Selected Transportation Facts

State	Roads (mi.)	Bridges	Freight rail (mi.)	Ports of entry	MPOs	Major Airports	Air Carrier Enplanements
Arizona	66,441	8,031	1,643	6	8	13	22,300,000
Colorado	88,565	8,666	2,662	0	5	15	27,200,000
Idaho	48,082	4,427	1,623	2	5	7	1,600,000
Montana	74,933	5,251	3,200	12	3	11	1,700,000
Nevada	40,139	1,896	1,192	0	4	5	21,700,000
New Mexico	70,772	3,951	1,837	2	5	10	2,600,000
Utah	46,254	3,014	1,343	0	4	9	9,800,000
Washington	82,448	8,107	3,192	15	12	11	19,200,000
Wyoming	29,024	3,124	1,860	0	2	10	532,200
TOTAL	**546,658**	**46,467**	**18,552**	**37**	**48**	**91**	**106,632,200**

[8] Source: 2015 State Transportation by the Numbers: A Compendium of State Summaries by Bureau of Transportation Statistics, USDOT

[9] A high resolution map of Population Concentration in the IMW can be accessed here: *http://www.azmag.gov/Documents/SHRP2_2016-08-11_Population-Concentration_2010.pdf*

[10] Source: 2015 State Transportation by the Numbers: A Compendium of State Summaries by Bureau of Transportation Statistics, USDOT

The SHRP2 Project

Given the significance of the IMW, the numerous stakeholders involved, and the need for transportation infrastructure expansion and improvements in the region, the Maricopa Association of Governments (MAG) applied for and received a Lead Adopter Incentive for the SHRP2 Implementation Assistance Program to implement the FHWA's solution C19, "Expediting Project Delivery." This solution is designed to address or avoid common issues in transportation planning and environmental review that delay implementation of needed transportation enhancements.

MAG has extensive experience coordinating with other planning entities over a large region and annually meets with other planning organizations in the IMW. The task of this project is an extension of MAG's existing cooperative efforts to include agencies throughout the IMW to expedite the delivery of transportation projects throughout the region. The goals of the project are to:

- Conduct outreach to key stakeholders to identify needs and potential gaps related to transportation and data resources.
- Develop a common GIS operating vision/platform to improve data and information sharing, reduce data redundancies, and inform transportation decision making across the Intermountain West region.
- Align expectations for a long-range vision to move people and goods in the Intermountain West region.
- Develop a report containing a risk register, which will be an analysis of risk levels associated with delivering a transportation project.

This report completes this last goal and describes the efforts made to meet the other three goals as well. Before detailing those efforts, it is useful to provide a deeper look at existing and anticipated transportation in the IMW, environmental considerations, and the economic impact of transportation infrastructure.

3. Intermountain West Transportation Resources

The IMW region is a network of widely dispersed metropolitan areas. While some regions of the United States are evolving from planning and constructing new interstates and highways to focusing on moving denser population concentrations with multiple transit options, communities in the IMW are growing rapidly, requiring more transit options, regional highways and loop systems. Unlike most other regions of the continental United States, the IMW's population is both less dense yet fast growing. As funding formulas are frequently based on the existing population base rather than anticipated growth, the region as a whole is inherently underfunded and, more than other regions, needs additional interstate connections to support growth and the transcontinental trade flows from coast-to-coast and with Mexico and Canada.

This chapter provides an overview of highway, railway, aviation and multimodal transportation within the IMW, discusses freight trends throughout the IMW, and highlights future partnering and planning opportunities.[11]

A Brief History of the Interstate Highway System in the IMW

Interstates are key commerce corridors fueling economic growth.[12] It is, therefore, important to consider the highway system in the IMW. To do that, a short history of the development of the interstate system in the IMW is useful. The U.S. Interstate Highway System authorized by the Federal Aid Highway Act of 1956,[13] as illustrated by *Figure 4,*[14] located most of the interstate system in the Midwest and along the East Coast to accommodate the higher population concentrations in those regions at that time. In 1956, the majority of the population in the western U.S. was located along the coast, with small population pockets in the IMW.

From 1957-1992 the federal government added to the 1956 system, as shown in *Figure 5,*[15] again mostly in the eastern U.S. but also providing two vital links in the IMW: extending Interstate 70 to connect Utah and Colorado through the Rocky Mountains and constructing Interstate 82 to connect Washington and Oregon.

Later, federal transportation acts, the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act for the 21st Century (TEA 21), identified additional corridors for the National Highway System, (NHS) including several additional interstate corridors primarily located east of the IMW (*Figure 6*[16]).

[11] A high resolution map of the transportation network in the IMW can be accessed here: *http://www.azmag.gov/Documents/SHRP2_2016-08-11_IMW_Transportation-Network.pdf*
[12] See, for example, Section 5, "Economic Perspective"
[13] Public Law 84-627
[14] Source: Maricopa Association of Governments
[15] *Ibid.*
[16] *Ibid.*

Figure 4
Interstate Highway System—1956 Federal Aid Authorization

Figure 5
Interstate Highway System—1957-92 Additions (red lines)

Figure 6
Interstate Highway System—ISTEA and TEA 21 High Priority Corridor Additions (yellow lines)

In 2015, Congress approved the new federal surface transportation legislation, Fixing America's Surface Transportation Act (FAST Act),[17] which, among other things, formally expanded the I-11 corridor designated made in the federal surface transportation act, Moving Ahead for Progress in the 21st Century Act (MAP–21).[18] The designation under MAP-21 follows Interstate 19 from Nogales to Tucson, Interstate 10 from Tucson to Phoenix, and US-93 from Wickenburg to the Nevada state line. The FAST Act continues the corridor designation north through Nevada along US-95, connecting Las Vegas with Reno up to Interstate 80.[19]

[17] Public Law 114-94.
[18] Public Law 112-557, Section 1104(b)(2).
[19] Public Law 114-94, Section 1416(a)(3).

Intermountain West Freight

Interstate highways not only are important to the movement of people, but also of goods.

Figure 7[20] highlights average annual daily truck traffic for major truck routes on the National Highway System (NHS) for the future forecast year of 2040. *Figure 8*[21] illustrates peak period congestion on high-volume truck portions of the NHS in 2040. The forecasts indicated that significant congestion will exist along the I-5 corridor from San Diego, California to Seattle, Washington. The majority of east-west transcontinental interstates that carry significant freight from West Coast deep water ports to the IMW and across the country are also congested, including the southern routes I-10 and I-40 and the northern routes I-80, I-84 and I-90. The IMW currently has two north-south interstate corridors (I-15 and I-25) that connect the IMW region and support trade with Mexico and Canada.

Policymakers and transportation investors must understand how the movement of goods affects their cities and region in terms of congestion, economics, safety and the environment. As part of this SHRP2 effort, the study team analyzed the IMW area using the FHWA Freight Analysis Framework database (version 4.0) to obtain a better understanding of the types of commodities that are being imported and exported throughout the IMW, and to evaluate future forecasts for tonnage, value, and mode (truck, train, pipeline, and air.) The analysis and data were used to identify the major transportation corridors and gaps that could lead to potential partnering opportunities.

Figure 9[22] illustrates the locations of the major West Coast deep water ports that significantly influence the IMW. Each port is among the top 10 in the country by containers shipped. Each port also connects to major transcontinental rail lines, interstates, and highways that in turn connect to IMW communities, creating significant freight corridors and economic engines for the national economy.

[20] Source: FHWA
[21] *Ibid.*
[22] Map prepared by Maricopa Association of Governments; Source: American Association of Port Authorities.

Figure 7
Major Truck Routes on National Highway System (NHS)
Average Annual Daily Truck Traffic (AADTT) in 2040

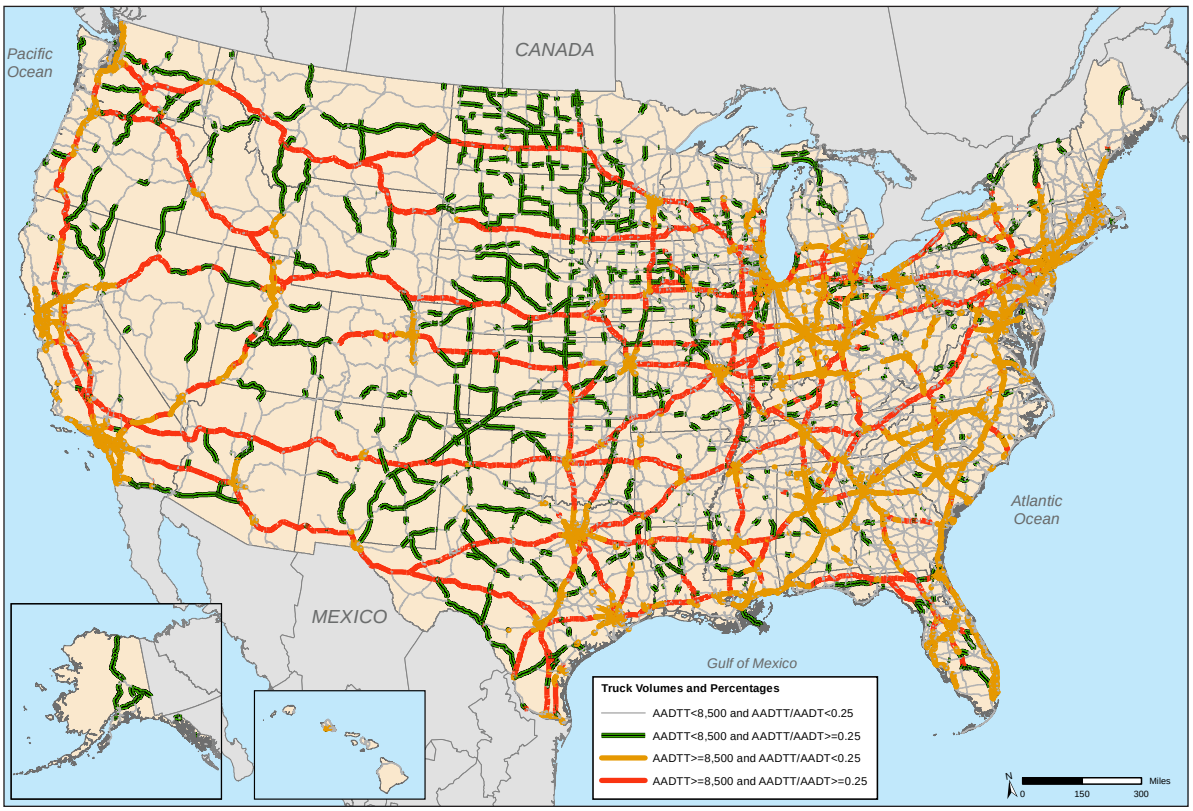


Figure 8
Peak-Period Congestion on High-Volume Truck Portions of NHS—2040

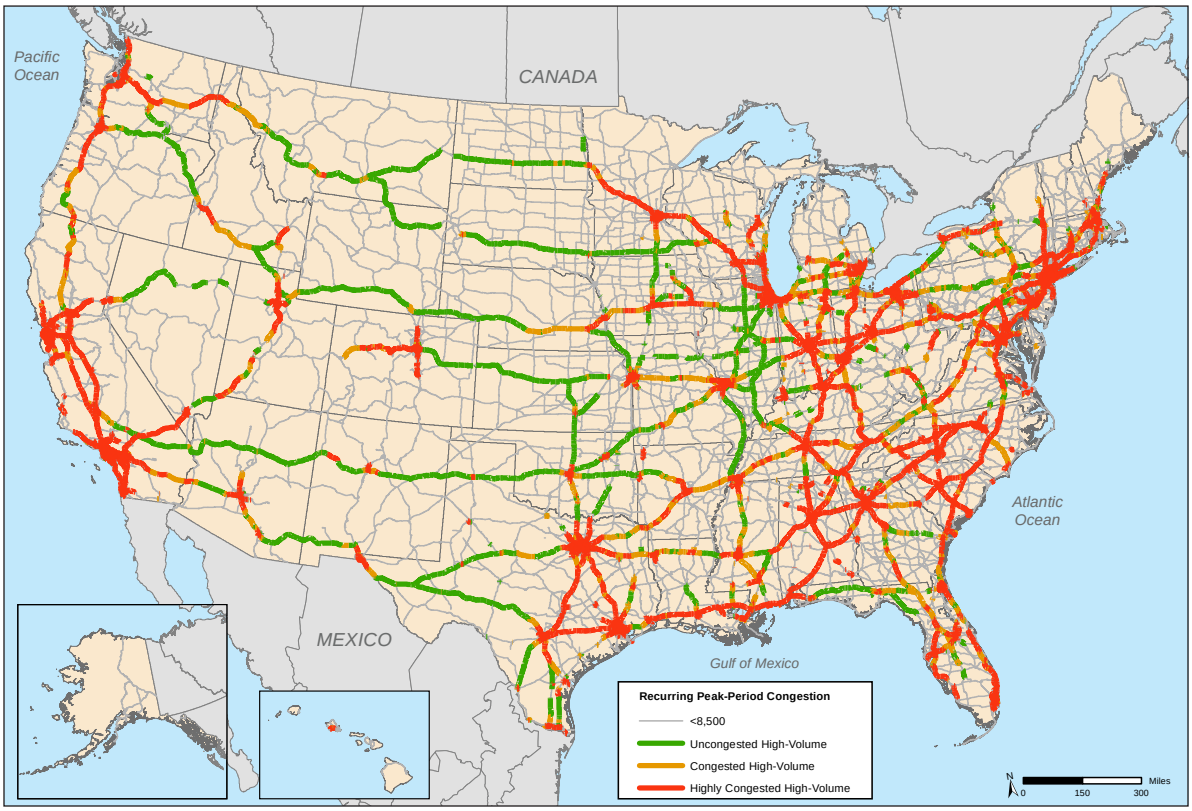
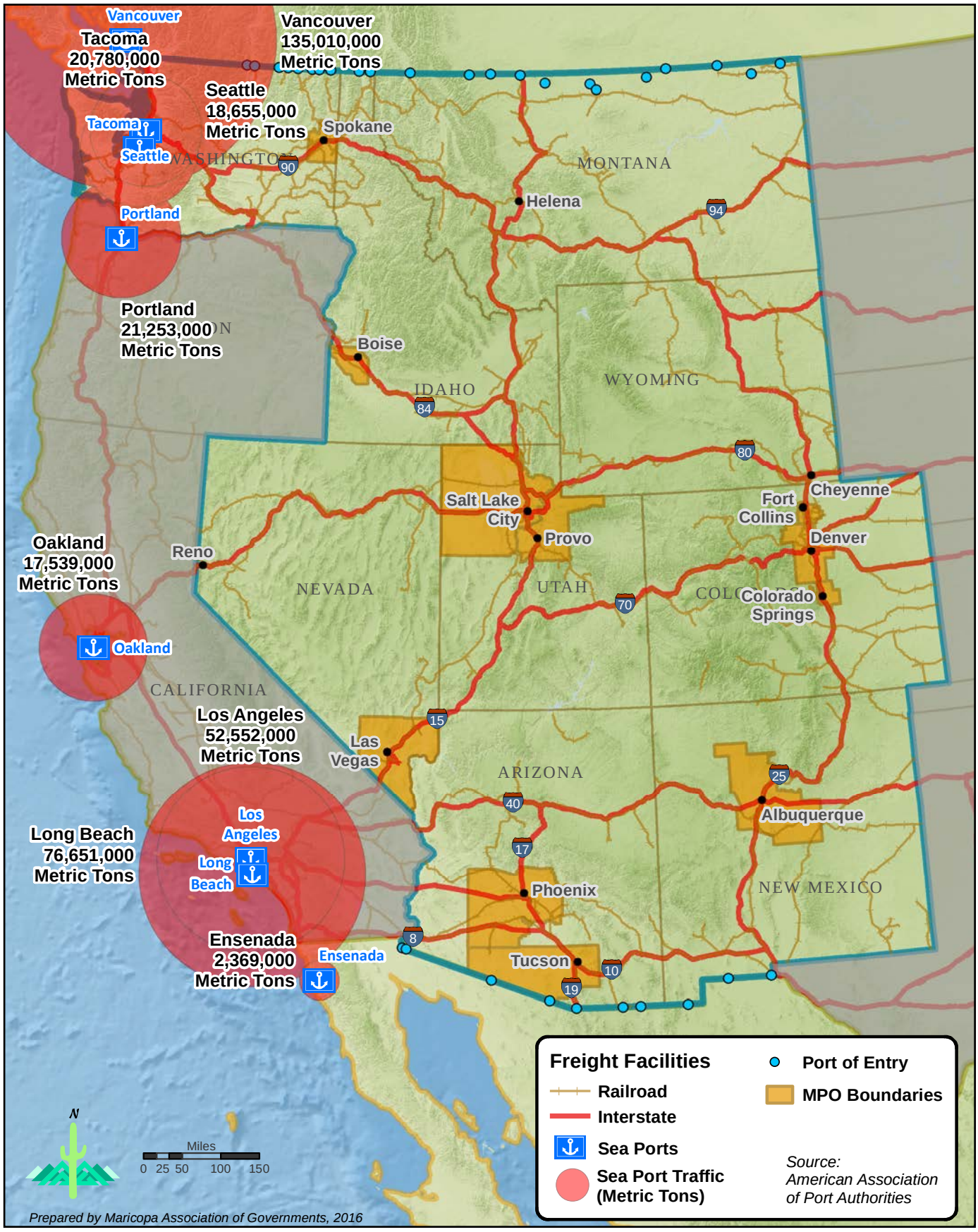


Figure 9
Freight Opportunities of the Intermountain West



Existing or future planning efforts require an understanding of which commodities are imported and exported, which commodities are shipped through, where the commodities originate, and where they are going. Getting a better understanding of local, regional, state, and multi-state freight flows is critical for economic development strategies.

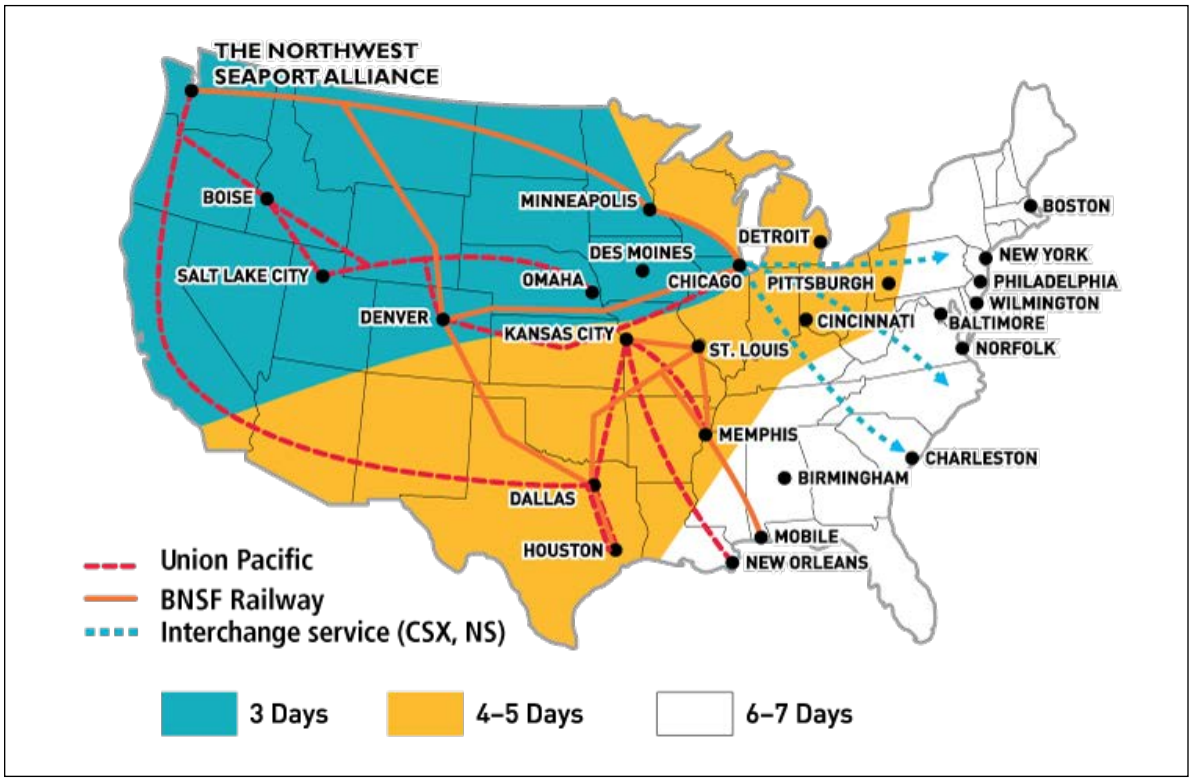
The SHRP2 project team analyzed the top trading partners and top imports and exports of the West Coast deep water ports (Northwest Seaport Alliance, Port of Oakland, and the Ports of Los Angeles and Long Beach) to gain a better understanding of the different economic opportunities for the different regions within the IMW.

Northwest Seaport Alliance (Seattle and Tacoma)

In August 2015, the ports of Seattle and Tacoma joined forces, creating the Northwest Seaport Alliance (NWSA) to unify management of their marine cargo facilities with the goal of strengthening the Puget Sound gateway.[23]

As shown in *Figure 10,*[24] which depicts travel time to and from NWSA ports, NWSA has a significant freight rail influence on the northern IMW states, connecting NWSA ports to major hubs in Boise, Idaho; Salt Lake City, Utah; Denver, Colorado; Spokane, Washington; and Billings, Montana.

Figure 10
Northwest Seaport Alliance Freight Rail



[23] The NWSA's top trading partners and commodities are detailed in Appendix A
[24] Source: Northwest Seaport Alliance

Port of Oakland

The Port of Oakland loads and discharges more than 99 percent of the containerized goods moving through Northern California, the nation's fourth largest metropolitan area. Oakland's cargo volume makes it the fifth busiest container port in the United States.[25]

Ports of Los Angeles and Long Beach

The Ports of Los Angeles and Long Beach are the two busiest U.S. ports. If combined, they would be the ninth busiest port complex in the world. Their proximity to BNSF and UP rail lines provides ready access to the majority of the IMW.[26]

In addition to rapid population growth in the IMW, exports from the IMW increased significantly faster than those of the rest of the United States over the last decade. *Figures 11*[27] *and 12*[28] show the forecast growth in IMW freight traffic in tonnage and value for inbound, outbound, and in-state freight traffic.

Figure 11
Forecast Growth in Intermountain West Freight Traffic Tonnage (thousands)

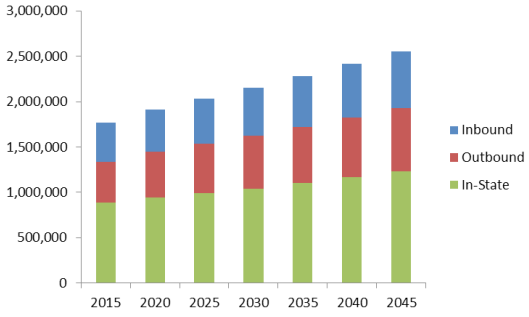
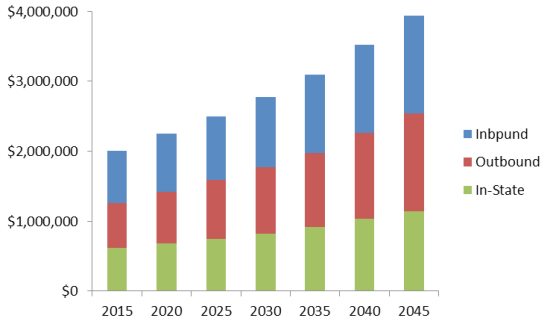


Figure 12
Forecast Growth in Intermountain West Freight Traffic Value (millions)



Outbound freight is expected to grow approximately 55 percent in tonnage and 117 percent in value over the forecast period, while in-state tonnage growth is forecast at 40 percent in tonnage and 86 percent in value. The value of all freight is forecast to grow from $2.0 trillion to $3.9 trillion, a growth of 96 percent over the forecast period.

[25] Statistics regarding the Port of Oakland's export and import activities are found in *Appendix B*
[26] Statistics regarding the two ports are found in *Appendix C*
[27] Source: FHWA Freight Analysis Framework 4.1
[28] *Ibid.*

Figures 13[29] *and 14*[30] depict the forecast freight traffic for value and tonnage by mode of transport.

Figure 13
Intermountain West Freight Forecast
by Mode Tonnage (thousands)

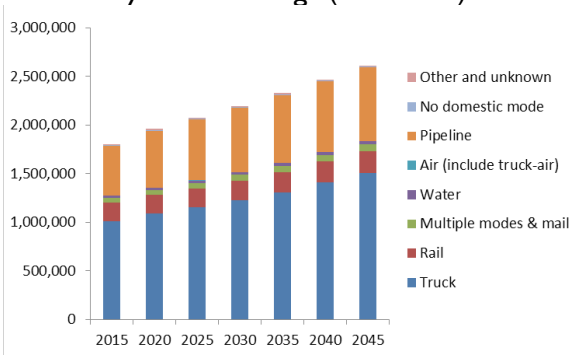
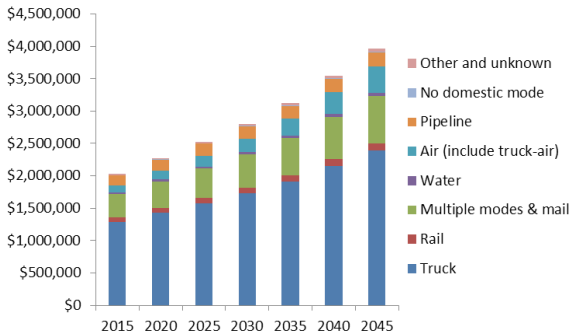


Figure 14
Intermountain West Freight Forecast
by Mode Value (millions)



In 2015, 56 percent of the freight traffic was serviced by the trucking industry, with 29 percent by pipeline. Although 800 million more tons, worth an additional $1.9 trillion, are forecast to be shipped in 2045, trucks and pipelines are expected to maintain similarly high percentages of the entire amount of freight shipped.[31]

[29] Source: FHWA Freight Analysis Framework 4.1
[30] *Ibid.*
[31] Illustrations of these forecasts by subregion are found in *Appendix D*

The International Trade Connection

International trade is vital to the success of the country and the IMW. U.S. exports to Mexico and Canada support more than three million American jobs.[32] For more than 30 states, Canada or Mexico rank as the first or second largest export market. As shown in *Table 3,* Mexico, Canada or both are in the top three export countries for all IMW states.[33]

Table 3
The Intermountain West Top Export Countries by State (by value)

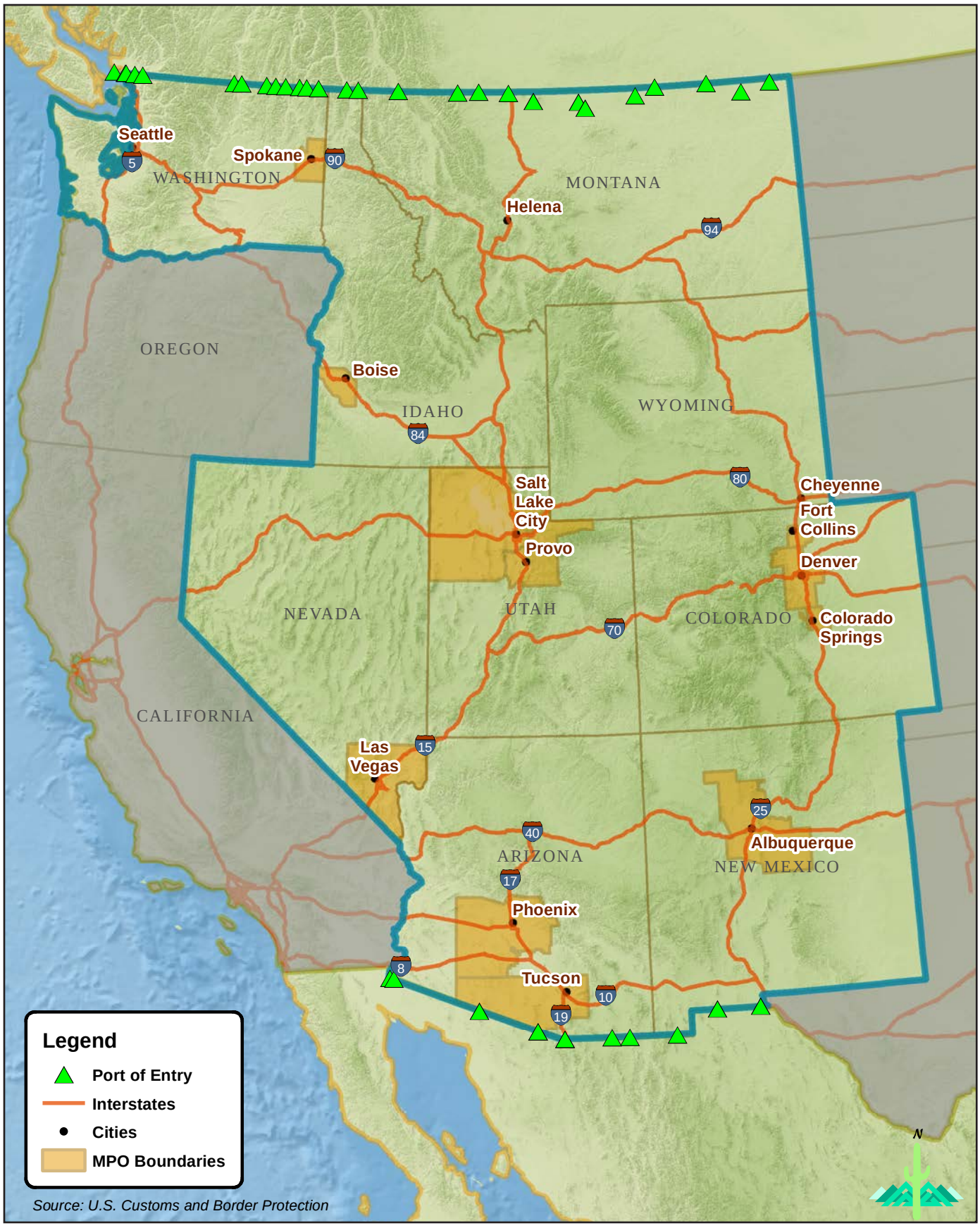
State	First	Second	Third
Arizona	Mexico	Canada	
Colorado	Canada	Mexico	
Idaho	Canada	China	Mexico
Montana	Canada	South Korea	Mexico
Nevada	Switzerland	Canada	Mexico
New Mexico	Mexico	Israel	Canada
Utah	United Kingdom	Canada	Mexico
Wyoming	Brazil	Canada	Mexico
Washington	China	Canada	Japan

The shared borders between IMW states and Canada or Mexico are gateways for billions of dollars of imports and exports as well as millions of people traveling each year. Millions of jobs across the country rely on trade with Canada and Mexico. *Figure 15* identifies the locations of the ports of entry for IMW states. Washington, Idaho and Montana have a total of 19 ports of entry with Canada; Arizona and New Mexico have 10 ports of entry with Mexico. Ports of entry include pedestrian only, commercial vehicles only, rail only or multiple modes combined.

[32] Source: U.S. Trade Representative

[33] Source: United States Census Bureau. Further details of import and export trade with Canada and Mexico are found in *Appendix E*

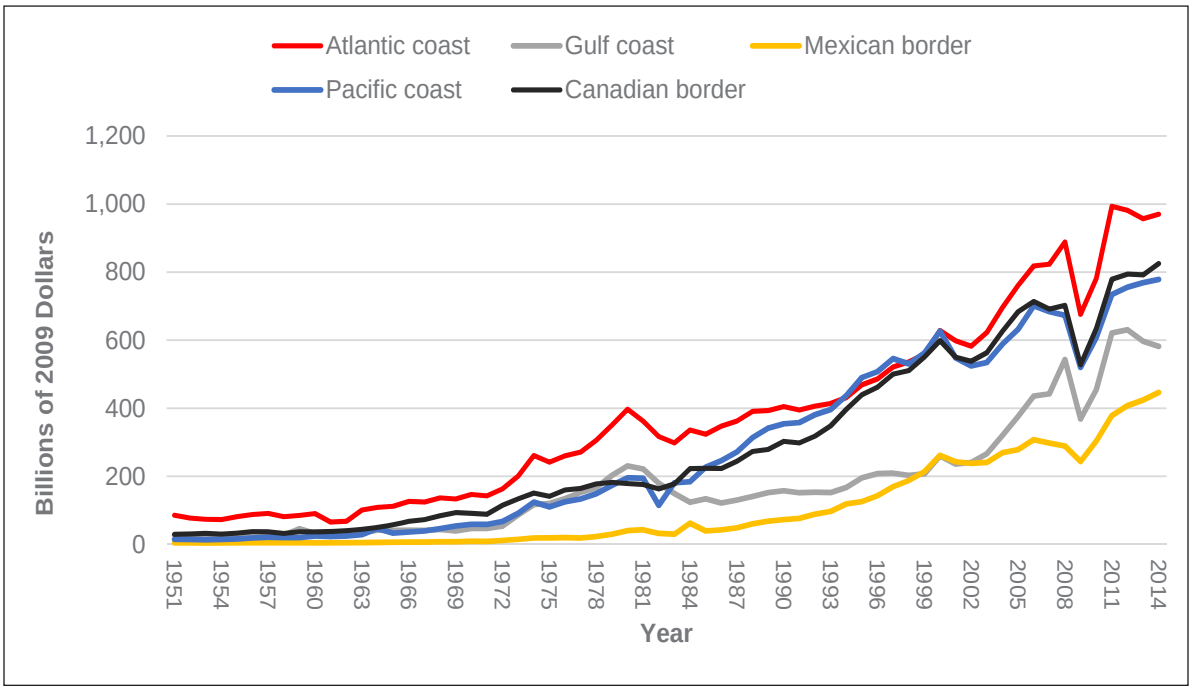
Figure 15
Intermountain West Ports of Entry *(Map prepared by Maricopa Association of Governments)*



Given this close association, trade between the IMW, Canada, and Mexico is forecast to grow substantially over the next decades. Forecasts from 2015 to 2045 indicate an 80 percent increase in tonnage with a 216 percent increase in value to Canada, and a 94 percent increase in tonnage with a 226 percent increase in value to Mexico.[34] This is consistent with the long-term effect of increasing trade across the borders. As shown in *Figure 16,*[35] since 1951 the value of merchandise trade has grown by twenty-fold in inflation-adjusted terms.

Sharing a border with Mexico and Canada presents opportunities for IMW states to coordinate planning and outreach efforts to both countries with a unified approach to international trade that highlights the region's major north-south trade corridors.

Figure 16
Value of U.S. International Merchandise Trade by Coasts and Borders—1951-2014



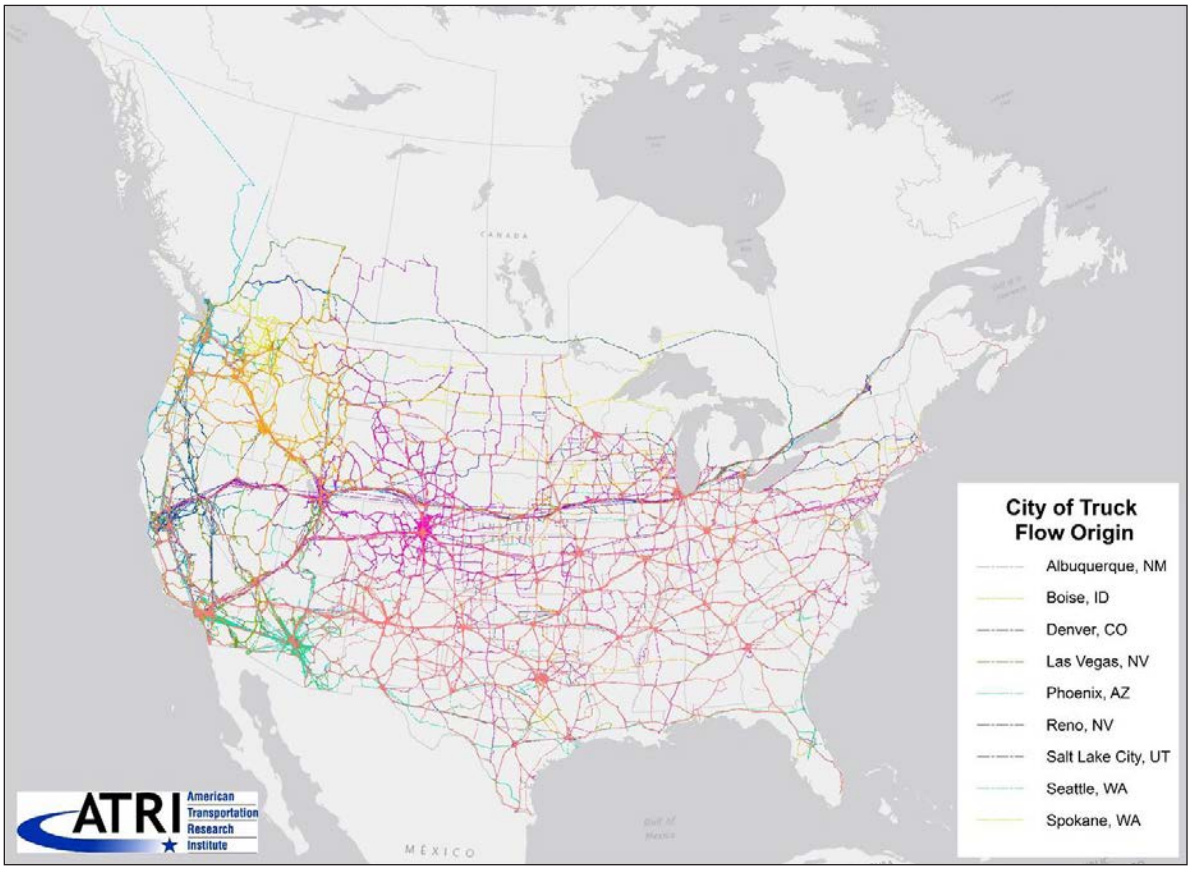
[34] Growth forecasts by IMW subregion are found in *Appendix F*

[35] NOTES: The value of coal shipments through Mobile, AL; Charleston, SC; and Norfolk, VA are considered proprietary information and are consolidated. The total value of coal exports for the above three cities are included under the Atlantic Coast Customs District. Sources: 1951-1970: U.S. Department of Commerce, Census Bureau, Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition (Washington, DC: 1975); 1971-1999: U.S. Department of Commerce, Census Bureau, Statistical Abstract of the United States (Washington, DC: annual issues); 2000-2015: U.S. Department of Commerce, Census Bureau, Foreign Trade Division, FT920 - U.S. Merchandise Trade: Selected Highlights (Washington, DC: annual issues). Implicit GDP Deflator: U.S. Department of Commerce, Bureau of Economic Analysis, Current-Dollar and Real Gross Domestic Product, available at www.bea.gov as of June 2015.

Truck Freight

Truck freight flows in the region illustrate the impact of cargo movement in the IMW. As part of this SHRP2 effort, the American Trucking Research Institute (ATRI) analyzed a sample size of commercial vehicles for each major metro area in the IMW including Albuquerque, New Mexico; Boise, Idaho; Denver, Colorado; Las Vegas and Reno, Nevada; Phoenix, Arizona; Salt Lake City, Utah; Seattle and Spokane, Washington; and *Figure 17*[36] depicts five days of truck flows for each individual city, highlighting truck travel patterns and major freight corridors throughout the IMW region.[37]

Figure 17
Truck GPS Truck Flows (5 Days)



The analysis identifies several important freight corridors to, from, in, and through the IMW:

- Interstate 15 (Southern California to Salt Lake City, UT)
- Interstate 84 (Salt Lake City, UT, to Central Washington State)
- Interstate 80 (Oakland, CA through IMW to Chicago, IL)
- Interstate 70 (Central Utah to Denver, CO)
- Interstate 5 (San Diego, CA, to Seattle, WA)
- Interstate 10 (Tucson, AZ, to Los Angeles, CA)
- US 93/US 60 (Phoenix, AZ to Las Vegas and Reno, NV)
- Interstate 40 (Barstow, CA, through IMW to Wilmington, NC)

Also notable are the activity and trade flows entering Canada at all ports of entry from Interstate 5 in Washington to Interstate 15 in Montana.[38]

[36] Source: American Trucking Research Institute
[37] The 5-day truck flow figures for the individual IMW cities are included in *Appendix G*
[38] Comparable data for Mexico is not collected by ATRI because of truck transferring at the ports of entry

The IMW can plan and coordinate projects on all the above-noted corridors. These data show the need for future transportation connections and gaps in the system that need future planning.

The nation's highway system will continue to experience congestion as the nation grows unless improvements to highway infrastructure are made along with improvements to other transport modes, such as rail, aviation and pipeline. All modes can work cohesively to move people and freight efficiently and safely. With IMW population centers dispersed over significant distances, the importance of airports and railroads to make those connections is critical.

Railroads

Railroads play a vital role in the movement of people and goods across the United States. Several Class I and Short Line railroads operate in the IMW today; for example, moving coal from the Powder River Basin in Wyoming. Amtrak provides coast-to-coast passenger service (New York to Los Angeles through the IMW.) As shown in *Figure 18,*[39] the existing railroad network is widely dispersed throughout the IMW and consists of several transcontinental east-west routes connecting the different regions to the deep water ports along the West Coast including the Ports of Seattle and Tacoma in Washington, and the Ports of Oakland, Los Angeles, and Long Beach in California.

[39] Map prepared by Maricopa Association of Governments; Data source: National Atlas of the United States

Figure 18
Railroads of the Intermountain West

Aviation

Cities throughout the IMW are separated by long distances, making air travel important to connect IMW cities to each other, to other regions in the country, and to the world economy. Aviation plays a critical role in moving people, as well as time sensitive, perishable, and high-value cargo around the world.

Figure 19[40] illustrates the location of the international airports throughout the IMW, color coded by level of enplanements. According to the FAA,[41] the IMW has five of the thirty busiest passenger airports in the United States by enplanements:

Airport Ranking:

6. Denver International Airport
9. McCarran International Airport (Las Vegas)
10. Phoenix Sky Harbor International Airport
13. Seattle-Tacoma International Airport
26. Salt Lake City International Airport

The FAA categorizes commercial services airports, those primarily handling passengers, by the relative number of enplanements compared to other airports in the country. The four categories are:

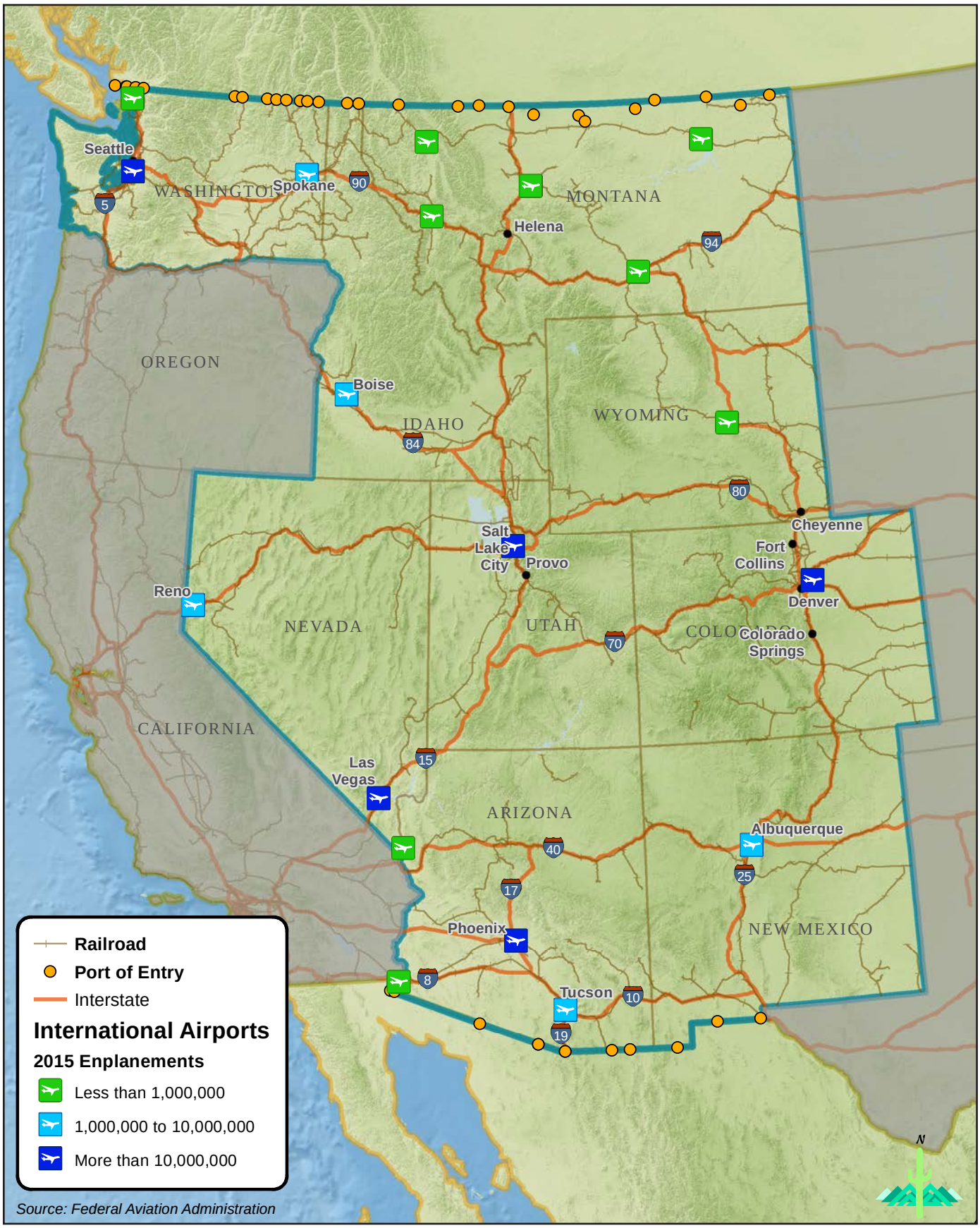
- Large Hubs
- Medium Hubs
- Small Hubs
- Nonhubs

The IMW states contain the following:[42]

- **Arizona:** 1 Large Hub (Phoenix Sky Harbor International); 2 Small Hubs (Phoenix-Mesa Gateway and Tucson International); and 6 Nonhubs (Laughlin/Bullhead International, Flagstaff Pulliam, Grand Canyon National Park, Page Municipal, Grand Canyon West, and Yuma MCAS/Yuma International)
- **Colorado:** 1 Large Hub (Denver International); 1 Small Hub (Colorado Springs Municipal): and 8 Nonhubs (Aspen-Pitkin County/Sardy Field, Eagle County Regional, Erie Municipal, Fort Collins-Loveland Municipal, Grand Junction Regional, Gunnison-Crested Butte Regional, Yampa Valley, and Montrose Regional and Joslin Field-Magic Valley Regional).
- **Idaho:** 1 Small Hub (Boise Air Terminal/Gowen Field); and 5 Nonhubs (Friedman Memorial, Idaho Falls Regional, Lewiston-Nez Perce County, Pocatello Regional)
- **Montana:** 2 Small Hubs (Billings Logan International and Bozeman Yellowstone International): and 6 Nonhubs (Butte Bert Mooney, Great Falls International, Helena Regional, Glacier Park International, Missoula International and Sidney-Richland Municipal)
- **Nevada:** 1 Large Hub (McCarran International (Las Vegas)); 1 Small Hub (Reno/Tahoe International); and 2 Nonhubs (Boulder City Municipal and Elko Regional.)
- **New Mexico:** 1 Medium Hub (Albuquerque International); and 4 Nonhubs (Four Corners Regional, Lea County Regional, Roswell International Air Center and Santa Fe Municipal)
- **Utah:** 1 Large Hub (Salt Lake City International); and 3 Nonhubs (Cedar City Regional, Provo Municipal and St. George Municipal)

[40] Map prepared by Maricopa Association of Governments; Data source: Federal Aviation Administration
[41] FAA Calendar Year 2015 Revenue Enplanements at Commercial Service Airports
[42] Source: FAA National Plan of Integrated Airport Systems (2015-2019)

Figure 19
International Airports of the Intermountain West



Source: Federal Aviation Administration

- **Washington:** 1 Large Hub (Seattle-Tacoma International); 2 Small Hubs (Bellingham International and Spokane International) and 7 Nonhubs (Friday Harbor, Tri-Cities, Prosser, Boeing Field/King County International, Walla Walla Regional, Panborn Memorial and Yakima Air Terminal/McAllister Field)
- **Wyoming:** 8 Nonhubs (Casper/Natrona County International, Cheyenne Regional/Jerry Olson Field, Yellowstone Regional, Gillette-Campbell County, Jackson Hole, Riverton Regional, Rock Springs-Sweetwater County and Sheridan County)

In all, the IMW has 5 Large Hubs, 1 Medium Hub, 9 Small Hubs and 49 Nonhubs. In total, these airports accounted for over 116 million enplanements annually.[43]

In addition to these commercial services airports, the IMW contains more than 700 general aviation airports.[44] In 2012, the FAA reclassified airports primarily involved in general aviation among four categories:

- **National Airports:** Support the national and state system by providing communities with access to national and international markets in multiple states and throughout the United States.
- **Regional Airports:** Support regional economies by connecting communities to statewide and interstate markets.
- **Local Airports:** Supplements local communities by providing access primarily to intrastate and some interstate markets.
- **Basic Airports:** Support general aviation activities such as emergency service, charter or critical passenger service, cargo operations, flight training, and personal flying.

Under this classification, the FAA determined the IMW includes seven National Airports,[45] which access national and international markets, and an additional 43 Regional Airports and 143 Local Airports, or an additional 186 airports that have significant exposure to intra- and inter-state passenger markets.

As noted elsewhere, infrastructure in the IMW generally tends to be much newer than that in other regions. Consequently, passenger airport infrastructure in the IMW is generally more accessible to people with physical impairments.

For air cargo, the IMW has five airports in the top 30 in the country by landed weight:[46]

Airport Ranking
18. Seattle-Tacoma International Airport
19. Phoenix Sky Harbor International Airport
20. Denver International Airport
27. Salt Lake City International
29. Boeing Field/King County International

An additional 8 were in the top 100 (Albuquerque International, Reno Tahoe International, Spokane International, McCarran International (Las Vegas), Billings Logan International, Snohomish County (Paine Field), Great Falls International and Tucson International). In all, airports in the IMW had landed cargo weight in excess of 9 billion pounds in 2015, nearly a 2% increase over the previous year.[47]

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[43] Source: Preliminary Enplanements at All Commercial Service Airports (by Rank) (June 2016)

[44] Source: FAA National Plan of Integrated Airport Systems (2015-2019). *Appendix H* to this report tabulates the IMW state information provided by the FAA

[45] Phoenix Deer Valley, Arizona; Scottsdale, Arizona; Denver Centennial, Colorado; Denver Rocky Mountain Metropolitan, Colorado; Las Vegas Henderson Executive, Nevada; Wendover, Utah; and Everett Snohomish County (Paine Field), Washington

[46] Source: FAA Preliminary Qualifying Cargo Airports, Rank Order, and Percent Change from 2014 (June 2016.) As some data were missing from this preliminary report, the rank order and other statistics are tentative.

[47] *Ibid.*

4. Intermountain West Transportation Vision/ Alignment of Expectations

Given the existing assets in the IMW, the existing and projected population in the region, and the certainty that transportation infrastructure is needed to catch up with that population and existing and projected economic activity, IMW transportation planning must be conducted efficiently with a regional, collaborative model.

Long-Term Transportation Considerations[48]

Collaboration on long-term strategies for multimodal transportation will help the region by

- Connecting communities, trade hubs and infrastructure.
- Enhancing the economic vitality of communities served by the infrastructure.
- Improving safety, travel time and reliability of moving people and goods.
- Enhancing competition for international trade.

Transportation studies demonstrate that to get in front of growth, planners must understand environmental issues, land use, socioeconomic and development patterns, cultural resources, programmed improvements, connections and continuity, and corridor preservation. A consistent understanding of these factors in the IMW will assist in expediting the delivery of infrastructure projects into the future.

Environmental Considerations in the IMW

The value of a consistent understanding of a factor in the entire IMW region may be shown by considering the interaction of environmental issues and large-scale transportation projects in the IMW.

The IMW region, from desert valleys to mountainous and riparian areas, is rich in diverse natural resources, which are under pressure from population growth in the region. This pressure is intensified because much of the land in the region is held by federal, state and tribal governments; there is simply not a great deal of private land on which development is feasible, even in the absence of significant environmental factors. Transportation planners must consider impacts on the environment caused by transportation projects. Under the National Environmental Protection Act,[49] the Environmental Protection Agency is tasked with identifying those species of animals and plants that are threatened or endangered.

Large transportation projects will generally require the development of an Environmental Impact Assessment, which in turn may call for the implementation of relocation of habitat or other mitigation efforts. Both production of the assessment and the potential or actual need for relocation and mitigation efforts add cost

[48] Transportation Analysis and Opportunities: Identifying Gaps and Opportunities in the Intermountain West, August 28, 2015, by Tim Strow, Senior Transportation Project Manager, MAG

[49] Public Law 91-190

and risk to the development of any large scale project. Transportation planners must consider these costs and risks with respect to the economic viability of the project. Each of the states in the IMW include habitat for a number of threatened or endangered species, as well as candidate species that may become listed in the future (*Table 4*).[50] However, as habitat recognizes no jurisdictional boundaries, no single transportation planning agency can control the impacts on habitat and take appropriate mitigation efforts; rather, a multi-jurisdictional approach may be a more efficient means of addressing environmental impacts. For this reason, a common understanding of the environmental issues across the IMW will assist in the efficient and economic development of transportation projects while lessening ***environmental impacts***.

Table 4
Threatened and Endangered Species in the Intermountain West (By State)

State	Animals Listed	Plants Listed	Recent Candidate Species for Listing
Arizona	44	21	15
Colorado	17	16	14
Idaho	11	4	8
Montana	12	3	11
Nevada	28	10	10
New Mexico	40	13	11
Utah	17	25	7
Washington	37	11	12
Wyoming	8	4	8

Acceleration of Multicorridor Project Delivery[51]

This SHRP2 project is internationally significant because it is innovative and designed to accelerate project delivery, better address natural resource issues that may be perceived as a threat to project delivery schedules, and assist with mitigation. The project is pioneering a regional ecosystem framework through applied ecology: structured decision making, adaptive management, performance-based solutions, and transportation as a means to an end, not an end itself.

Two important tools are GIS resources and risk registers. GIS is vital to good transportation planning in providing the raw information needed to make decisions on projects. Risk registers are a communications platform that uses GIS data to assist in

- Focusing limited resources.
- Strengthening the ability to efficiently manage program and project delivery.
- Improving communication and managing risk corporately.
- Reducing extraneous costs.

By emphasizing GIS and including the risk register, this SHRP2 project employs these necessary resources and tools to promote expedited delivery of significant transportation infrastructure projects.

[50] Source: U.S. Fish and Wildlife Service. *Appendix I* lists the species in the IMW states that were listed as of May 2016 as threatened or endangered. *Appendix J* lists species in the IMW states that as of May 2016 were the subject of petitions for listing. A total of 74 petitions were pending as of May 2016 in the nine-state region.

[51] Kevin Moody, FHWA, Infrastructure Ecologist, presented on Acceleration of Multi-Corridor Project Delivery on August 27, 2015

Aligning Expectations: IMW Transportation Vision

The Interstate Highway System has produced significant efficiencies in the movement of goods and people in and through the IMW. The further development of multimodal transportation in the West will help it reach its full potential. The IMW region is a natural bridge between Canada and Mexico, and between the ports of the West Coast and the industrial hubs of the Midwest and beyond. Enhanced transportation in the region would improve global competitiveness by better connecting the IMW with these international trade sources and while better connecting communities, improving the economy of the IMW, and travel safety and efficiency.

It is important to have key corridors, networks and facilities connecting the IMW in order to efficiently and safely move goods and people. As stated by the U.S. Department of Transportation, "Because of their high use, any failure of assets or degradation of service along these networks, or the unavailability of network segments for any length of time, can cause major impacts to the safety and movement of people and goods. To illustrate this, the National Highway System comprises four percent of the public road miles, but carries about 75 percent of the nation's truck freight."[52]

The *Western Regional Alliance's Strategic Plan* notes that urban area population in the IMW will grow from 16 million in 2010 to 25 million by 2040, driving economic growth and changing trade patterns. It further points out that over the last 25 years, metropolitan areas in the region have needed to use local revenues from local taxes to invest in their transportation infrastructure. Federal funds have been used to focus infrastructure investments on economic vitality in the region.[53]

Although growth in the IMW will occur regardless of the decisions of transportation planners, the breadth and quality of that growth can be influenced by strategic, cooperative efforts among the various stakeholders in the region. Each subregion may have its own priorities, particularly for locally significant projects, but collectively the IMW shares many areas of commonality. Enhancing those areas of agreement while identifying potential conflicts with a goal of reducing or resolving those conflicts, will provide for a more cohesive, rational growth pattern for the best interest of the region as a whole and the stakeholders individually.

In developing long-term transportation planning visions, the impact of disruptive new technologies must be considered. The advent of self-driving passenger vehicles requires planners to consider the impact of driverless vehicles, including connected freight vehicles, in the planning of new, more efficient roadways.

The importance of improving transportation resources in the West has been the subject of significant commentary. In 2015, the Western Governors' Association (WGA)[54] adopted a Policy Resolution regarding transportation infrastructure in the West.[55]

Among the key findings of the WGA:

> "Perhaps more than any other region, terrain and landownership patterns in the West underscore the purpose and vital need for a federal role in surface transportation. Western states are responsible for vast expanses of national highways and interstates that often do not correlate with population centers, but serve as critical national freight and transportation routes for the nation."

[52] U.S. Dept. of Transportation, Federal Highway Administration, "Risk-Based Transportation Asset Management," March 2013, pp. 11-12.

[53] Areas of Policy Focus, Western Regional Alliance, August 2016, Retrieved from: http://westernregionalalliance.com/strategic-plan/

[54] The Association includes governors of all of the IMW states and other states in the Western United States and Pacific territories.

[55] Western Governors' Association Policy Resolution 2015-05, "Transportation Infrastructure in the Western United States."

"The transportation and transit needs in the West differ significantly from our eastern counterparts. Western states are building new capacity to keep up with growth, including new interstates, new transit systems and increased capacity on existing infrastructure."

In February 2015, the Western Regional Alliance (WRA) commissioned a report[56] that noted that:

"If the four states of Arizona, Colorado, Nevada and Utah were linked by a new trunk line system for moving passengers and freight to form a more reliable, cost-effective, safe and integrated unit of global competition, they would represent the *18th largest world economy*.

"This trunk line system would also create the framework for linking an additional four states, Idaho, Montana, Wyoming and New Mexico, resulting in an eight-state trading bloc that would represent the *16th largest world economy.*"[57]

Noting that the region discussed in the WRA report does not include one IMW state, Washington, the size of the economy of the entire IMW region studied here would be that much greater.

That same report also makes several important general points about the need for integrated multimodal system planning. Noting that transportation planning was fragmented, not only among various levels of government (federal, state, regional, local) but also among the various transport modes:

"Today, the various modes do not operate together as an integrated system as they are planned in modal silos rather than together. For example, the Interstate Highway System is not planned in conjunction with local arterial roads, nor are airports or seaports planned in relation to the surface system. Additionally, system behavior is not accounted for nor measured, but rather each individual segment is planned and evaluated independently of system behavior. Currently even single modes, notably roads and transit, are not planned as individual segments, and more importantly multiple modes are not planned as integrated elements of an overall transportation system. As a result, plans are developed to address specific problem areas rather than overall system performance."[58]

This logically leads to a more optimal approach to transportation planning:

"The question of transportation planning is whether to start with the system and look for its effects or to start with an economic, environmental, or other system goal and design the transportation system, involving all modes, to achieve the goals. Rather than planning the transportation system and seeking to determine the economic effect, the entire system needs to be planned based on the desired economic effect and then the type of system we need to produce it. This would require a 180-degree shift in current transportation planning methodology."[59]

[56] Michael Gallis & Associates, "Creating a Vision for the Region in the 21st Century Global Network-Step 2: A Framework for Bridging the Islands-Strengthening the Region in the Global Economy"
[57] Ibid. at p. 2
[58] Ibid. at p. 10
[59] Ibid. at p. 11

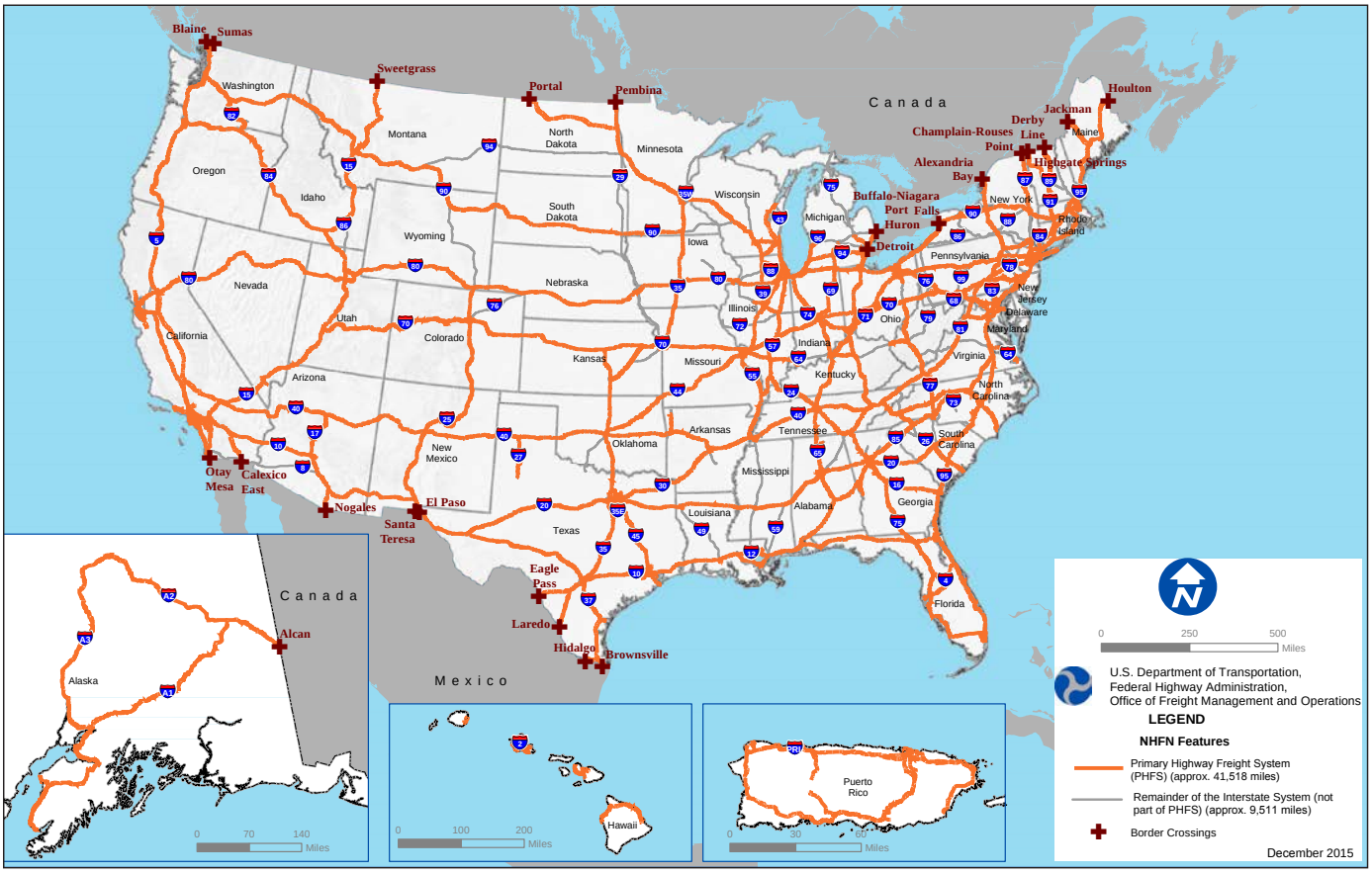
FAST Act Freight Program and Partnering Opportunity

Given the need for additional transportation infrastructure in the IMW and the need for multijurisdictional awareness and collaborative planning, additional resources for multijurisdictional projects would greatly assist in the expeditious delivery of these needed projects. A recent federal initiative may provide some impetus to that goal.

The FAST Act[60] provides, for the first time, a dedicated source of federal dollars for freight projects. The National Highway Freight Program provides $6.3 billion in formula funds over five years for states to invest in freight projects on the National Highway Freight Network depicted in *Figure 20.*[61]

Up to 10 percent of these funds may be used for intermodal projects. In addition to this "formula" funded program, the FAST Act provides a nationally significant freight and highway projects competitive grant program, FASTLANE, that provides $4.5 billion, $4 billion of which may be used for highway projects, both freight and passenger; the remaining $500 million is dedicated to freight rail and ports.

Figure 20
National Highway Freight Network



[60] Public Law 114-94

[61] Source: U.S. Department of Transportation, Federal Highay Administration, Office of Freight Management and Operations

The SHRP 2 project team analysis of the formula funding portion of the program suggests that approximately $625 million would be distributed to the IMW states, an average of $125 million per year. IMW formula funds may be used on the IMW's approximately 7,400-mile network.[62]

Grants are primarily designed for projects of a minimum $100 million, and although multijurisdictionality is not required, it is encouraged, making these grants particularly suitable to large-scale transportation infrastructure projects in the IMW.[63]

The IMW, with its interconnection by interstates, highways, railway lines, pipelines and airports, has a significant opportunity to plan and submit projects together over the next several years, expediting delivery of these needed projects. The relationships and tools developed in this SHRP2 project will greatly assist in that collaborative effort within the region.

[62] The network has four components: 5,400 miles of already designated interstates and intermodal connectors; 1,200 miles of critical rural freight corridors; about 550 miles of critical urban freight corridors; and an additional 280 miles of interstates.

[63] Eligible projects include highway freight, highways or bridges on the national highway system, rail-highway grade-crossings or -separations, and freight intermodal, rail and port projects

5. Economic Perspective[64]

A proper economic analysis of state and local transportation infrastructure investments allows for better understanding of the complexities transportation planners must face. Factors to be considered include project identification, financial constraints, and project queuing and timetable given financial constraints.

In planning the development of new roads, maintaining and expanding current ones, and other transportation infrastructure projects, such as port expansion, transportation planners have primarily analyzed traffic flow and safety and secondarily considered the potential economic benefits of strategic infrastructure investments. A weak economic recovery from the last recession has placed even greater emphasis on efficient use of limited resources, and determining whether transportation infrastructure investment could lead to economic development opportunities to offset some of the calculated costs.

With opportunity comes risk. Negative impacts may be realized if a transportation system is not properly maintained and expanded. Rigorous analysis conveys, quantitatively and qualitatively, how a project might impact an economy. These economic benefits often determine whether a project gains public and policymaker support. Opportunities and risk arise in many places, including, among others:

- Local infrastructure health
- Local economic base
- Location
- Current transportation related industries
- Current higher value-added (high wage) industries
- Fiscal health
- Past vs. current vs. future planning and policy
- State alignment of infrastructure and economic development planning
- Business cycles
- Public support
- Policymaker support

Public policy considerations must first be examined and understood before analyzing the economic development potential. The first step in understanding opportunities and risks is adequately describing the project. A given transportation project does not stand alone, but rather is part of the aggregation of current transportation infrastructure, such as existing roadways, railways, aviation, and ports; expanded and improved transportation corridors and the potential for new construction of other infrastructure. Consideration must be given to access to other markets through efficient ports of entry. Less tangible but important considerations are economic development enhancements derived through partnerships and collaboration between communities, states, and even countries.

[64] Source: "SHRP2–Economic Development Concepts," Rounds Consulting Group, Inc., prepared for Maricopa Association of Governments, 2016

Investment decisions must follow best practices in transportation infrastructure planning and be economically and fiscally responsible. Regardless of political affiliation or jurisdiction, transportation infrastructure is deemed fundamental to growing the economy and a proper role of government. Trust must be established among planners, policymakers, and the public. The consensus-building process must combine a clear description of the project, its sources of funding, and its economic benefits.

Calculating Economic Benefits

Economic benefits from projects include job creation and enhanced income opportunities. A unified strategy building on economic development efforts already completed or taking place in the region leads to broader, more robust support. Key economic base sectors—those industries that drive the local economic environment and bring wealth into the region—must be identified. Reasonable projections of the effect of transportation projects on those sectors may indicate that the cost of the identified infrastructure could substantially be paid for by the net new economic activity brought by the project that would otherwise not occur in the absence of the project.

Consideration must also be given to the effect a transportation project may have in directing economic activity to one region or another based on the economic fundamentals of each region. Factors in this analysis include economic profiles of the regions, location, community management, and many others.

The interrelation among regions also informs this discussion. For example, many rural areas are disproportionately dependent on tourists, many of whom come from metropolitan areas. A stronger metropolitan area may create additional tourism activity across the region as a whole. In this case the opportunity and risk is in understanding how economic regions are linked together.

It is similarly important to know how different industries are linked together. Enhanced transportation infrastructure impacts on the economy can be seen most clearly in those industries directly dependent on the efficient flow of goods. The employment category of trade, transportation, and utilities offers one of the best examples of displaying direct economic benefits from increased employment counts. Improvements in retail and wholesale trade categories are also easily converted into economic impacts tangential to transportation infrastructure. Because manufacturing activity impacts nearly every employment category, it is typically a target for state and local economic developers.

Job creation in base sector industries results in economic benefits across nearly all industries in a state, county, or community. Tabulating multipliers for these industries best captures these benefits.[65]

Risks and Opportunities

Despite the interconnections between transportation planning and economic growth, additional opportunities and risks to local communities remain. Each community in an economic region has its own economic base, fiscal stability, and local transportation infrastructure health. Those communities that have thoroughly addressed these issues over longer time periods have greater opportunities to benefit from enhanced economic activity than those that have not.

A local community's ability to connect to broader regional or state infrastructure efforts will similarly impact opportunity/risk. Communities with deficient local transportation networks find it difficult to attract new

[65] An example of a tabulation of multipliers is found in *Appendix K*

businesses. Instead, economic development might take place in nearby communities with similar economic profiles but better transportation networks. More aggressive local economic development planning in one community would similarly impact that community's ability to benefit from increased trade.

It is difficult to provide localized estimates at a city or county level of the economic benefit of a regional or statewide project. The best predictor of expansion of a community's employment base is its existing employment base, which reflects the effect of many of the contributing factors to economic activity such as local transportation infrastructure health and fiscal stability. For example, an industry already present in a community will have opportunities to expand that presence. While existing employment is primarily based on past economic development and policy decisions, opportunities going forward are more dependent on recent actions. Past decisions, current policy and future economic development strategies must be considered together.

The analysis of opportunity and risk will differ among communities and therefore, must be reviewed separately under the economic and policy considerations outlined above. In some cases, broad geographical regions can be identified for review; in others, communities with similar economic profiles should be grouped regardless of geographical location.

Several important factors are revealed by this discussion.

- Location is important in identifying the kinds of economic opportunities that could arise with strategic transportation infrastructure investment.
- Past economic statistics are not the sole predictor of future growth potential.
- Economic development and public policy impact an area's ability to not just grow, but to grow well.
- While common themes exist in any discussion of how transportation infrastructure investment could positively impact an economy, the analysis needs to be completed at the local level. Impacting factors that vary widely from one community to the next make it difficult to generalize.
- Policy formulation that is not based on statistics and understanding is just a guess.

Fundamental Concepts

This section provides a broader-based understanding of the economic and political issues that arise when planning transportation infrastructure improvement projects. They can be considered fundamental concepts as they relate to blending economic development with transportation planning.

Economic impact reports will not be wholly sufficient to drive quality public policy decisions, including how to pay for and implement transportation infrastructure. Consensus building needs to begin before any report is completed. A region examining transportation infrastructure has to be politically astute. Limited resources, problematic business cycles, and a skeptical public ought to be considered. Economic benefits need to be calculated carefully and clearly explained.

Transportation Infrastructure Economics

As transportation plans extend decades into the future, and as projects themselves develop over an extended period, many transportation infrastructure options will need to be included in the analysis. Transportation and economic needs should be identified segment by segment. If new funding mechanisms are identified for specific segments, those segments may be constructed at an earlier date and opportunity costs can be minimized.

Furthermore, while transportation projects should be evaluated in the context of the broader transportation system, the system itself also has to be evaluated in the context of the region's broader economic development plans to enhance the potential for any infrastructure investment to yield a positive return to the public. Economic benefits also should be weighed against other transportation issues such as safety, road quality, traffic congestion and other factors.

New, large-scale transportation plans need to be evaluated in the context of funding mechanisms and other current transportation projects, including those planned at the local level, so the potential for one project to disrupt or build upon another may be considered.

The scale of infrastructure costs makes it imperative that jurisdictions not fall behind in investment and have to prevent excessive backlog of needed projects. Taxpayers, local policymakers, and the federal government will not be enthused to spend many years reducing a large and expensive backlog of infrastructure projects.

Three levels of improvement must be funded:

- Basic preservation and maintenance of current infrastructure
- Current roadway expansion
- New roadway construction

Because costs increase with construction complexity, simple and efficient improvements to the system should be considered before complex improvements.

Highway Development Timing (Queue)

The primary questions are:

- What gets built?
- When does it get built?
- How will it be funded?

Generally, in a properly analyzed project, the simple question relates to when construction will occur. This depends on funding and priorities, among other factors. Most projects may be justifiable, but the date of construction will vary.

Economic Development Considerations

Any statewide or multi-state transportation plan should yield positive impacts to many local economic regions, including those in which the project is not built. Those latter regions will only benefit, however, if they also have up-to-date infrastructure and economic development plans. It is important that local leaders understand current conditions, and what can be done to enhance opportunities.

It is impossible to completely disaggregate the efforts related to transportation infrastructure investment from strategic economic development planning. Economic development planning and success can be directly enhanced by the provision of a quality transportation system or thwarted by a decaying transportation network. Estimates of the benefits from efficient transportation infrastructure investment may be made, with long-term employment forecasts as the starting point.

Many assume that building a transportation project necessarily means it will be used, but as with all products and services, demand must first exist for the project, i.e., there must be some degree of economic potential in an area prior to roadway construction for the new infrastructure to yield economic benefits. Roads are significant, but not the sole driver of economic development opportunities.

Public Policy and Transportation Infrastructure Investment

The large financial scale of projects necessitates a package of financial resources. Federal funding likely will not pay fully for any project of significant scale. A dedicated tax, other funding options, or both may be required to adequately finance the needed infrastructure improvements over several decades. However, taxing for the sake of spending will not yield a positive result within the economy nor is it good public policy. A balance must be reached between providing any new public funding for transportation projects and maintaining competitive and fair tax rates. Extremes in either direction diminish economic opportunities.

Transportation Infrastructure Cost/Benefit Analysis

Transportation planning is a long-term strategic process. Roadways have a longer life than many other types of projects. Roadway life cycle estimates typically begin with a 20-year development and funding timeframe for county roads and other local area streets, while major highway or freeway infrastructure can be analyzed over an even longer period, with 25 to 35 years being appropriate. Therefore, it is reasonable to analyze economic and fiscal impacts on a similarly long-term scale.

Most studies place a greater weight on construction impacts. These impacts can be significant but will not provide the economic justification for an investment. Future business development will be enhanced or weakened depending on the decisions made today. Relatively small changes in economic activity each year can become very large as benefits compound over a number of years.

Economic Impact Considerations: Best Practices

A very straightforward approach can be used to calculate the extent transportation infrastructure investment could positively impact tax revenue collections if efficiently planned and implemented. This analysis is critical as many of the investment decisions currently being discussed could generate sufficient net new economic activity to pay the costs of projects if done properly.

The approaches to statewide calculations are included in this section. Local economic opportunity and risk considerations are provided in a following section.

Build from Previous Studies to Identify Opportunities

In 2014, the Arizona Commerce Authority, with support from the Arizona Department of Transportation, commissioned a study, ***Growing an Economy with Strategic Transportation Planning***,[66] noting that while construction impacts and net new economic development opportunities (i.e., enhanced business activity) can be considered, each analysis must be done separately.

> "A carefully considered plan will yield economic impacts during the construction phase, as well as benefits related to a heightened level of economic development that could occur once the roadway improvements are completed. Construction impacts can be large, but if funded from local taxes they cannot be considered wholly net new. This is because if people weren't taxed for a transportation project, they would spend their money elsewhere in the economy and a portion of that in-lieu activity would stay within the state and be locally taxed."

[66] Elliott D. Pollack & Company, August 2014

> "On the other hand, the broader point is that the construction of new and better roads would help encourage net new business activity and add to the economic base. If done well it will positively impact the incomes of . . . residents and the return on the investment will be positive. The potential to grow [a] state's economy over the longer term and produce higher value-added jobs in "base" sectors that drive the economy should be the focus of attention. Base sector companies can locate anywhere and are driven by specific economic development inputs. Local market companies rely on the base sector activities to import monies which then circulate and provide support for local market operations."

Thus, it is recommended that similar analyses in other jurisdictions should distinguish between construction-related benefits and benefits related to building the economy as a whole. This is a major deficiency in several reviewed transportation studies.

The economic and fiscal impact calculations related to construction activities follow common standards across all states. Labor and materials costs impact the figures, as do local tax rates. However, the process is very similar across jurisdictions as common cost calculations can be used depending on the type of highway construction that is being considered. Calculations related to net new business activity from the enhanced infrastructure investment are more complicated. Fully benefiting from these activities represents one of the larger opportunities and risks that will be studied.

For opportunities related to expanding business activity beyond construction impacts, multiple approaches should be used. Initial analysis can include global economic development opportunities or focus on expansion opportunities in key target industries and improvement in the long-term forecast for employment growth. New job creation estimates can then be calculated. Follow-up studies can convert these new job creation figures into economic and fiscal impacts. These same fiscal impacts can indirectly provide the funds needed for infrastructure projects.

The two most important takeaways are that very minor changes in a jurisdiction's ability to grow can produce large economic and fiscal impacts, and that under very reasonable assumptions these benefits can amount to the cost of building the very same transportation infrastructure network under consideration. These economic fundamentals also align voters with policymakers with planners.

Understand How Industries Interrelate from a Modeling Perspective

Industry concentration has connective elements, just as communities have. Many things make a community work and many economic inputs move together rather than in isolation. This is easy to understand as a basic concept, but can result in economic analyses becoming very complex. Fortunately, economic models may be run for various economic sectors to offer quantitative examples of the relationship between industries. The analysis may show, for example, that for each 1,000 workers directly employed in one industry, another 1,500 are employed in supporting industries throughout all of the jurisdiction's major employment sectors. This is how an economy functions.

The main point is that job creation in base sector industries results in economic benefits across nearly all industries in a state, county, or community. Tabulating multipliers is the best, most straightforward method of capturing these calculations. Multipliers vary by region. If an economic region has a greater ability to supply goods and services to the base sector industry, the multiplier values increase and more local job creation occurs. Because many business inputs are often imported to rural areas rather than being produced there, multipliers in rural areas are typically lower than in urban areas.

It is not just communities that have interrelated opportunities and risks; individual business operations have far-reaching impacts as well. This implies that economic benefits will go well beyond the traditional transportation-related industries. Virtually all industries will see some benefit.[67]

Economic Conclusions and Recommendations

- Geography is important in identifying the kinds of economic opportunities that could arise with strategic transportation infrastructure investment, but is simply one contributing factor to how a community's economic base develops over time. An examination of the economic base itself will prove more useful in this kind of a review. Economic statistics will pick up most of the past influencing factors including those that are difficult to quantify, such as public policy issues.

- Past economic statistics are not the sole predictor of future growth potential. The exceptionally harsh recession of 2008 and subsequent difficult recovery that impacted all states, especially those in the western, impact the predictive value of past statistics. In many cases even the most current economic statistics do not tell the full economic story.

- Economic development and public policy indeed impact an area's ability to not just grow, but to grow well. A thorough understanding of current public policy and economic development plans will influence an opportunity/risk matrix.

While this analysis identified some common themes in the discussion of how transportation infrastructure investment could positively impact an economy, the analysis needs to be completed at the local level. There are far too many impacting factors that vary widely from one community to the next to generalize.

[67] An example three-county case study is found in *Appendix L*

6. SHRP2 Project Stakeholder Engagement and the Project Process

Fundamental goals of this SHRP2 project included building new relationships, strengthening existing ones and creating awareness to expedite planning and environmental review of key transportation projects within the IMW. GIS and data analysis are critical transportation planning tools. Quality regional data would provide decision makers with better situational awareness of the region and enable them to make more fully-informed decisions if made available through a common operating system.

During this project, much time and effort was dedicated by many agencies building a network among GIS and technical professionals to exchange ideas on issues impacting their respective agencies, highlight the tools each agency has developed, and form recommendations for future phases to continue efforts.[68] To best accomplish this, the group:

- Assessed available GIS data resources through survey
- Developed a common GIS vision/platform
- Collaborated on data conflictions, data standards, and data gaps
- Developed best methods for sharing data

For efficiency, most of the project's efforts were conducted using webinars and conference calls. Over 13 separate webinars were held providing an overview of the project and highlighting key web mapping services/GIS tools used by stakeholders in the region.

Other activities of this project included the development of a webpage for the project, which includes fact sheets, surveys, presentations, webinars, meeting information, and other documentation of the efforts made in this project.[69] Additionally, the study group conducted a GIS survey of each stakeholder entity. Responses were consolidated, analytics were reviewed, and available data sets were identified. Follow-up interviews also were conducted to ensure the comprehensive collection of data.

This project began in earnest with a kick-off call between the Federal Highway Administration and the Maricopa Association of Governments on March 31, 2014. Since that time, a number of meetings, conference calls, webinars and other events have occurred in order to fulfill the goals of this project. A detailed list of the activities may be found in *Appendix M*. Significant events in the project are highlighted below. This does not include the innumerable day-to-day efforts of MAG's team, nor that of the other stakeholder entities, including internal meetings, calls, and the development and updating of documentary materials.

SHRP2 Project Kick-Off

On April 2, 2014, MAG contacted directors of other stakeholder entities throughout the IMW to introduce the project and seek their input. This was followed up with a kick-off teleconference among the directors

[68] Participating entities represent the vast majority of the IMW; not all entities in the IMW chose to participate.
[69] https://www.azmag.gov/information_services/shrp2-expediting-project-delivery-grant.asp

to further discuss the project and to coordinate points of contact among the members of the group. That information was consolidated and shared via email with the entire group.

In August 2014, MAG began the process of developing a survey to obtain GIS information from each of the stakeholders. Responses to that survey were compiled and supplemented through October 2014. A SHRP2 technical team was developed that reviewed those responses, and by the end of October 2014 a webpage for the project was unveiled, *SHRP2 Solutions: Tools for the Road Ahead,* where documentary resources could be consolidated and made available to stakeholders in particular and the public at large.

On October 31, 2014, GIS webinar presentations began. This method of information sharing was relied on as a more efficient way for the groups, scattered over a large region, to be able to meet virtually and exchange information and ideas. The dozen webinars may be found on the project webpage. As webinars frequently included multiple presentations from different stakeholders, the number of presentations exceeded twenty. Webinars continued through the end of the project. In addition to the webinars, throughout the project numerous teleconferences with various stakeholders have helped fill in knowledge gaps and share both experiences and lessons learned among the stakeholders. In addition, informative interviews were conducted with CalTrans and the Colorado DOT on developing a risk register.

From January through March 2015, individual agency interviews took place where additional information on GIS was obtained and summarized. This information was shared with the technical team and other stakeholders.

In March 2015, members participated in the Intermountain West MPO/TMA/Transit meeting, presenting the project to that group and requesting involvement from more regional agencies.

During the period from June through August 2015, the technical team developed draft land use lookup tables for the IMW. These lookup tables are a significant step towards understanding the available resources and aligning expectations of what may be accomplished readily or what may require more extensive work.

In August 2015, an additional survey of the technical team regarding their employment of risk registers was conducted.

On August 27-28, 2015, twenty-six technical staff from 14 agencies convened a key meeting in Denver to provide input and share information on a number of subjects. These subjects included an overview of the project and a discussion of GIS resources in the region, transportation in the region, other data and analysis,

Technical staff at the SHRP2 project August 2015 meeting, hosted by the Denver Regional Council of Governments

growth patterns, and online collaboration tools. The Federal Highway Administration presented on interconnected economies, as well as SHRP2 project-related updates on the implementation plan, transportation data and analytics, other data, long range growth patterns in the IMW, and a common data reporting and mapping tool. This meeting helped identify areas of consensus on the project's four main goals with a key focus on recommendations for the GIS common operating platform/vision for the broader IMW.

In January 2016, the drafting of this report commenced and continued through the summer. In the meantime, webinars and presentations continued, including project updates to various stakeholders. At various times throughout the project, MAG provided FHWA with detailed progress reports.

On April 25-26, 2016, the Intermountain MPO/TMA/Transit group held its annual meeting, hosted by MAG. A more detailed SHRP2 presentation was provided to highlight project efforts to date along with next steps. Additionally, the IMW GIS tools developed and potential freight opportunities identified in the IMW were also presented.

April 2016 Intermountain MPO/TMA/Transit meeting included 34 representatives (four federal) of eight transportation and transit agencies

SHRP2 Project Close-Out

Finally, a close-out webinar/meeting was held on September 27, 2016, to conclude the process.

Throughout this process, a SHRP2 contact list was developed comprising 73 various transportation, GIS, and policy staff within the IMW representing 28 agencies. This contact list was organized by agency, name, and title, and contact information was maintained and made available to the SHRP2 project team for their use.

In addition, MAG staff kept the Western Regional Alliance abreast of the SHRP2 project and provided opportunities for their engagement as well.

7. IMW GIS Resources

The SHRP2 project team realized from the initiation of this project that GIS resources were critical in attempting to create a common platform for this large region. The FHWA has previously noted the benefits of regional collaboration in GIS.[70]

Time and cost savings

- Increased efficiencies and leveraged resources
- Strengthened partnerships or new partnerships
- Improved decision making

For this reason, a great deal of emphasis was placed on the sharing of GIS information by the various stakeholders involved, so that these benefits could be realized by the study team.

This section summarizes the relevant information from:

- Summary of presentations made regarding GIS resources during the SHRP2 project by the following entities:
  - Arizona Department of Transportation (ADOT)
  - Colorado Department of Transportation (CDOT)
  - Community Planning Association of Southwest Idaho (COMPASS)
  - Denver Regional Council of Governments (DRCOG)
  - Federal Highway Administration (FHWA)
  - Maricopa Association of Governments (MAG)
  - Mid-Region Council of Governments (MRCOG)
  - Mountainland Association of Governments (MAG)
  - North Front Range Metropolitan Planning Organization (NFRMPO)
  - Pikes Peak Area Council of Governments (PPACG)
  - Regional Transportation Commission (RTC) of Southern Nevada
  - Spokane Regional Transportation Council (SRTC)
  - Utah Department of Transportation (UDOT)
  - Wasatch Front Regional Council (WFRC)
  - Western Electricity Coordinating Council (WECC)
  - Western Governors' Association (WGA)
  - Western Regional Partnership (WRP)

[70] U.S. Department of Transportation John A. Volpe National Transportation Systems Center, "Regional Models of Geospatial Cooperation, Case Study Report-May 2015."

SHRP2 Project Presentations, *2014-2016*

The following are summaries of the GIS-related presentations made by seventeen entities, which helped to highlight available relevant resources and provide information to assist with the development of a common GIS vision/platform detailed later in this chapter. The summaries are not comprehensive in nature, but feature significant efforts relevant to this project. These summaries are not intended to be inclusive of all the resources used or maintained by each entity; rather, these are summaries of the presentations that the individual entities made to the study group. This project created additional awareness of the significant GIS-related resources of the IMW SHRP2 partners, allowed for sharing best practices and leveraging efforts, and developed recommendations on bridging GIS resources across the IMW.

Arizona Department of Transportation (ADOT)[71]

ADOT is a multimodal transportation agency serving some of the fastest-growing areas of the country, including the Phoenix metropolitan area, where more than half the state's population resides. ADOT plans, builds, and operates a complex highway system of 20,014 roadway lane miles (as of 2014.) It also operates the Grand Canyon Airport.

ADOT recognizes the importance of GIS, and has decentralized its use of GIS across the agency, but does not have a centralized GIS group. Its Multimodal Planning Division maintains the linear referencing system, specifies roadway characteristics, responds to data and mapping requests, and supports online mapping. ADOT coordinates with other state agencies, counties, districts, and metropolitan planning organizations (MPOs) to have adequate and accurate roadway centerline and inventory and to ensure all supporting GIS data is up to date. Among the GIS data and projects used or maintained by ADOT are:

- Arizona Transportation Information System (ATIS), the GIS system for ADOT, which uses a linear referencing system that can display route and milepost data on a map. ATIS provides road centerlines as common points of reference for data.
- Roadway Characteristics Editor (RCE), an online editing tool from Esri's Roads and Highways. It has 98 event feature classes (through lanes, functional classification, etc.).
- Highway Performance Monitoring System (HPMS), a federally mandated program, which contains road data (e.g., roadway extent, use, condition, performance).
- GIS support for the Five-Year Transportation Facilities Construction Program, which contains the five-year development plan for highways, transit, airports and highway support facility projects and expenditures.
- Photo log, which is an annual video inventory of ADOT's highways providing a historical record of the State Highway System.
- APLAN, a web-based application using ArcGIS Online for data sharing, editing and analysis. It was designed with planners in mind and has a user-friendly interface for non-technical users. ADOT worked closely with the Utah DOT on best practices. APLAN has many capabilities, including the ability to add/view spatial data interactively over base maps, access sensitive data (bridges and crashes) and set up maps via security protection. It has different permission levels: User, Publisher and Administrator. APLAN includes dynamic maps and data that were previously available only in static form.
- ADOT Transportation Asset Management System (AZ-TAMS), which provides internal data sharing using ADOT data to improve transportation safety and efficiency and to support economic development. AZ-TAMS displays maps, charts, dashboard graphics, and text of state and district performance.

[71] Patrick Whiteford, SP, Senior GIS Analyst, Arizona Department of Transportation (ADOT) presented on October 31, 2014, August 27, 2015, and April 22, 2016.

- AZGEO, an initiative of the Arizona Geographic Information Council (AGIC,) supports state agency GIS data sharing by providing GIS users with links to Internet map services, metadata, and geospatial data, including boundaries, demographics, environmental factors, hydrology, imagery, indices, mining, natural features and transportation. ADOT coordinates with AGIC for sharing data with state agencies through this project.
- Other ongoing items such as development of static maps, the annual map book and supporting metadata-data dictionary (metadata on all GIS data).

Colorado Department of Transportation (CDOT)[72]

CDOT has responsibility for more than 23,000 lane miles of highway and 3,000 bridges. CDOT has many data management/GIS projects, such as:

- The CDOT Online Transportation Information System (OTIS), which provides access to data used in transportation planning and project development, including current and projected traffic volumes, roadway attributes and statistics, demography and geography.
- Geographic Roadway Database Management System, an updated system that sits on top of roads and highways and allows for more automated and seamless management of CDOT's linear reference system, including allowing data owners to manage their data themselves.
- RoadX, an attempt to jump into the future by quickly piloting connected/automated vehicle and other advanced projects. For example, working with the technology company HERE, CDOT is conducting a pilot project to push useful information to drivers' mobile devices and dashboards along I-70 to help drivers better handle road conditions.
- Working with the SAP data engine and ESRI to implement a suite of software to digitize data collected from the field for work orders so that the information is tied to the GIS/LRS system and linework. Geocoded work orders can then be layered onto CDOTs data.

There are also a number of open data efforts in Colorado, such as the Colorado Office of Information Technology Data Portal and Open Colorado, designed to provide open access to government data (e.g., crime, health, GIS, transit) and to inform both government entities and citizens on creating more transparent, participatory, and collaborative communities.

Community Planning Association of Southwest Idaho (COMPASS)[73]

COMPASS is the metropolitan planning organization (MPO) for Ada and Canyon Counties, Idaho, the largest metropolitan area in the state. According to 2015 COMPASS statistics, the area population is 646,450. COMPASS is governed by a board of directors representing its member agencies.[74] COMPASS has 19 staff members who staff all efforts including four committees and nine workgroups.

Every few years COMPASS updates its transportation plan for Ada and Canyon Counties. The plan looks forward over the next twenty-plus years to prioritize projects (roads, bridges and transportation services)

[72] Erik Sabina, P.E., Manager, Information Management Branch, Colorado Department of Transportation, Division of Transportation Development, presented on August 27, 2015, and April 22, 2016.

[73] Eric Adolfson, Principal Planner/GIS Coordinator, presented on Community Planning Association of Southwest Idaho (COMPASS) and related project initiatives on August 27, 2015.

[74] General members: Ada and Canyon Counties, Ada County Highway District, Canyon Highway District #4 and cities of Boise, Caldwell, Eagle, Garden City, Kuna, Meridian, Middleton, Nampa, Parma, Star, Wilder; Special members: Boise State University, Capital City Development Corporation, Idaho Department of Environmental Quality, Idaho Transportation Department, Valley Regional Transit and Ex Officio members: Central District Health Department/Southwest District Health, Office of the Idaho Governor and Greater Boise Auditorium District.

so that there is regional cooperation and vision on transportation efforts and funding. For more information, please see Communities in Motion 2040.

COMPASS's many efforts include: performance measures, demographics, bicycle and pedestrian planning, project development assistance, small project grant program, grant research and writing, education series, development review, and analysis of freight, level of service, and crash data.

GIS is used for a variety of internal and external data efforts, planning projects, environmental reviews, development monitoring evaluations, and engineering studies such as:

- Data management (collecting, storing, translating, updating.)
- Regional Data Center, through the direction of its Regional Technical Advisory Committee (RTAC) and Regional Geographic Advisory Committee (RGAC), hosts GIS data that can be shared among all COMPASS agencies and, in the case of some layers, with the public as well. For some datasets, it allows automatic updates for regional data, both from the regional version and to the regional version from the local, authoritative data sources.
- Data Services for Public, an open data site that contains open data for use by the general public.
- Performance Dashboard, developed for COMPASS members and stakeholders to access data, maps and trends, and learn more about the region's goals on transportation, housing, health and the economy. An example of such information available was the map of 2014 permits in Ada and Canyon Counties by building type.
- Support regional transportation planning efforts including: Transportation Improvement Program (TIP), regional long-range transportation plans, regional studies, modeling, and demographics. For more information, please see: Products, Services and Data.
- Air quality conformity analysis using EPA's Motor Vehicle Emission Simulator (MOVES). For more information, please see: Air Quality Conformity Demonstrations

Denver Regional Council of Governments (DRCOG)[75]

The DRCOG region includes the area in and around the city of Denver.[76] DRCOG is one of the nation's three oldest councils of governments. It functions as a regional planning commission (per Colorado state statute), is the federally designated Area Agency on Aging (AAA), and serves as the metropolitan planning organization for the region.

DRCOG produces regional planning data, information, visualizations and applications including:

- The Data Portal, which allows for secure data exchange between DRCOG and its members to help create regional planning and forecasting datasets. The secure nature of the Portal increases and improves data transactions; increases communication between and among members and DRCOG; and promotes understanding of use restrictions to allow sharing regional datasets when possible. Key features of the Data Portal include: privacy and security; transaction tracking; user-friendly upload and download functionality; commenting/forum feature; customizable upload form to gather specific information (e.g., licensing); participation map; and an automatic sync with Open Colorado. Its specifications include: CKAN platform (same as Open Colorado); Python backend

[75] Ashley Summers, Information Systems Manager, Denver Regional Council of Governments (DRCOG), provided information on DRCOG's data efforts on December 12, 2014, August 27, 2015, and April 22, 2016.

[76] The DRCOG region includes Adams, Arapahoe, Boulder, Clear Creek, Douglas, Gilpin and Jefferson counties, the City and County of Denver, the City and County of Broomfield and southwest Weld County. The DRCOG Area Agency on Aging service area includes Adams, Arapahoe, Clear Creek, Douglas, Gilpin and Jefferson counties, the City and County of Denver, and the City and County of Broomfield.

and JavaScript frontend; sits on Linux server (development and production); uses PostgreSQL database and is web map embedded.

- Regional Data Catalog is an online data catalog open to the public featuring GIS data and map data available for download. The purposes of the catalog are to better serve GIS power-users in communities; reduce manually handled data requests; and promote and support open data. Key features include: data preview, download functionality, multiple data formats, data and map gallery. The specifications: Drupal (open source content management system, content rendered through views and blocks and PostgreSQL database.) DRCOG has spatial and tabular data needed for regional planning and policy decision making. Data can be searched by keyword or browsed by subject. Spatial data can be previewed with OpenLayers (map viewer) and downloaded in KML, WMS, GeoRSS, and shapefile. Among the included data are transportation, land use, demographics and employment.
- Denver Regional Equity Atlas is an online, interactive web map showing access to opportunity in the region by displaying demographic, education, employment, health and housing data in relation to the transit system. Key features include: interactive web map, custom data mashups, ability to save and share custom maps, dynamic legend, and dynamic graphs and charts. Specifics for the system: SQL server for frontend, PostgreSQL for backend, and data processing intensive.
- Denver Regional Visual Resources (DRVR) is a repository of data-driven stories and infographics that explain the region, specifically in the topic areas of economics, transportation and aging. The visualizations on this site turn data into information for the benefit of the public, communities, elected officials and others. Key features include interactive maps, graphs, and charts, rich infographics, regional analysis with "drill-down" capability to the local level and data provided with context/narratives.

Federal Highway Administration (FHWA) Presentation on Geospatial Data Collaboration[77]

U.S. Department of Transportation
Federal Highway Administration

An FHWA initiative, Every Day Counts (EDC), identifies and deploys innovations that: reduce highway project delivery time, enhance safety and protect the environment. Geospatial Data Collaboration (GDC) is an element of the EDC and a new initiative for geospatial data sharing sponsored by the Federal Highway Administration (FHWA).

GDC involves the use and sharing of geospatial data and tools to provide better information and make efficient transportation decisions while allowing State DOTs and other agencies to work better together. Among the benefits of data sharing are:

- Stronger communications—data can be consumed as it is published and can be viewed through a common framework.
- Increased efficiencies—it is easier to address data gaps, reduce redundancies and find information and respond to data requests.
- Improved data quality—more transparent information helps show data quality issues and encourages data owners to address errors,
- Streamlined project screening and development—provides for earlier coordination,
- More strategic decision making—example provided of Nevada DOT's Planning and Needs System (PLANS) includes a mapping component to categorize "bundles" of transportation projects with similar features.

[77] Mark Sarmiento, Community Planner, Federal Highway Administration (FHWA), USDOT Headquarters, presented on Geospatial Data Collaboration: Tools for Data Sharing, on November 18, 2015.

FHWA conducted a study to document examples of tools supporting GDC goals, share lessons learned/success factors and develop and strengthen community of those engaging in GDC-related efforts. The study included a literature review, telephone discussions with 22 transportation entities, case studies, two peer exchanges and a final report[78] that identified three general classes of tools and effects: repositories of data; gateways to data, tools and viewers; and means of collaborating. The study found that most agencies are moving away from repositories and focusing on gateways, particularly cloud based, and convening intra- and interagency groups for collaborating. Motivating factors include federal requirements to receive federal aid; natural disasters, e.g., flood events, which suggest a need for rapid data sharing; lower cost, and more efficient sharing. For example, the Arizona DOT developed a historic preservation portal, accessible to DOT staff, consultants and professionals. For more information: NEPA Guidance for Federal Aid Projects-Cultural Resources.

FHWA's study found that factors supporting successful data sharing include having champions, identifying common goals among multiple stakeholders, and promoting and demonstrating the tools and efforts to support users. For example, in 2009 Maryland made data for the Maryland Integrated Map available to agencies across the state and to the public. It acts as a portal, making it possible to access multiple databases from multiple repositories from one location. For more information: Maryland State Highway Administration's (MDSHA) Enterprise Geographic Information System (eGIS), MD iMAP-Maryland's Mapping & GIS Data Portal and Maryland Department of Information Technology Open Data Portal.

The study also found that agencies are using both off-the-shelf software and customized platforms. Agencies need to choose flexible and adaptable solutions, integrate new technology into existing systems, and understand the capabilities and limits of these technologies as they impact user interaction. For example, Colorado DOT built its Online Transportation Information System (OTIS) in 2009 as a "one stop shop" for transportation, environmental, and other data, and has evolved it over time in response to user needs. For more information: OTIS.

Similarly, North Carolina DOT developed Go!NC, a cloud-based (ArcGIS Online) service to aggregate and share geospatial data within and outside the agency. For more information: Go!NC

Data management and governance must be considered:

- Establishing data and governance standards—most agencies do not have formal standardization processes. One approach is a guidance document. Two examples are the Montana DOT's best practices guide that provides guidance but no specific standards (Montana DOT AGOL), and the Iowa DOT's Geospatial Governance Guidance document that lays out responsibilities of Iowa DOT, metadata, project standards, etc.
- Assigning data owners—it is difficult to establish authoritative data sources and maintain quality; agencies should assign someone (such as the developers of the data) as owners, freeing up GIS to increase access to data. An example is Pennsylvania DOT's enabling of business units to be data owners. For more information, see PennShare.
- Setting standards for metadata is burdensome and it is unclear who owns it, so most states do not prioritize it and therefore, do not have robust metadata. The study found a fear of sharing data and uncertainty about data quality. Others are concerned that showing a planned project area might give the impression it is set in stone when it is not, so disclaimers are used. Examples include:
  - Washington State DOT: 27 different agencies were consulted to develop a portal, including a start guide and video tutorial. For more information, see Planning Policy & Implementation.
  - Montana DOT: unusual in that it coordinated with its state library. For more information, see Geographic Information Clearinghouse.

[78] Available at https://www.gis.fhwa.dot.gov

- Missouri DOT: used a more formal Memorandum of Understanding approach for sharing natural resource information to protect sensitive species, integrating planning, and best practices.

For future data sharing, there are a number of evolving issues, such as federal reporting requirements may be overlapping or inconsistent, data owner may move away from the GIS agency, or there is more emphasis within and between state agencies to coordinate. Technology advances, such as smart phone apps, feedback loops, and field editing will improve quality of data. Funding challenges require doing more with less, and government transparency will assist in showing the benefits of data sharing to the public and policymakers.

Additional resources highlighted:

- Planning and Environmental Linkages (PEL)—Transportation planners, NEPA practitioners or agency staff involved in NEPA or conservation planning and members of the public use PEL in planning transportation projects as it allows for early consideration of environmental, community, and economic goals and provides information, analysis, and products that support the environmental review process.
- Eco-Logical —This tool developed from an interagency effort of the BLM, EPA, FHWA, NOAA Fisheries Service, NPS, USACE, USFS and USFWS to encourage federal, state, tribal and local agencies in planning and constructing infrastructure, providing a conceptual framework for integrating plans across agency boundaries and endorsing mitigation on an ecosystem scale.
- American Association of State Highway and Transportation Officials (AASHTO) GIS for Transportation (GIS-T) Symposium —This annual symposium of over 400 participants and 30 exhibitors allows government and private industry to meet, see the latest software demonstrated, and share experiences in the use of GIS for transportation purposes.

Maricopa Association of Governments (MAG)[79]

The Maricopa Association of Governments is a Council of Governments (COG) that serves as regional planning and policy agency for the metropolitan Phoenix area, and was formed in 1967. MAG is the designated metropolitan planning organization (MPO) for transportation planning in the greater Phoenix metropolitan region, including the Phoenix urbanized area and the contiguous urbanized area in Pinal County. MAG also has been designated by the Governor to serve as the principal planning agency for the region in a number of other areas, including air quality, water quality management and solid waste management. In addition, through an Executive Order from the Governor, MAG develops population estimates and projections for the region. Extensive primary research drives this work. MAG provides a research, discussion and study forum on regional issues, promoting the identification and solving of problems through intergovernmental cooperation and adopting common policies promoting regional growth and development.

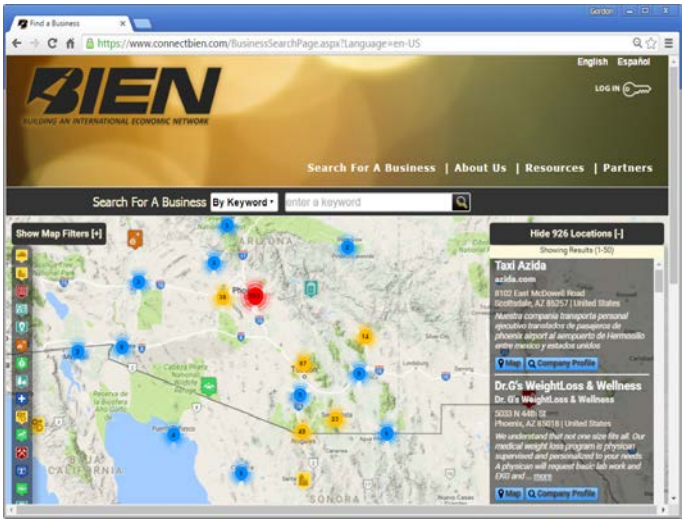
The MAG region is nearly 15,000 square miles, over 60 percent of which is in Maricopa County. The population of the MAG region is about 4.4 million. MAG consists of 34 member agencies in Maricopa and Pinal Counties.[80]

[79] Anubhav Bagley, Information Services Manager; Denise McClafferty, Regional Program Manager; Jason Howard, GIS Program Manager; Vern Wolfley, Geographic Information Systems Analyst II, and Natalia Cuneo, Regional Research Analyst I of Maricopa Association of Governments (MAG) presented on MAG and related efforts on December 12, 2014, August 27, 2015, and April 22, 2016.

[80] Members: Cities of Apache Junction, Avondale, Buckeye, Carefree, Chandler, El Mirage, Glendale, Goodyear, Litchfield Park, Maricopa, Mesa, Peoria, Phoenix, Scottsdale, Surprise, Tempe, and Tolleson; Towns of Cave Creek, Florence, Fountain Hills, Gila Bend, Gilbert, Guadalupe, Paradise Valley, Queen Creek, Wickenburg, and Youngtown; Fort McDowell Yavapai Nation, Gila River Indian Community, Salt River Pima-Maricopa Indian Community; Maricopa and Pinal Counties; Arizona Department of Transportation; and Citizens Transportation Oversight Committee.

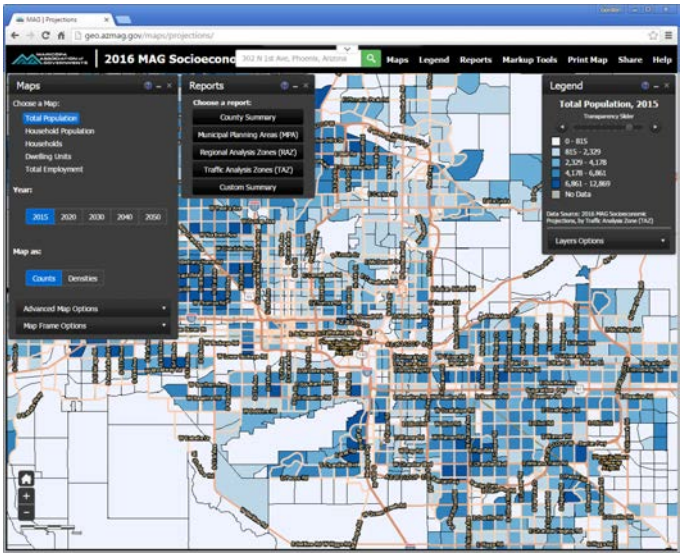
MAG currently staffs eight policy committees and 18 technical committees. One of the newest committees, the Economic Development Committee (EDC), was formed in October 2010 to address the economic downturn. In March 2010, the MAG region was the second worst in the country for distressed residential properties. EDC's role is to develop an opportunity-specific and action-oriented plan to foster and advance regional infrastructure, especially transportation infrastructure, that would enhance economic development. The committee is composed of 35 members, 19 from local government agencies, 15 business representatives, and a representative of the Arizona DOT. Its focus areas include transportation, Mexico initiatives, foreign direct investment, employment, education, economic recovery, and Canadian impact. In support of EDC efforts, MAG has developed in partnership with other key stakeholders:

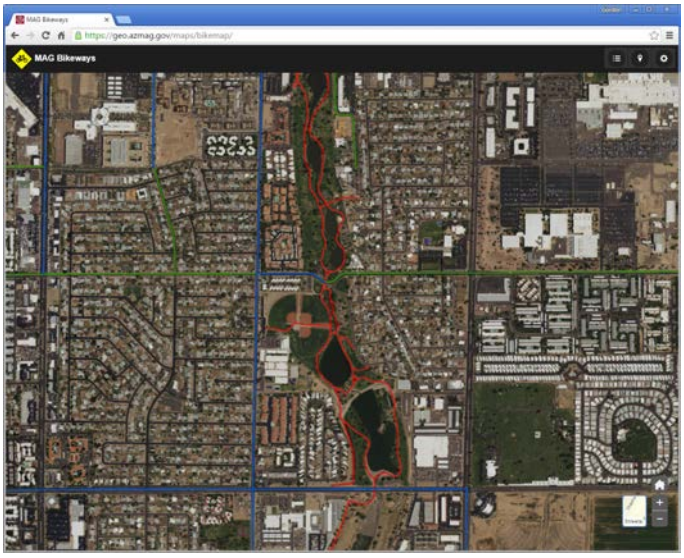
- GreaterPhoenixRising provides information about the region to help businesses and residents interested in the region, including relocating to Arizona, expanding existing businesses, or encouraging local residents starting new businesses.
- ConnectBIEN (Building an International Economic Network) provides a business-to-business platform to connect individual businesses across international borders.



MAG provides a number of regional demographic, land, and employment data and analytics, including many maps and other tools for policymakers on various topics. MAG tools and products include:

- Analytics, such as Maricopa County housing completions, Canadian housing investment, population and employment projections, commuting patterns, labor force analytics, and the migration patterns of college graduates.
- Enhanced, platform independent online mapping and data analysis tool (MAG Mapping). MAG's development software is ArcGIS Server and JavaScript. MAG also uses custom scripting tools developed in Telerik using Kendo. Reports may be downloaded in Excel and PDF.
  Map viewers include:
  - MAG Region Demographic: an interactive mapping and analysis site with selected population and housing data for the MAG region.
  - State Demographic: provides similar mapping and analysis for the entire state of Arizona.
  - Employment: displays selected employer data.
  - Read On Arizona's MapLIT: an interactive mapping tool designed to be a "one stop" resource for key data sets (census, school, health, family engagement) impacting literacy.
  - Land Use: provides existing and future land use data mapping.
  - MAG Neighborhood Explorer: shows landmark data.





- Projections: depicts 2016 MAG population and employment projections for the region.
- Bikeways: provides data on bicycle facilities.
- Victim Services: provides data to assist advocates for domestic violence victims.

- Regional Data Center, MAG's central location where its Information Services Division makes available a number of regional datasets related to socioeconomic data, land use, and geography. Typically, it is used by municipal and county planners, GIS analysts and economic development personnel, but it is publicly available to anyone interested in the socioeconomic characteristics of the MAG region. Data products include: geography, housing, census demographics, live-work patterns, job centers, socioeconomic patterns, population updates/estimates, land use, employment, and economic indicators.

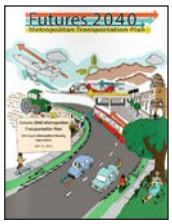
Mid-Region Council of Governments (MRCOG)[81]

MRCOG was established in 1969. MRCOG is the metropolitan planning organization for the Albuquerque Metropolitan Planning Area (AMPA).[82] The population for the area (2012) is around 880,000. MRCOG's role is advisory with its primary task to provide member governments with data and plans to allow them to make better informed decisions. MRCOG also serves as the Rural Transportation Planning Organization (RTPO) Regional Transit District (Rio Metro), supports local agribusiness, provides local planning assistance, houses the Workforce Connection of Central New Mexico (WCCNM), and manages the NM Rail Runner Express.

MRCOG program areas include data collection, analysis, and visualization; public involvement and outreach; the Transportation Improvement Program; socioeconomics and forecasting using multiple datasets; transportation system data, including Congestion Management Process, travel time and INRIX data; active transportation initiatives, such as bike sharing, and health impacts; land use and transportation integration; economic development (Transight); transit system data collection and analysis; and local development review advisement.

[81] Caerllion Thomas, AICP, GIS Coordinator/Transportation Planner and Andrew Gingerich, Transportation Planner presented on Mid-Region Council of Governments (MRCOG) and related GIS efforts on January 29, 2015, and August 27, 2015.

[82] Members: Cities of Albuquerque (Administration), Albuquerque (City Council), Belen, Moriarty and Rio Rancho; Counties of Bernalillo, Sandoval, Torrance and Valencia; Towns of Bernalillo County, Edgewood, Estancia, Mountainair, Peralta; Pueblo of Laguna; Villages of Bosque Farms, Corrales, Cuba, Encino, Jemez Springs, Los Lunas, Los Ranchos de Albuquerque, Tijeras and Willard; Albuquerque Metropolitan Arroyo Flood Control Authority; Public Schools: Albuquerque, Los Lunas and Rio Rancho; Middle Rio Grande Conservancy District; Southern Sandoval County Arroyo Flood Control; and University of New Mexico. Advisory Members: Kirtland Air Force Base, Federal Highway Administration, New Mexico Department of Transportation, Pueblo of Santa Ana. Associate Members: Valley Improvement Association.



The Futures 2040 MTP is the update to the 2035 Metropolitan Transportation Plan (MTP) and includes projections and forecasts of what Albuquerque's metropolitan area will look like in 20-plus years from now in terms of population, employment, housing, number of vehicles on roadways, and other considerations. The plan will evaluate how the region should invest in the transportation system to maintain and improve mobility, safety, and economic growth by determining what roads need to be built or improved, where transit investments should be made, and how to best provide bicycle and pedestrian infrastructure. The plan supports coordinated transportation and land use planning to make the region as livable and sustainable as possible. Futures 2040 MTP includes several important new elements: scenario planning, which includes climate change consideration and analysis, and a Long Range Transportation System Guide that will provide guidance on right-of-way widths, roadway access and multimodal and context-sensitive design. The plan describes a preferred scenario to increase attractiveness with activity centers and transit nodes, incorporating the existing roadway network but building out the transit network. The preferred scenario uses the same levels of population and employment growth as a trend-based scenario anticipating 460,000 more people and 185,000 new jobs by 2040. The traffic volumes differ between the two, and in the preferred scenario, they project that people will live closer to activity centers, transit hubs, and employment sites. Vehicle miles traveled per capita has dropped 10 percent since 2004, while transit usage has increased 81 percent from 2005-2012. See Futures 2040 MTP Map Gallery.

The guiding themes for MRCOG are to facilitate informed regional decision making by providing robust data quality and management and a balanced approach to multimodal planning and regional engagement. Some of the GIS projects include: master road network relational database, Z Drive, ArcGIS Online, collection and analysis of traffic count and crash data, and preparing data for their land use model.

MRCOG provided a demonstration of Transportation Analysis and Querying Application (TAQA), which makes a range of transportation data easily accessible to member agencies and the general public. The goal is to help make informed decisions regarding transportation infrastructure and to assist in the project development process. For this effort, MRCOG used INRIX data, which has a large quantity of data and is collected at decision points (points of entry of intersection, on-ramp, etc.) However, because MRCOG's data is based on midpoints of intersections, MRCOG contracted with Cambridge Systematics to develop a method for making the INRIX data work with MRCOG's. (The querying tool and conversion of data algorithm are proprietary to Cambridge Systematics.) All data is available for public access. Three of TAQA's modes were demonstrated:

- Travel time data, for which they have data from 2011-2012 and are adding 2013-2014. TAQA provides the ability to query by date, compare average speed data to free-flow speed; providing a travel time index condition showing the difference between free-flow and actual; export queried data to, for example, compare data from different times of day; map out average conditions; search by travel direction and route; and filter out specific geographies and corridors.
- Traffic count data was demonstrated for average weekday traffic, historical published traffic flow maps compared over time, and isolating to particular corridors or system-wide. These data have an inventory from 2000 forward.
- Observed traffic counts data by date, by daily volume, and by peak period.

MRCOG has interactive showcasing data using the ArcGIS online platform, including:

- Long Range Transportation System Guide Gallery
- Regional Traffic Safety Report
- Socio-Economic Data that pertain to population, housing, jobs, and land use. Some of the specific datasets collected include labor market statistics, census data, commuting data, land use inventories, and building permits.
- Maps highlighting Data Analysis Subzone Boundary, Census and Growth Maps by Census Tracts
- Maps to support various planning activities such as traffic flow, congested corridors, limited access roadway, and priority transit improvements evaluation corridors.

Mountainland Association of Governments (MAG)[83]

MAG was organized in 1972 through an Interlocal Cooperation Agreement. It provides community and economic development, regional planning and aging and adult services to the Utah counties of Summit, Utah, and Wasatch and the cities and towns in those counties.[84] The area has been referred to as the "Silicon Slopes" for the many high-tech businesses that have located there. The largest job center is in Provo, Utah County.

MAG creates maps for a number of plans and programs such as transportation, funded projects, geologic features, trails, and transit. Most of its maps are interactive. It is also the Utah State Data Center for the region, publishing census data, population estimates, historic data, and future projections. They use Story Maps to share information. Collaboration among Utah agencies is very robust. There are no major problems sharing data between and among agencies as most of the data comes from the same source. A vision map showing potential future freeways was demonstrated. Some of the MAG Maps and data include:

- Interactive Mapping
  - Story Map of MAG
  - Regional Transportation Plan 2015 to 2040
  - Transportation Improvement Program
  - Utah County Environmental Impacts
  - Utah County Trails and Bikeways
  - Utah County Electric Car Charging Stations
  - Utah State Legislature District Information
  - Utah, Wasatch, and Summit County Hazards
- Population and Demographics
  - Future Population Projections: Municipal and county projections out to 2060 for the state of Utah
  - Historic Population Data for Utah cities to 1950 and Utah counties and US states to 1900
  - Census Data: Latest Census Population Estimates, 2010 Census Data, 2000 Census Data
- Hazard Mitigation Data

North Front Range Metropolitan Planning Organization (NFRMPO)[85]

NFRMPO's region is an area in Colorado of 675 square miles, north of Denver and includes portions of Larimer and Weld counties with a population over 488,000. It includes an interstate highway, three US highways, seven state highways and three railroads (two Class I Railroads and one shortline railroad.) There are 15 member agencies.[86] The NRFMPO administers the region's federally mandated transportation and air quality planning processes.

NFRMPO uses data to analyze current travel conditions, forecast demographic and travel trends, and provide ad-hoc mapping and analyses. While the NFRMPO produces little original data, it has compiled spatial data covering the NFRMPO from a wide variety of federal, state, local, and private sources. Its GIS/data

[83] Tim Hereth, GIS Analyst/Transportation Modeler for Mountainland Association of Governments (MAG) presented on August 27, 2015.

[84] Executive Council Members: Counties of Utah, Summit and Wasatch; Cities of Alpine, American Fork, Cedar Fort, Cedar Hills, Draper, Eagle Mountain, Elk Ridge, Fairfield, Genola, Goshen, Highland, Lehi, Lindon, Mapleton, Orem, Payson, Pleasant Grove, Provo, Salem, Santaquin, Saratoga Springs, Spanish Fork, Springville, Vineyard, Woodland Hills, Coalville, Francis, Henefer, Kamas, Oakley, Park City, Charleston, Daniel, Heber, Hideout, Midway, Wallsburg; and non-member: Town of Independence.

[85] Angela Horn, Transportation Planner for North Front Range Metropolitan Planning Organization (NFRMPO), presented on the NRRMPO on August 27, 2015.

[86] NFRMPO Members: Berthoud, Eaton, Evans, Fort Collins, Garden City, Greeley, Johnstown, Larimer CO, LaSalle, Loveland, Milliken, Severance, Timnath, Weld CO, Windsor; Colorado Transportation Commission and Colorado Department of Public Health and Environment.

projects include freight, non-motorized, and regional transportation plans; a transportation improvement program; a congestion mitigation process; a regional transportation profile; and an inventory of the US-287 corridor. They have identified a number of challenges, including consistency in data recording, a "doughnut" area within the travel demand model, and a lack of freight and non-motorized count data. The NFRMPO has also recognized a number of opportunities, such as purchasing Bluetooth vehicle travel time collectors; bicycle and pedestrian counters; HERE data; INRIX data; model data; and state and local partner agencies. See NFRMPO GIS information.

Pikes Peak Area Council of Governments (PPACG)[87]

PPACG is the designated metropolitan planning organization for the Colorado Springs urbanized area, with a population of over 600,000 in two counties and seven municipalities.[88] As the MPO, PPACG is required to maintain a regional transportation plan and transportation improvement program to determine priorities for federal, state and local funds. In order to promote cooperation and early collaboration among agencies in transportation improvements by providing more comprehensive information, PPACG developed an Integrated Regional Mitigation Plan (IRMP), a spatial database intended to identify opportunities and support the selection of mitigation sites as transportation projects are implemented.

PPACG uses a Google Earth Professional-based website. Data collected include:

- Demographic information—where people live and work now and in the future, forecast into 2035 using different scenarios.
- Environmental, like floodplains
- Endangered species
- Potential mitigation sites
- Schools
- Parks and campgrounds
- Boundaries
- Transportation
- Roads
- Bike routes
- Truck routes
- Congestion
- Road surface conditions
- Traffic volumes, capacity and volume to capacity ratio
- Projects that have been funded with a one cent sales tax

Datasets are all available publicly. A separate website, not available to the public, includes ownership of parcels, land cover data, US Army Corps of Engineer data on projects they are proposing, flood data, ecosystem data, and channel sustainability. Another GIS-related resource is Open Matrix, a forum for transportation and land use professionals who want to encourage the use of common formats for the large, usually proprietary data repositories.

[87] Rich Muzzy and Craig Casper from PPACG presented on January 9, 2015, and August 27, 2015.

[88] Board of Directors: Cities of Colorado Springs, Cripple Creek, Fountain, Manitou Springs, Victor and Woodland Park; Counties of El Paso, Park and Teller; Towns of Green Mountain Falls, Ramah, Alma, Calhan, Fairplay, Monument and Palmer Lake; and Non-voting members: Colorado Transportation Commission, Military Community, Fort Carson, Peterson AFB, Schriever AFB, United States Air Force Academy, Public Transportation, Air Quality Control Commission, and Water Quality Control Commission.

PPACG identified certain challenges they experienced in an earlier SHRP2 project:

- Data
  - Conservation data is often sensitive and non-public.
  - Colorado Parks and Wildlife data are not freely available; the process to obtain data is labor intensive and results are uncertain.
  - Mapped locations of significant cultural sites are sensitive and difficult to acquire.
  - IRMP only considers mitigation sites for transportation projects, not other development.
  - Data to represent ecosystem services are lacking at regional scales.
- Cost
  - The cost of on-the-ground mitigation is difficult to determine. Modeling market value may be a substitute.
- Mapping
  - The SHRP2 website was migrated to GeoServer, a Java-based, open-source mapping tool.
  - GeoServer allows PPACG to control data in its own servers, necessary because of the sensitivity of some datasets.
  - GeoServer uses PostgreSQL database and PostGIS, a database extension adding spatial functionality.
  - PPACG anticipated its GeoServer interface to be tested in the first quarter of 2016.

Regional Transportation Commission (RTC) of Southern Nevada[89]

The RTC is the metropolitan planning organization and the transit authority for Southern Nevada.[90] The RTC planning area is all of Clark County in Southern Nevada and has a population of about 2.14 million and 1.1 million jobs. RTC's responsibilities include public transport and traffic management, essentially for the Las Vegas area; roadway planning and construction funding; and regional transportation planning. The area's increasing population means that the RTC must develop both short-term and long-term solutions to traffic congestion; at the same time, RTC focuses on sustainability, transportation mobility and safety, economic development, air quality improvement, and increased quality of life.

RTC provided an overview of its efforts developing interactive mapping tools in a platform to assist transportation professionals and planners with interactive data sharing and mapping. The data provided includes projects in the Regional Transportation Plan and Transportation Improvement Program (TIP.) The TIP project data has related information such as street and highway project type, project sponsors, project numbers, locations, completion date and funding information. The platform also provides data from Congestion Management Program, transportation planning and political boundaries, RTC Travel Demand Forecast Model, RTC transit routes and ridership, land use, and Nevada DOT crash and traffic counts data. The tool incorporated some graphical, spatial and text query, data and file extracting and mapping features. RTC demonstrated its RTC TIP interactive mapping tool makes it easier for transportation professionals to access TIP related information and frequently used regional transportation planning data.

RTC highlighted HERE data on the Freeway and Arterial System of Transportation (FAST) Dashboard. FAST monitors and controls traffic. The Dashboard (Performance Monitoring & Measurement System), designed by RTC staff, builds on data gathered by NDOT plus incident data input by FAST. FAST Dashboard conveys transportation data in a user-friendly and meaningful way to:

- Create plots, charts, graphs, and maps.
- Provide real-time traffic information and calculate route travel times.
- Provide freeway traffic congestion levels and travel trends by corridor, direction, month, day and hour.
- Provide roadway data to the public and policymakers.

[89] Beth Xie, Manager of Planning and Gang Xie, Project Engineer, presented on August 27, 2015, and May 11, 2015.

[90] Membership: Clark County, Cities of Henderson, Las Vegas, North Las Vegas, Mesquite, and Boulder City; and Ex Officio: Nevada Department of Transportation.

FAST Dashboard establishes a TMC Network (sequence, connectors and roadway information). The Dashboard won the DOT Data Innovation Challenge 2014 and ITE Best Project of the Year Award for Management Operation & ITS Council 2011.

Spokane Regional Transportation Council (SRTC)[91]

SRTC is located in Spokane County, Washington; the area has a population around 480,000. SRTC is the metropolitan planning organization, transportation management area and the regional transportation planning organization for Spokane County, including the cities of Spokane and Spokane Valley and other small cities and towns in the county. SRTC's Board has 14 voting and three ex officio members.[92]

SRTC encourages coordination and collaboration for better connectivity between planning and transportation departments in the cities and towns, the county, Spokane Transit and the Washington State Department of Transportation. SRTC has a staff of 11 employees, two of whom are GIS staff members.

There are four SRTC core programs and functions: planning, programming, coordination and administration, and technical modeling/data. GIS constitutes a large part of SRTC's efforts including maintaining datasets of road features, transportation analysis zones (TAZs), building permits, crash locations and bikeways/trails; developing maps for transportation plans and documents; and modeling of travel forecast and air quality. SRTC's ArcGIS Online homepage includes featured maps, such as:

- Spokane Regional Road Construction Map, a detailed interactive map of road and other construction projects informing the public of the dates, locations and possible impacts of projects. This is the most popular map with over 10,000 views to date.
- Spokane Regional Bike Map, another popular map, highlighting bicycle facilities throughout all of Spokane County.
- Spokane Regional Transportation Council's Transportation Improvement Program (TIP), which includes transportation projects planned to be completed or constructed in the upcoming four years in the Spokane region.

SRTC does not manage many of their own datasets, but refers to each entity that is managing the authoritative data layers. They do have modeling data, including Featured Data Groups. In addition to providing a demonstration of the above SRTC maps, SRTC showed available data through:

- Washington State Department of Transportation (WSDOT) data and GeoData Distribution Catalog. SRTC works closely with WSDOT and shares data.
- Spokane County's Interactive map, with property, planning, zoning and crime data.
- Wiggio, a free collaborative web tool, which was started a couple of years ago from information obtained at an ESRI user conference. There is an MPO GIS community available.

Horizon 2040 is Spokane County's metropolitan transportation plan (MTP), a long-term, multimodal "blueprint" aimed at meeting the mobility needs of the area through 2040. It uses projections for population, housing, and jobs, and includes consideration of private vehicles, public transit, bicycling, walking, freight movement, rail, and air travel. The Horizon 2040 Implementation Toolkit assists in implementing MAP-21 performance measures to better align with nationally required measures for determining WSDOT efforts, regional performance measures, and targets.

[91] Kevin Shipman, Geographic Information System Analyst, presented on three occasions (November 21, 2014, August 27, 2015, and April 22, 2016).

[92] Members: Cities of Airway Heights, Liberty Lake, Spokane, Cheney and Spokane Valley; Representatives of Major Employer and Small Towns; Spokane Airports; Spokane County; Spokane Transit Authority; Washington State Department of Transportation; and Washington State Transportation Commission; Ex Officio: Spokane Rail, Transportation Advisory Committee chair, and Transportation Technical Committee chair.

Utah Department of Transportation (UDOT)[93]

The mission of UDOT: "Innovating transportation solutions that strengthen Utah's economy and enhance quality of life." UDOT's goals include reducing crashes, injuries, and fatalities through its management of its 6,000-mile system of roads and highways by investing in transportation infrastructure and using innovation to improve statewide mobility.

UDOT GIS data is stored in UGate, a central repository of UDOT data for easy sharing. UGate supplies data to UPLAN, an interactive mapping platform using ArcGIS Online that supports the Department's ability to model data, inventory transportation assets and use improved analysis with shared information to enhance planning.

UPLAN efforts began in 2010 and continue to evolve. Information includes: Utah's unified transportation plan, pavement management, safety and crash analysis, bridge locations, bike lanes, and mileposts. UPLAN was developed for UDOT personnel and consultants, local governments, and interested parties. UPLAN includes a gallery of maps regarding the UDOT Three Year Plan to assist coordination for larger projects. Projects in the Three Year Plan may be sorted by program funding source, year and region. The gallery includes all projects, both funded and unfunded. Data are broken down by program, year, maintenance stations, milepost data, and regions. Milepost data are collected every two years using LIDAR images. Maps allow a user to toggle plans and assets on and off (e.g., centerlines, RLS, culverts or signs in poor condition, choke points, pavement issues, etc., and projects that are going on around them). The object is to match projects with assets to enable coordination and more efficient use of funds. By linking data to mileposts, the user can go directly to Google Streetview or Roadview Explorer and see the particular culvert, sign, etc.

All public data are available on the Open Data platform, which UDOT has been using since October 2014. Only two UDOT datasets are private (crash locations and a bridge layer). When the data are published, the platform links directly to the endpoint showing the source of the data, a level of consistency that did not exist prior to the adoption of this platform. Projects link to a document management system, so if the user needs access to that information, they can connect into ProjectWise from the map, making it easier to get to the computer-aided design (CAD) file.

If local governments use UDOT's server or ArcGIS Online, UDOT can use their data, and copy/paste into the maps. For more information, see Utah Data.

Wasatch Front Regional Council (WFRC)[94]

The Wasatch Front Regional Council is an association of governments for the region consisting of Salt Lake, Davis, Weber, Tooele, Morgan and Box Elder Counties in Utah. WFRC is the designated metropolitan planning organization for the Salt Lake City-West Valley City and Ogden-Layton urbanized areas.

The Transportation Coordinating Committee (Trans Com) serves as a policy advisory body for the short range six-year Transportation Improvement Program. Transportation technical advisory committees, composed of engineers from each of the jurisdictions and state agencies, provide technical advice to Trans Com and the WFRC.

The Regional Growth Committee (RGC) acts as the policy advisory committee for the development of the 30-year horizon long-range Regional Transportation Plan and the Wasatch Choice for 2040 Vision for

[93] Becky Hjel, GIS Manager for UDOT, presented on October 31, 2014
[94] Scott Festin, AICP, Senior Planner/Demographer for Wasatch Front Regional Council, presented on August 27, 2015

growth and development. The Vision is a comprehensive template for growth planning along the Wasatch Front, considering that they project 1.2 million new residents by 2040, a 59 percent increase.

Two main products are developed for transportation planning. The Regional Transportation Plan (RTP) recommends improvements to highways, transit, and other modes to meet the area's needs over a 20-year period and beyond. The Transportation Improvement Program (TIP) is a six-year capital improvement program for highway and transit projects contained in the RTP. The RTP is updated every four years, while the TIP is approved annually.

The I-15 and I-80 corridors are key because of the freight from the West Coast that comes through these corridors. They obtained a TIGER grant to study the I-15 corridor. This study included land use.

The WFRC encourages cooperation among jurisdictions, coordinates local projects with federal and state programs, coordinates local transportation plans and programs that overlap city or county boundaries, promotes regionally-developed strategies for cost effective, environmentally responsible development and studies transportation needs and solutions. The multiple agencies involved are very collaborative.

WFRC maintains a number of datasets to support planning and other processes, including air quality, socio-economic data, traffic analysis zones, UDOT traffic data and traffic projections. WFRC uses employment data from the Quarterly Census of Employment and Wages, which they receive free of charge. Housing data are derived from the census and from a commercial product. For more information, see Wasatch Front Regional Council Data.

Western Electricity Coordinating Council (WECC)[95]

WECC is responsible for coordinating and promoting Bulk Electric System reliability in the Western Interconnection, a territory of 1.8 million square miles extending from Canada to Mexico. It includes the provinces of Alberta and British Columbia, Canada, the northern portion of Baja California, Mexico, and all or portions of the 14 U.S. western states between. WECC's non-planning functions track renewable energy credits for states that have responsibilities for renewable resources, and include monitoring, enforcement, standards, market-operations interface, training, and collaborating with the Western Renewable Energy Generation Information System. Its planning functions include system adequacy, stability, performance, event analysis, and standards. Membership in WECC is open to all entities who meet the qualifications in the WECC Bylaws.[96] WECC strives for transparency and open participation in all of its meetings and processes.

In 2010, WECC formed an Environmental Data Work Group (EDWG) with a broad representation of stakeholders providing input to the electric transmission planning process. Primary EDWG products are: preferred datasets that are available and relevant for transmission planning; a risk classification system; the WECC Environmental Data Viewer that graphically displays the area types within the Western Interconnection and their associated environmental risk classifications; a comparison methodology to compare relative risks of transmission alternatives and reviewing study case results.

The preferred environmental data include: sensitive species areas, tribal lands, conservation areas, wilderness areas, scenic management areas and historical trails. WECC's data come from authoritative data sources

[95] Byron Woertz, Manager of System Adequacy Planning and Jon Jensen, Staff Engineer for Western Electricity Coordinating Council (WECC) presented on November 18, 2015.

[96] Membership extends to any entity that meets WECC's qualifications set out in its Bylaws. Members must be in the business of generating, transmitting, distributing or trading electricity or related energy services in the region, large end-users of that electricity, and policy or regulatory representatives of states and provinces. See WECC Bylaws Section 4.2.

(state governments and other agencies). While most environmental data provided by WECC is entirely public, some are licensed from private sources and has some restrictions on its display or use.

Cultural resource data are treated differently because of sensitivity. This data are also available throughout the WECC Environmental Data Viewer, although the display format is different from environmental data. Cultural data does not show exact location, but a relative location within half square kilometer grids. Cultural data are currently available for five states (Colorado, Nevada, Utah, Wyoming and Washington) with others in the process of being approved for release.

There are four risk levels of lands. Category 1, the lowest risk, may already have transmission or other rights-of-way in it, so is usually appropriate for transmission. Category 2 is probably acceptable for transmission development, but some mitigation may be required. Category 3 may be acceptable, but mitigation is likely. Category 4 represents exclusion areas, for example, wilderness areas, where development is prohibited by legislation or regulations. WECC has developed a data viewer on the WECC website showing these risk categories and other data such as transmission lines, highways, railways, and pipelines. A user can select a proposed line, determine whether it goes over high risk areas, and then "bend the lines" around these areas into lower risk categories. They can show those areas that are low risk to high risk, compare relative risks of alternatives, and consider the impacts of moving the transmission to different areas.

The WECC data viewer allows all stakeholders access to its datasets and risk classifications. By doing so, many stakeholders believe conflicts could be avoided early and alternate route opportunities may be explored. State, regional, and federal agencies can use EDWG data to better understand, at the planning stage, how transmission projects may impact environmental and cultural resources.

For more information, see WECC's website.

Western Governors' Association (WGA)[97]

WGA represents the governors of 19 western states and three U.S. territories in the Pacific.[98] It was established in 1984 for bipartisan policy development, information exchange and collective action by the governors on issues important to the western United States.

In a 2008 WGA report, the Western Governors called for the creation of a cross-state decision support system and passed resolutions in support of this effort. This system is referred to as a Crucial Habitat Assessment Tool or CHAT. In the WGA Policy Resolution 2014-14, State Wildlife Science, Data and Analysis, it notes, *"The Governors encourage widespread use of CHATs by industry, the public, and state and federal agencies. Planners at all levels in the public and private sectors can use state CHATs as a "first look" to help identify where states' wildlife assets are located."*

CHAT is a sixteen-state collaborative, intended to be used as a pre-planning tool for energy, transportation, and land use. It is non-regulatory and provides a high-level overview of wildlife conservation priorities across the west. State data are combined into map layers using a common framework (species of concern, native and unfragmented habitat, species of economic and recreational importance, landscape integrity, wetlands and connectivity) and aggregated into a prioritized Crucial Habitat Layer.

[97] Carlee Brown, Policy Advisor, WGA and Laura Canaca, Project Evaluation Program Supervisor, Arizona Game and Fish Department presented on November 21, 2014.

[98] Alaska, American Samoa, Arizona, California, Colorado, Guam, Hawaii, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Northern Mariana Islands, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington and Wyoming.

Much effort was spent to define "crucial habitat" and "important wildlife corridors" and identify consistent categories of data that constitute "crucial habitat." Flexibility in data aggregation and map presentation allowed each state the ability to accurately depict, and periodically update, conservation objectives, regulations and priorities as well as display information included within State Wildlife Action Plans. A demonstration of CHAT showed many of its features, such as ability to turn on/off features, ability to zoom in, quick planning analysis, metadata available, and links to state data. Data are accessible via web services and for download.

The CHAT effort helped to facilitate a state-federal dialogue. In 2009, an MOU (now expired) was signed between WGA and the U.S. Secretaries of Agriculture, Energy, and the Interior. This created the original framework for the development of CHAT. Follow-on projects helped build a user base and improve CHAT with National Landscape Conservation Cooperatives (LCCs) and FHWA. A steering committee of state and federal transportation experts along with state wildlife professionals assessed current uses and future needs regarding wildlife data then provided their findings in a report titled Development of Sustainable Strategies Supporting Transportation Planning and Conservation Priorities across the West.

In May 2015, the WGA CHAT transitioned to the Western Association of Fish and Wildlife Agencies (WAFWA) for long term hosting and management of CHAT.

Western Regional Partnership (WRP)[99]

The mission of WRP is to provide a "proactive and collaborative framework for senior-policy level Federal, State and Tribal leadership to identify common goals and emerging issues in the states of Arizona, California, Nevada, New Mexico and Utah and to develop solutions that support WRP Partners and protect natural resources, while promoting sustainability, homeland security and military readiness."[100]

The WRP structure includes three co-chairs,[101] WRP principals, a steering committee (representing the governors' offices from the WRP region, many federal management agencies, Native American leadership, and the Western Governors' Association), and three committees: Energy; Natural Resources; and Military Readiness, Homeland Security, Disaster Preparedness and Aviation. The WRP region includes Department of Defense (DoD) installations and ranges, significant state trust land, and many federally recognized tribes and federally managed land.

WRP holds GIS to be an important tool for projects and to support policy makers in decisions. A demonstration of the capabilities of WRP's GIS tools and analysis was provided:

- WRP Web Mapping Application provides the ability to query and download spatial data, export maps, search data from over 50 sources, and utilize mapping services. Data is accessible by permission level, thereby ensuring any secure/sensitive data are properly maintained.
- Regional Project Database (RPD) allows a user to input project location and information, identify project needs and search for projects. The main goal of the RPD is to create more awareness of projects, reduce redundancies, and drive efficiencies. This tool was developed to enable users to use technology to find helpful project information.
- Land Use Planning Tool (LUPT) provides information that can be spatially searched, such as critical habitat, RPD, energy point of contact, and military operating areas. LUPT enables the user to generate reports.

[99] Gabe Lovasz, GIS Manager, ManTech International Corporation, and Amy Duffy, Duffy Consulting, presented on January 9, 2015.

[100] After this presentation, WRP expanded its geographic region to include Colorado as well.

[101] Currently, Gary Herbert, Governor of Utah; Janice Schneider, Assistant Secretary for Land and Minerals Management, DOI; and Dave Duma, Principal Deputy Director, Operational Test & Evaluation, DoD.

8. GIS Survey and Results

As part of the project, two surveys were drafted and circulated among the stakeholders regarding GIS resources. The purpose of the surveys was to: assess available GIS data resources; develop a common GIS vision/platform; collaborate on data conflicts, data standards and gaps; and to develop best methods for sharing data.

GIS Survey #1: Assessing Data Sharing for the IMW and Recommendations

The first survey had eight questions to establish:

- Whether data can be shared and how data could be shared
- Tools/functions desired in a common data operating platform for the IMW
- Recommendations on tools, websites, data analysis to highlight on future webinars
- Recommendations on further outreach engagement
- Missing data that would be helpful to include in this project

The specific questions asked in the first survey along with a compilation of responses are found in *Appendix N*.

GIS Survey #2: Specific Datasets Available to Share for This SHRP2 Project

A follow-up survey was also drafted and circulated. This survey was directed specifically at the question of data. Respondents were asked to specify datasets they had on the following topics:

- Current land use
- Planning/zoning
- Development projects (pipeline projects)
- Employment inventory
- Housing (dwelling units inventory)
- Land ownership (private, federal, state, military, etc.)
- Demographic data (other than census)
- Open space
- Natural constraints (terrain, wildlife corridors, floodplain, etc.)
- Current and future transportation networks (highways, major roads, rail, airport, etc.)
- Buildings and landmark location (education, facilities, etc.)
- Other

Fifteen agencies (11 MPOs and four state DOTs)[102] submitted responses, and there were follow-up interviews to confirm data responses. Those responses and interviews were consolidated, analyzed and assessed, providing an understanding of resources in the region and made available in summary for the IMW region and by agency. This extensive amount of data mining was useful for this project and should serve as a baseline for any further, relevant efforts.[103]

[102] The participating agencies were: ADOT, COMPASS, DRCOG, MAG, Mountainland AOG, MRCOG, NFRMPO, NDOT, PAG, PPACG, RTSCN, SRTC, UDOT, WFRC, and WSDOT.

[103] A spreadsheet containing the entire survey responses can be found here: GIS Survey 2

Observations from surveys

Most agencies have few concerns with sharing data, as most data are publicly available and shareable with some exceptions, such as development projects (for example, fuel pipeline projects).

All agencies have similar datasets and similar tools to manage and maintain these datasets. Consequently, the agencies have similar problems.

As to those datasets obtained through licensing from other entities, some interest surfaced in pursuing group licensing or some similar method to enhance data sharing. The object is to not recreate data but pool data as much as possible.

All jurisdictions have several websites. The study group evaluated metrics for each website, such as data sharing, data uploading, data editing and reviewing, mapping capabilities, analytical capabilities, spatial analysis, and upload/download of data.

Some general observations by the study group included:

- Webinars improved understanding of the region's tools and functionalities.
- It is helpful to share information/learn from others.
- Efforts are transferable.
- Better purchasing power may be gained by pooling resources.
- Limited staff resources/Need for efficiencies.
- Need for data to be refreshed/maintained.
- Need for data commonality.

In addition, respondents provided information about the socioeconomic and transportation modeling and analytics datasets available.

9. SHRP2 Project: Development of a Common GIS Vision/Platform

Throughout the project, updates on the efforts and key input were provided by the SHRP2 project technical team on recommendations for a common GIS vision/platform for the IMW. From a review of GIS resources in the IMW, various datasets and web-mapping services are currently available. For a complete listing, see *Appendix O*.

At the August 28, 2015, in-person SHRP2 technical meeting, presentations by MAG staff focused on project data, growth patterns, and common data and mapping. These presentations helped assess next steps for the project's common GIS vision/platform.

The project data presentation[104] covered the following areas:

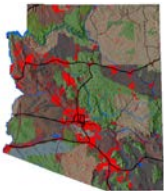
- **Project data needs:** an overview of identified datasets (local, state, regional, national); data gaps and information on additional data resources.
- Data collected from SHRP2 study team agencies that could be used in development of an IMW common data operating platform.

Members were asked for their input on whether the SHRP2 project should include a risk score analysis for the IMW region and if so, which, if any, of the following factors should be included:

- **Demographics:** The region's population as of 2010 is over 28 million and is projected to grow by nearly 30 percent by 2030, for a total population over 37 million expected to be concentrated in existing highly populated areas. The 2010 population statistics for the area indicate 15 percent were below the federal poverty line, 23 percent were minorities, 12 percent were over age 65 and 62 percent were working age. Should population access/concentration and/or characteristics (environmental justice) be assessed a risk to a transportation project?
- **Land Attributes:** The IMW contains land with various attributes, such as managed by different agencies (Bureau of Land Management (BLM), tribal, DoD, private, etc.), possessing unique land cover (developed, forest, water/wetlands, etc.), various future land use (open space/undevelopable, etc.), topography, hydrology (rivers, streams and lakes), and environmental (Areas of Critical Environmental Concern, air quality boundaries, critical habitat, superfund sites, national and state parks, herd management, Crucial Habitat Assessment Tool, etc.). A draft risk was reviewed; members were asked if this risk should be treated the same across the IMW or differ by region/state.
- **Transportation Attributes:** Proximity to border crossing/ports of entry, airports, bridge and seaports; future modeled volumes of networks; freight volumes; and I-11 alternatives. Should any of these factors be considered?
- **Location of Resources:** Proximity that might have an impact on development and/or enhance potential for multimodal partnership, such as resources located near DoD operations, power lines, railroads, schools and employer locations.

[104] Presented on August 28, 2015 by Mark Roberts, MAG Senior Project Manager.

An example of a composite WECC Environmental Data Viewer was shown, and members were asked for their input on project next steps.



An overview of the growth patterns presentation was also provided. In 2004-2005, MAG developed "Arizona Red Dots" at the request of Arizona COGs and MPOs, to visualize long-term growth for the state. Limited data were available, and only out-of-date long-term population projections were available. The project was completed in one month with a simplistic, grid-based model. It looked at land ownership (private, State Trust, BLM, tribal, military, and forests/parks/monuments), urban/rural status, and proximity to developed areas, freeways/highways, forests, parks and monuments, and floodplains and topology. Each factor was given a score and population projections for 35 years were considered. Members were asked to consider whether such a project would be a useful tool for the IMW. If so, using available data and tools, including currently available projections, a project could place buffers and weigh factors such as:

- Location of U.S. Census Places, where development would be allowed to expand their footprint.
- Proximity to current development and roads, which increases chance of development.
- Proximity to water, rivers and floodplains, which may increase or decrease the chance of development.
- Slope, where higher slopes are more expensive and difficult to develop.

The starting point would be the current population, augmented by TAZ projections, planned and future land use data, and growth patterns from COGs, MPOs and TMAs, and the application of state/county projections for areas outside COGs/MPOS/TMS projections, leading to projections for the entire region. From this, by using Census Places, evaluation of the split between incorporated/unincorporated places can be made. Potential constraints on growth include:

- Protected open space (no development)
- Military lands (no development)
- BLM lands (generally no development)
- Tribal lands (restricted development)

A presentation[105] was made with a request for input on an IMW data mapping tool. Members were thanked for the information shared to date, which helped to understand types of map viewers currently used by the various agencies. Of those reviewed, eight were a single topic, two were a story map, two were a dashboard, and one was an all-in-one platform. Six agencies offer viewers with reports and two offer analytical viewers. Transportation is the most common data, followed by employment and land use. This information is all summarized in the IMW Functionality and Data Matrix.

In building a map viewer, consideration must be given to the purpose of the application, the questions it answers, the audience, and the user's end product. Consideration of those factors will govern the data needed, tools that must be built and reports that will be generated. The goal is to develop a common operating vision and platform for easier data sharing, and develop a risk register that documents various risks that would stand in the way of successfully completing an activity. A common operating vision details the data and standards. A common operating platform would enable data to be viewed, resources to be discovered, routes/areas to be analyzed, and data to be downloaded.

A proposed viewer was storyboarded, showing a map, a categorized list of layers, analysis tools, and a results/report window. An areas report tool would allow selecting an area from a list and getting a pre-generated report or a custom area for a custom report. A corridor risk tool would allow the user to draw a line for a route and would then analyze the route for environmental and land use risks. Risk values would be predetermined in building the tool, and reports could be generated of constraints such as critical habitat, wetlands, etc.

[105] Presented on August 28, 2015, by Jason Howard, MAG GIS Program Manager.

Important viewer data would include at least: demographics—which census topics to display at what scale (total, minority, poverty); economy—what classification system to use (major employers, employment density); energy resources (BLM solar, geothermal); natural resources (Areas of Critical Environmental Concern, critical habitat); hazards (flood zones, expansive soils); and other constraints, such as land use/ownership—what classification scheme to use.

There was also discussion of how the tool would be branded and named, its appearance, which variables to include and how to assign weights, whether the jurisdiction impacts land use and ownership analyses, and whether the application calculates risk for the entire route, individual segments, or both.

After much deliberation, the following input was developed on the project's goals relating to GIS:

- Attendees appreciated the opportunity to exchange information throughout the meeting and desire that such a forum continue. The webinars on GIS-related tools have been very informative and enjoyable. Attendees also believe that the request for input for this project to date has not been taxing. MAG noted that they will continue to respect everyone's time.

- Participants recommended that there be continued discussions/collaboration on crash data to better understand each other's data analysis/processing for consistency. Perhaps there are ways to use similar methodology in order to have a more seamless data layer. There was not complete unanimity and clarity on next steps for this project's GIS common operating vision/platform tool. Members agreed to have a follow-up call to discuss next steps, thereby allowing time to review entities' tools. Future discussion items:
  - Evaluate and discuss the need and target audience for a unified analytical and data sharing tool
  - For the project's operating vision/platform (consistent with project scope of work):
    - Ensure clear understanding of the audience for project.
    - Clear commitment on how the tools will be used and marketed.
    - Need to determine appropriate scale for the tool.
    - Evaluate the possibility of restricting the use of analytical tools.
    - Evaluate national/regional authoritative data layers that are available via WMS.
    - Agency datasets to include and best ways to keep information updated.
    - How best to connect megaregion workforces and communities.
    - Include capability to print a map.

- Other Notable items:
  - Many of the entities are experiencing large increases in population, and many have increasing average population age.
  - Story maps are becoming more popular.
  - Most difficult datasets: employment, vehicle trajectory, and housing.
  - Members expressed concern over employment data as it takes much time to clean up and there is a need for multiple datasets.
  - Zoning data is hard to maintain given the fluidity of the dataset.
  - There is an interest in effective freight planning (how to get goods delivered quicker and more efficiently).
  - It is helpful to continue conversations on buying power (how working together might get datasets more cost effectively).
  - There is a need to work together/support each other.
  - There are data stovepipes in agencies, which inhibit filling the need for robust data sharing.
  - It is necessary to reduce duplication on data management/gathering, etc., and drive efficiencies.
  - Policymakers review data differently than GIS/technical members; they look for "nuggets" to use in discussion such as advocating for more transportation funding.
  - It would be helpful to compare areas (find a road that is similar, etc.).

Based on input provided at the August 2015 in-person meeting and follow up discussions during the SHRP2 study team teleconference on September 25, 2015, the study team recommended:

- MAG was to finalize the land use lookup table based on information already collected (this information will assist with development of IMW GIS common operating platform) for team review and input.
- MAG was to compile data and maps collected from IMW partners into a story map that highlights the region's significance (jobs/economy, population, etc.).
- Develop recommendations for IMW GIS common operating platform to include: target audience and level of usage; which agency datasets to include; best ways to keep information updated; appropriate scale; use restrictions of any analytical tools developed; how to "connect" megaregions (workforces/communities) and needed functionalities.
- Continue conversations on buying power (how working together might get datasets more cost effectively).
- Continue with GIS coordination/information sharing.
- Continue discussions/collaboration on crash data to better understand each other's data analysis/processing for consistency. Potential to develop similar methodology to have a more seamless data layer.

These tasks were continued in developing the tools and recommendations described below.

SHRP2 Project GIS Tools Developed and IMW Recommendations

This grant has enabled efforts to identify available GIS resources, begin sharing data and identify commonalities and gaps. It was determined that the best way to use resources and begin more collaboration is to develop an IMW story map. The IMW story map can be found here: http://arcg.is/1MThxpp

IMW Story Map

The intention at the start of this project was to create a common platform. However, after realizing the different resources of the various stakeholders, their varying levels of interest in interconnectability, and the enormous scope of the project, the study team concluded that creating a common platform at this time was a bit ambitious. For this reason, the team decided on a logical first step toward the creation of a common platform, the IMW Story Map.

MAG compiled data from its team partners, federal agencies, other local and regional agencies across the Intermountain West, and proprietary databases to create the Story Map. The Story Map interface provides a simple online viewer to display spatial data with a brief synopsis or analysis of the data. Using the Story Map platform, MAG embedded map viewer applications, making the simple map viewer portion of the Story Map more interactive, enabling the user to turn layers on and off, view layer attribute data, and export data. The Story Map was divided into five categories: Transportation, Demographics, Economy, Land, and Environmental.

Figure 21
IMW Story Map Screenshot Depicting Demographics Layer List and Options

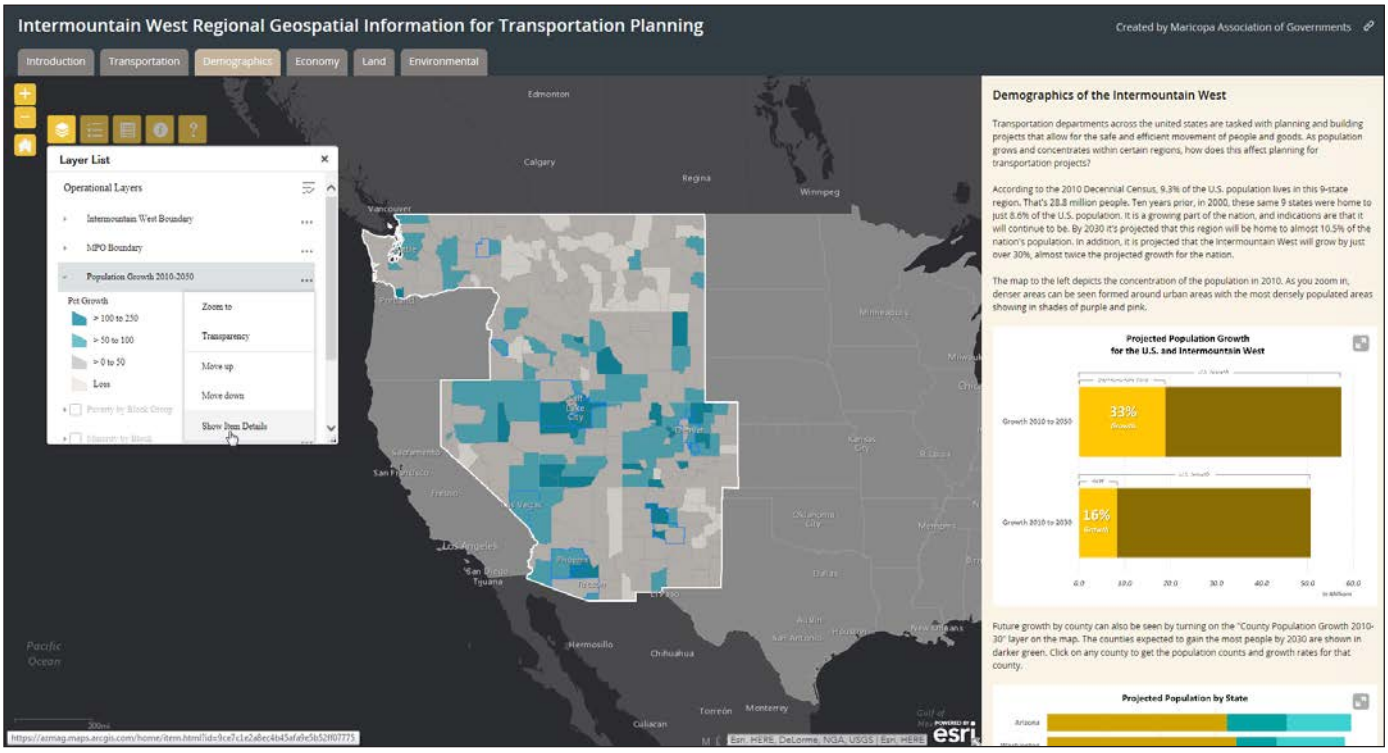


Figure 22
IMW Story Map Screenshot Depicting Transportation Attribute Tables

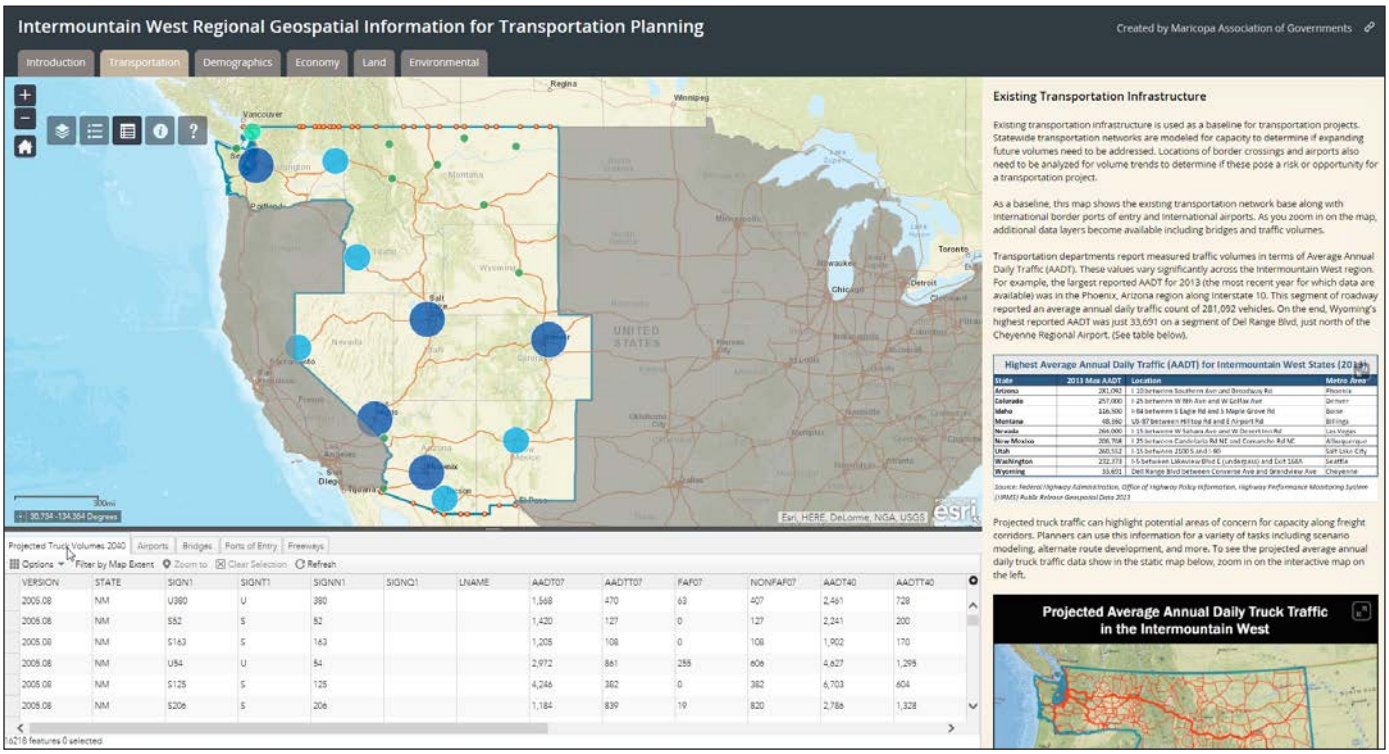
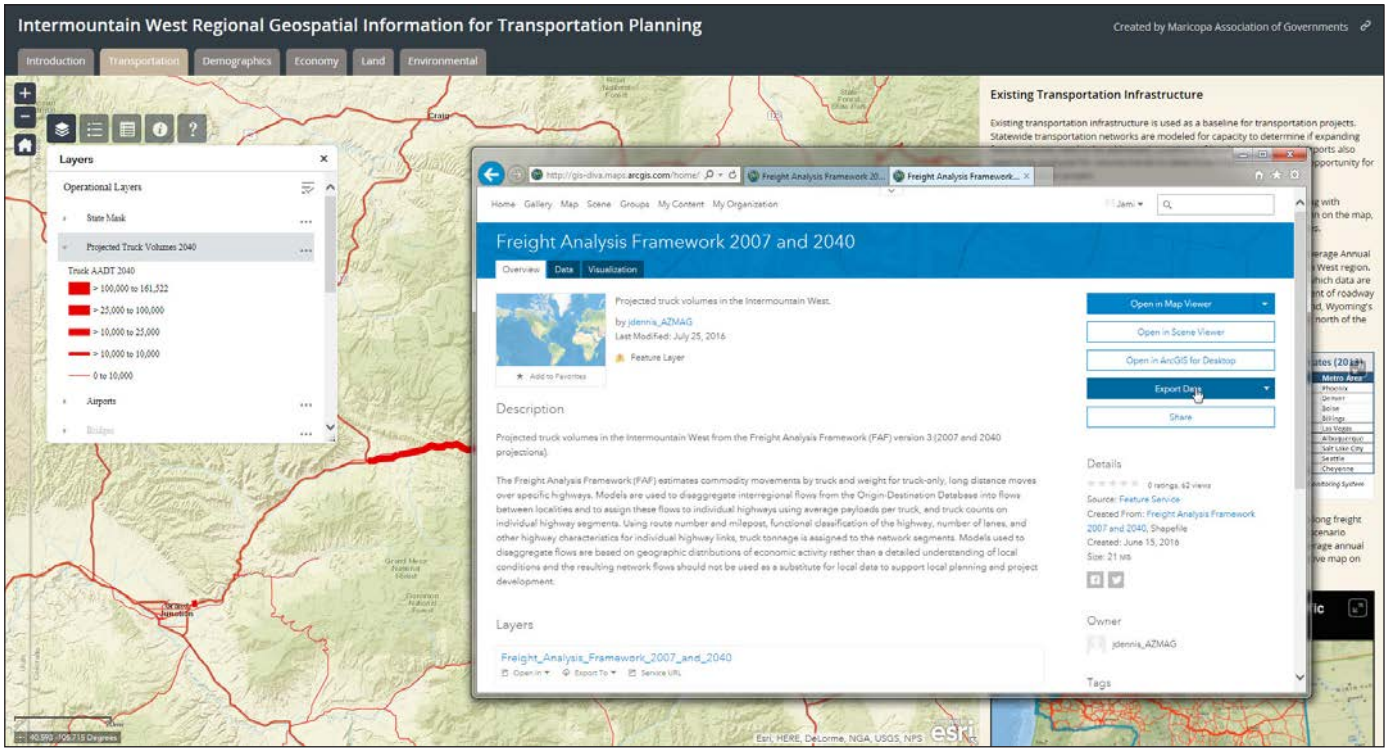


Figure 23
IMW Story Map Screenshot Depicting Transportation Data Download



At least 26 data layers from at least 11 authoritative mapping services are included in the Story Map.[106] While there are a multitude of factors involved in planning for transportation projects, these data allow for a high-level review of information that may affect certain transportation projects. Five separate themes were identified for inclusion in the Story Map:

1. Transportation
    a. Existing transportation infrastructure
    b. Models of statewide transportation networks to determine if future volumes need attention
    c. Analysis of border crossings and airports for volume trends to determine if these pose risks or opportunities for transportation planning
    d. Additional data layers including bridges and traffic volumes.
    e. Projected truck traffic highlighting potential freight corridor capacity concerns
2. Demographics
    a. Population concentration as of 2010
    b. Future growth by county
3. Economy
    a. The effect employment clusters have on roadway demands
    b. Growth in jobs and businesses after the completion of a roadway project
    c. Job trends

[106] Details of the particular data layers and sources are found in *Appendix P.*

4. Land
    a. Variety of factors affecting the ability to develop land for transportation corridors
        i. land ownership—IMW is composed of 49 percent federally-owned land, 39 percent private land, six percent state-owned, and six percent Native American land [107]
        ii. Slope and terrain vary from state to state and county to county[108]
5. Environmental
    a. Overview of potential environmental concerns
        i. Critical habitat areas
        ii. Protected wilderness areas
        iii. Other areas of concern

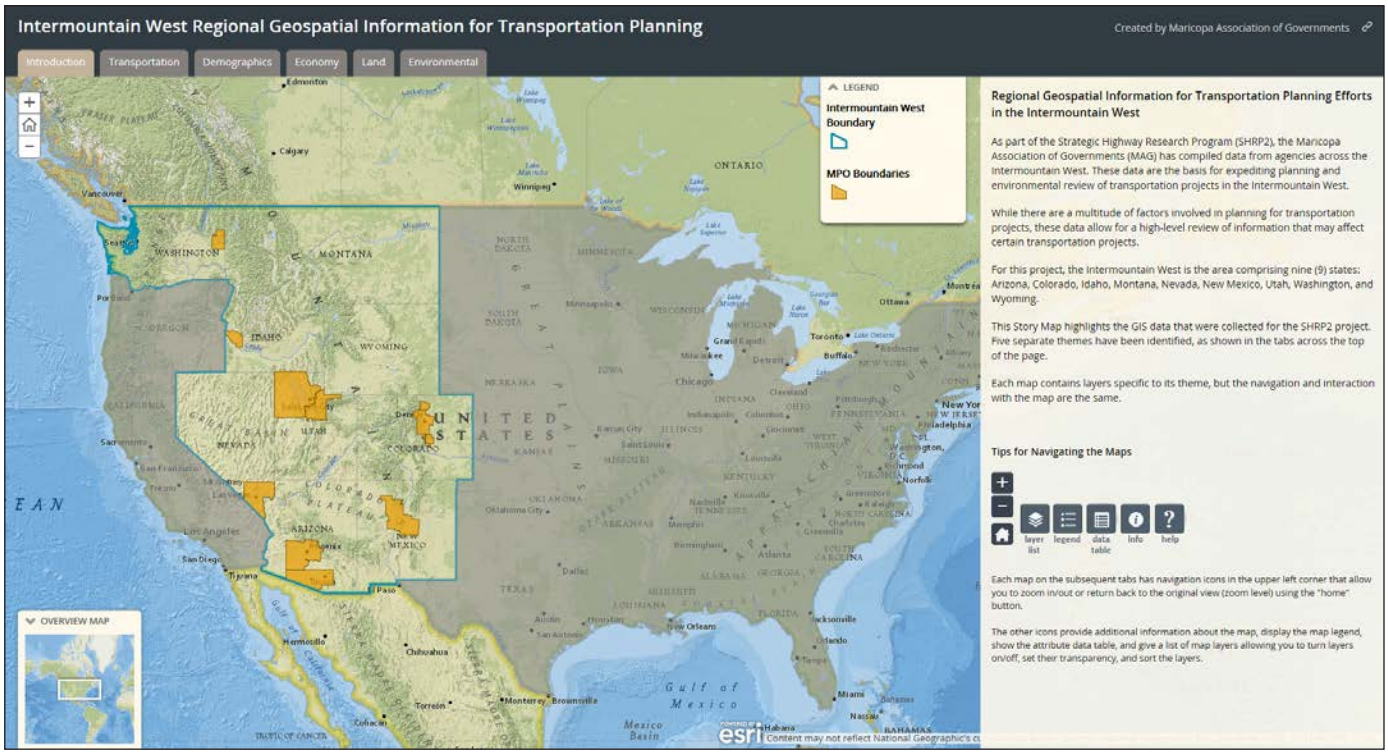
In developing the Story Map, MAG and its partner agencies recognized that it would be necessary to standardize land use descriptors among the various jurisdictions in the region. Each jurisdiction defines land use categories that satisfy their particular needs; consequently, land use categories vary among the different jurisdictions. Given the size of the IMW, there is a great variety of categories. In order to create a cohesive dataset for land use across the Intermountain West, MAG worked with the partner agencies to create the following set of land use codes for use in the IMW Story Map:

- Agriculture Land
- Residential Land
- Mixed Use Land
- Undevelopable Land
- Open Space
- Water
- Native American Community
- Vacant
- Retail
- Office
- Industrial
- Public
- Other Employment

For each partner agency, a lookup table was created to match existing and future land use categories to the agreed-upon land use codes used in the IMW Story Map.[109] This undertaking by all the agencies was difficult and involved employing considerable resources on the part of all the agencies to complete such a large project. Without doing so, however, the IMW Story Map could not have been completed to become a useful tool for transportation planners in the IMW. Additionally, the goal of expediting planning and environmental review of transportation projects throughout the region would have suffered without this accomplishment.

[107] A high resolution map of land ownership in the IMW can be accessed here: http://www.azmag.gov/Documents/SHRP2_2016-08-11_Land-Ownership.pdf
[108] A high resolution map of land cover in the IMW can be accessed here: http://www.azmag.gov/Documents/SHRP2_2016-08-11_Land-Cover.pdf
[109] The lookup table can be accessed here: http://www.azmag.gov/Documents/SHRP2_2016-08-11_Land-Use-Lookup-Tables_Final.xlsx

Figure 24
IMW Story Map Screenshot



10. Risk Register

Risk registers help bridge the gap between design and construction. Project cost overruns frequently arise because of some unforeseen risk.[110] The purpose of the risk register is to expose these unseen risks and develop a framework for mitigation. Trying to ascertain any project uncertainty at a broad scale can be extremely complex. Some of the ways risk registers can assist are to:

- Focus limited resources and save time
- Provide awareness of threats and opportunities (e.g., land management)
- Improve communication/transparency
- Assess external information/assist with predictability
- Identify, assess, mitigate, and control project costs
- Create awareness of how to better avoid, minimize, and mitigate risks

In August 2015, in preparation for the in-person SHRP2 technical meeting, agencies were asked if they currently use risk registers in their planning efforts. At that time, the majority of agencies did not specifically use a risk register, but they do analyze and incorporate risk management in planning efforts. For this reason, the project team determined that this project's risk register (contained in this chapter) would serve as a proof of concept for the broader Intermountain West Corridor Study (IWCS) region. This proof of concept would serve as a tool that others may adapt to their particular project.

SPECIAL NOTE ON THE RISK REGISTER

After this SHRP2 grant was awarded and work begun on this project, including the required development of a risk register for the proposed Interstate 11 corridor concept in Arizona, the I-11 Tier 1 Environmental Impact Statement (EIS) process has begun on a portion of the I-11 and Intermountain West Corridor Study (IWCS) preferred corridor alignment, specifically from Nogales to Wickenburg. Consequently, in order to assure that the work done in this report did not impact the I-11 Tier 1 EIS study process in any way, the risk register itself will be developed as a high-level tool providing an overview and qualitative measure of the risks. The history of the development of the corridor is included by way of background only and is the work of the Maricopa Association of Governments. The views expressed herein should not be attributed to any other entity, public or private. For further information on the I-11 corridor process, reference is made to the Arizona Department of Transportation; please see: http://i11study.com/index.asp

[110] In one study of 258 infrastructure projects over more than 70 years, project costs were found to have been underestimated in approximately 90 percent of the projects and actual costs averaged 28 percent higher than estimated. Flysberg, B., et al., "Underestimating Costs in Public Works Projects: Error or lie?" *Journal of the American Planning Association,* 68(3) (2002).

The Risk Register Study Area

This risk register identifies potential risks to transportation projects in the initial focus region outlined in the I-11 and Intermountain West Corridor Study (IWCS) (Nogales to Las Vegas via Phoenix,) see *Figure 25.* At the time this SHRP2 proposal was approved and awarded funding, the I-11 Tier 1 Environmental Impact Statement (EIS) had not been started; it is now in its initial phase. Given the breadth and scope of the I-11 Tier 1 EIS, and the immense size of the IWCS preferred corridor alignment area, the following risk register was drafted as a high-level tool providing an overview and qualitative measure of the risks to ensure no efforts are pre-decisional or impact I-11 Tier 1 EIS Study efforts. The risk register was tailored to gather relevant information, provide awareness at a very broad scale of the potential constraints and opportunities, and improve communication.

Leading up to late 2005, the Federal Highway Administration (FHWA) and the Arizona Department of Transportation (ADOT) received numerous requests for traffic interchanges along the Interstate 10/Papago Freeway between the SR-303L/Estrella Freeway and 459th Avenue in the area west of the White Tank Mountains known as Hassayampa Valley. These requests were to accommodate travel demand from more than 100 entitled master-planned communities along this region's primary freight corridor connecting I-10 in the western Phoenix area with the ports of Long Beach and Los Angeles. In addition, the recent proposal to redesignate the CANAMEX corridor in the Hassayampa Valley and its connections to US-93 and Las Vegas needed further definition for accommodating travel demand.

It was determined that the entitled development in the Hassayampa Valley represents a population of close to three million by buildout, but there was little coordinated transportation infrastructure planning for the Hassayampa Valley. In response, the Maricopa Association of Governments, in association with ADOT, the Maricopa County Department of Transportation, and the Cities of Buckeye, Goodyear and Surprise, funded and developed the Interstate 10-Hassayampa Valley Roadway Framework Study.

This study was the first framework effort in the MAG region to establish a network of transportation facilities to meet the buildout travel demand. In doing so, the Hassayampa study team was able to identify high capacity roadway and transit corridors to frame transportation in the Hassayampa Valley. The Hassayampa team also conducted a precursory environmental scan of the study area so that transportation corridors could be identified to avoid known environmental factors.

In May 2006, the Hassayampa study began for an area bounded by SR-74 on the north, SR-303L on the east, the Gila River on the south, and 459th Avenue on the west. Through an extensive process that included opportunities for stakeholder input, the project established a transportation framework that included multiple high capacity freeways (see *Figure 26,* Hassayampa, White Tanks, and Lake Pleasant Freeways) in the area to serve as high capacity corridors to move people and freight north-south through the study area.

The Interstate 10/Hassayampa Valley Roadway Framework Study was the first of three frameworks that developed an interconnected transportation system from the Town of Wickenburg to the City of Casa Grande. *Figure 26*[111] illustrates the recommended transportation network in the Interstate 10/Hassayampa Valley Framework Study.

Figure 27[112] displays the transportation framework that was recommended in the Interstates 8 and 10 Hidden Valley Transportation Framework Study. The Hassayampa Freeway was continued from the Hassayampa Valley Study and became a key corridor through the Hidden Valley Study area.

[111] Source: Maricopa Association of Governments
[112] *Ibid.*

Figure 25
I-11 and Intermountain West Corridor Study Recommended Corridor Alternatives

Sources: Arizona Department of Transportation, Nevada Department of Transportation

Figure 26
Interstate 10/Hassayampa Valley Roadway Framework Study

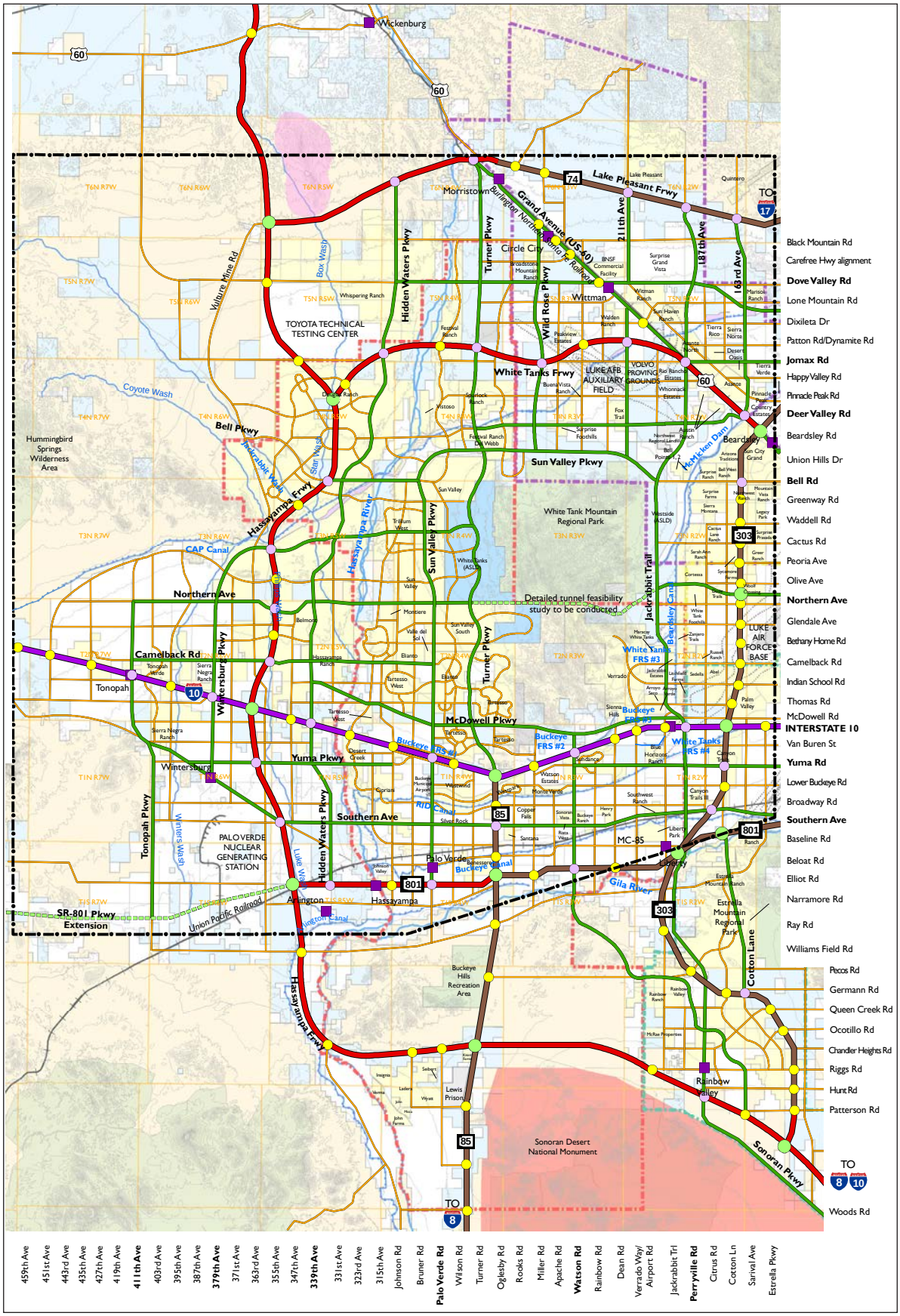
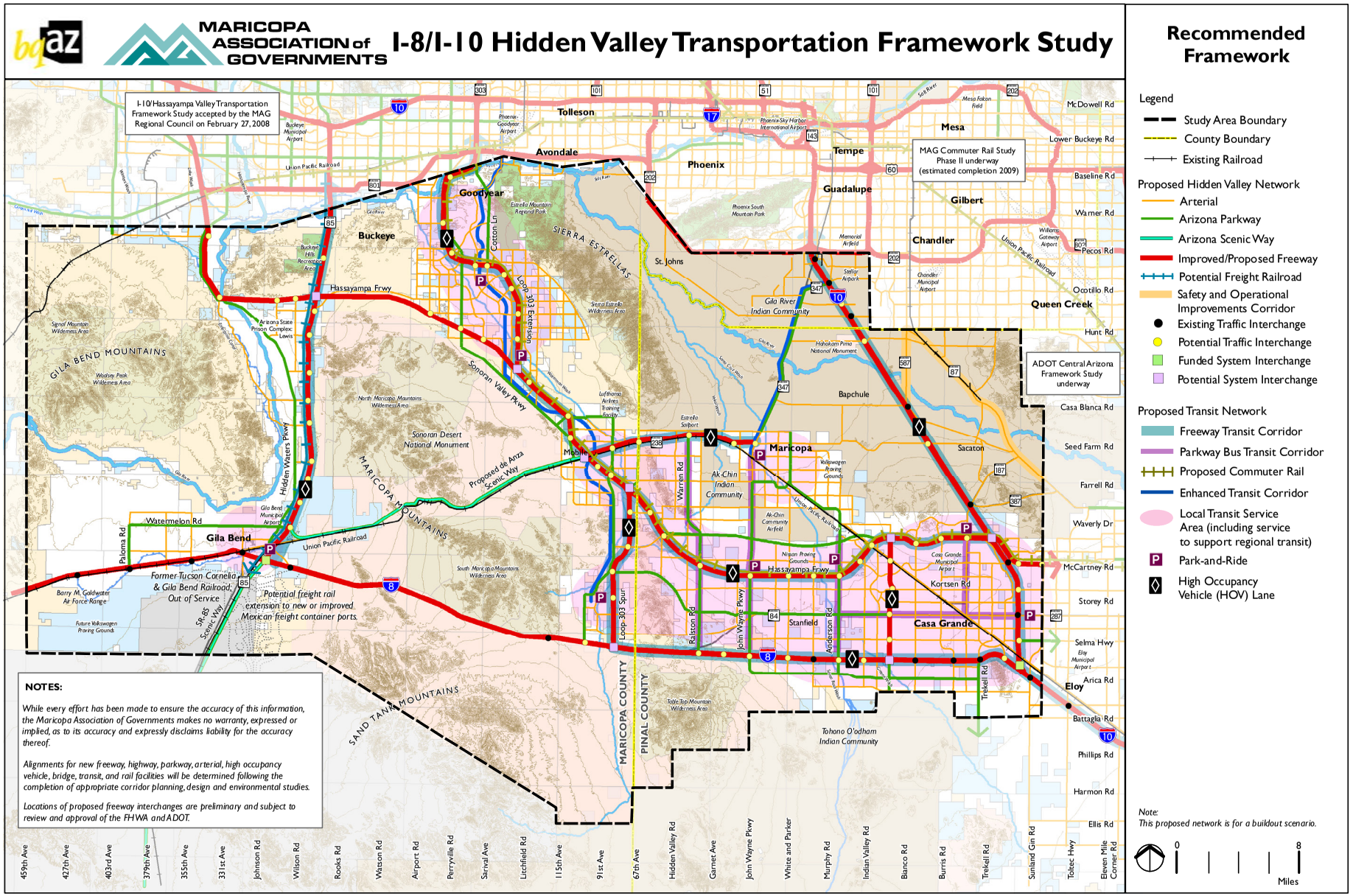


Figure 27
Interstates 8 and 10 Hidden Valley Transportation Framework Study

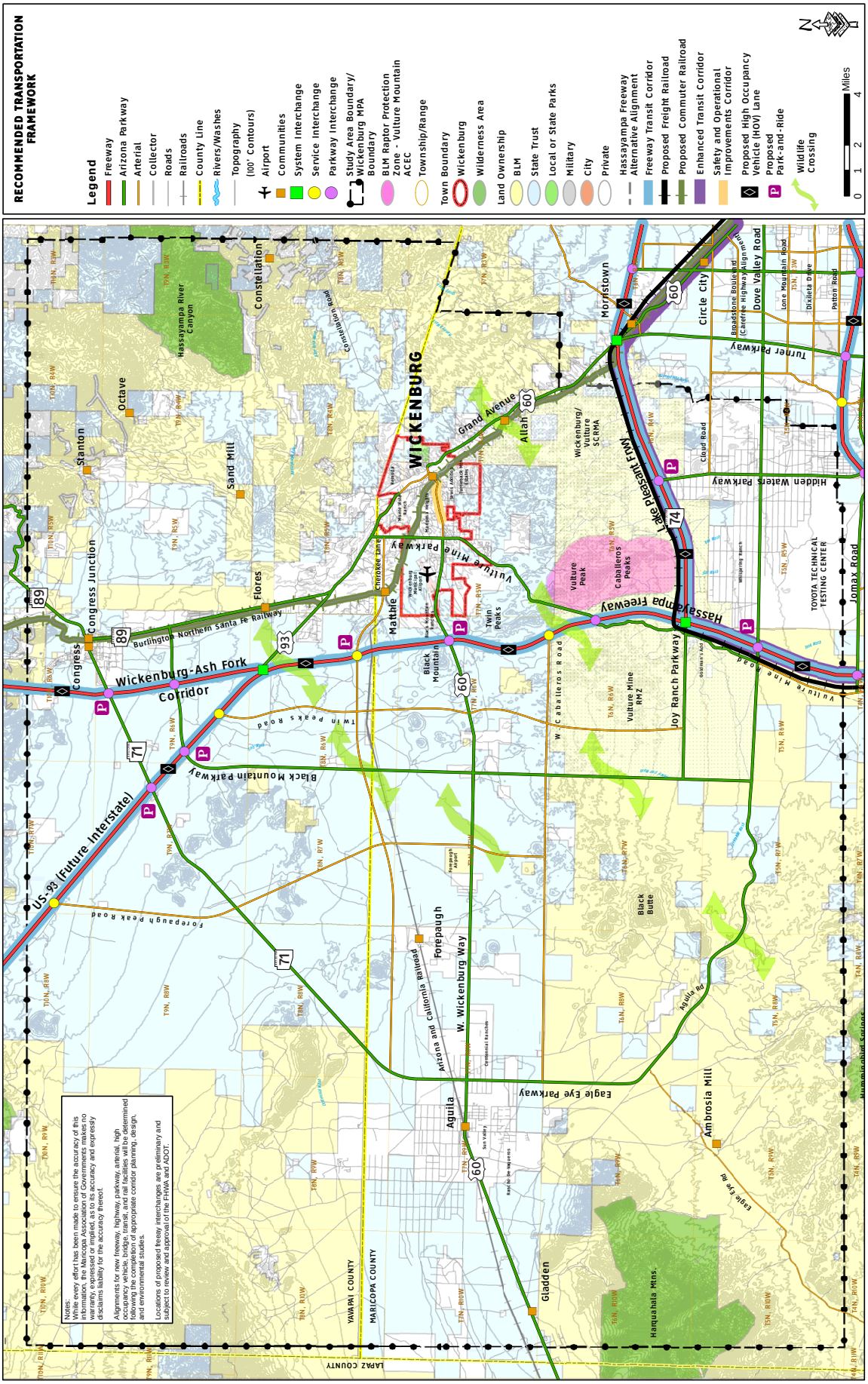


Sources: MAG, ADOT, ALRIS, Maricopa County, Pinal County, City of Casa Grande, City of Goodyear, City of Maricopa, Town of Gila Bend; 2007

October 1, 2009

Figure 28

Potential Alignment for the Hassayampa Freeway (Hassayampa Framework Study for the Wickenburg Area)



The Hassayampa Framework Study of the Wickenburg area (*Figure 28)*[113] was the last framework study that included the Hassayampa Freeway. The Wickenburg Study continued the northern section transportation network from the original Hassayampa Framework Study and developed a high level network to accommodate future population growth.

After the transportation frameworks were completed, the I-11 and Intermountain West Corridor Study (IWCS) was completed in September 2014 after two years of work and resulted in identifying an IWCS preferred corridor alignment. It was a joint project of the Arizona and Nevada DOTs, in association with FHWA, Federal Railroad Administration, MAG, and the Regional Transportation Commission (RTC) of Southern Nevada. The study included detailed corridor planning of a possible interstate link between Phoenix and Las Vegas, and high-level visioning for extending the corridor south to Mexico and potentially north to Canada.[114] Congress recognized the importance of the corridor between Phoenix and Las Vegas and designated it as future I-11 in 2012 in the Moving Ahead for Progress in the 21st Century Act (MAP-21).[115]

NDOT is currently constructing the first segments of I-11 near Boulder City, Nevada. The IWCS developed many route alternatives, but the IWCS preferred corridor tracks with the CANAMEX Trade Corridor. However, the IWCS preferred corridor alignment northward lies west of the CANAMEX Trade Corridor, from Las Vegas to Interstate 80 near Reno, Nevada, and possibly extending farther. The risk register does not include consideration of any portion of the corridor north of the Nevada border.

In December 2015, Congress approved the Fixing America's Surface Transportation (FAST) Act, which is a 5-year legislation to improve the Nation's surface transportation infrastructure. The FAST Act formally designates I-11 throughout Arizona, reinforcing ADOT's overall concept for the I-11 Corridor that emerged from the IWCS.

On May 20, 2016, the Federal Highway Administration issued a Notice in the Federal Register[116] of its "intention to prepare a Tier 1 EIS for the Interstate 11 (I-11) Corridor between Nogales and Wickenburg, AZ (I-11 Corridor)." At the time this SHRP2 grant report was prepared, FHWA and the Arizona Department of Transportation had concluded the scoping phase and have begun developing the alternatives selection report and the Tier 1 EIS document in accordance with the National Environmental Policy Act (NEPA)[117] and other regulatory requirements. As part of the NEPA process, ADOT and FHWA have begun to engage and involve stakeholder agencies, organizations and members of the community in the study process,[118] and have already held numerous public comment meetings in the study area.

I-11 Corridor in Arizona: Geographic and Planning Considerations

When considering the overall width and breadth of the proposed Arizona I-11 corridor as designated in the MAP-21 and FAST Acts, the potential corridor alternatives are composed of privately held, federal and state trust land. Tribal lands exist in the I-11 Tier 1 EIS study area but, according to ADOT, at this time no corridor alignments will be studied on Tribal sovereign lands unless it is explicitly requested to do so by the Tribal Governments.

Within the I-11 corridor considered in the risk register there are six counties (Santa Cruz, Pima, Pinal, Maricopa, Yavapai, and Mohave); eleven cities and towns (Buckeye, Casa Grande, Eloy, Gila Bend, Goodyear,

[113] Source: Maricopa Association of Governments
[114] ADOT- I-11 & Intermountain West Corridor Study
[115] Public Law 112-557
[116] 81 FR 32007
[117] Public Law 91-190
[118] ADOT-Interstate 11 Corridor Tier 1 Environmental Impact Statement, Nogales to Wickenburg

Kingman, Maricopa, Nogales, Surprise, Tucson, and Wickenburg) and five COGs/MPOs with planning areas in the vicinity (Central Arizona Association of Governments, Maricopa Association of Governments, Pima Association of Governments, SouthEastern Arizona Governments Organization, and Western Arizona Council of Governments). Additionally, there are many other stakeholders and planning entities in this area such as the Bureau of Land Management, the U.S. Forest Service, the National Park Service, the Bureau of Reclamation, the U.S. Fish and Wildlife Service, Native American Tribes, and State Trusts.

In addition, the border ports of entry in Arizona, including Nogales, are seeing increased northbound traffic, with a more than two percent increase in truck traffic and four percent increase in passenger vehicles crossing the ports of entry in 2015.[119] In March 2016, Arizona and Mexico entered into an agreement to further develop the trade corridor through Nogales, which should further enhance the significance of the port of entry.[120]

I-11 Potential Opportunities

The following risk register represents an example proof of concept for the I-11 corridor concepts that were identified during the IWCS process which are approximately 450 miles long and up to 25 miles wide in Arizona—the land (ownership, topography, land coverage, future land use), hydrological, environmental, infrastructure, and economic considerations. A high-level tool providing an overview and qualitative measure of the risks was conducted to assess certain considerations that may prove to be useful at this stage of planning. The risk register analyzes past planning efforts and applied a two-mile planning buffer for the illustrative corridor analysis. It should be noted that this does not in any way reflect the final alignment. All information shown in the risk register is to support a proof of concept. After the current Tier 1 EIS process is completed, a more "standard" risk register to assist with construction may be performed.

[119] https://www.azdot.gov/media/News/news-release/2016/05/24/cross-border-traffic-on-the-rise-between-arizona-and-mexico
[120] https://www.azdot.gov/media/News/news-release/2016/03/03/arizona-mexico-sign-agreement-to-further-develop-binational-trade-corridor

Risk Register

Subject	Category	Subcategory	Risk Analysis
Land			
Land ownership	Federal	Bureau of Land Management (BLM)	Roughly 25% of land in corridor is owned by BLM; will need coordination with BLM on right-of-way acquisition. May have restrictions on potential access points and connections.
		National Forest	Less than 1% of land in corridor is designated national forest; will need coordination on right-of-way (ROW) acquisition. May have restrictions on location of freeway and access points or avoid the property altogether.
		National Monument	Less than 1% of land in corridor is designated national monument; highly unlikely ROW will be acquired. May have restrictions on location of freeway and access points or avoid the property altogether.
		National Park	Roughly 2% of land in corridor is designated national park; highly unlikely ROW will be acquired. May have restrictions on location of freeway and access points or avoid the park property altogether.
		Other Protected	Less than 1% of land in corridor is federally protected; will need coordination on ROW acquisition. May have restrictions on location of freeway and access points.
		Military	Less than 1% of land in corridor is military highly unlikely ROW will be acquired. May have restrictions on location of freeway and access points.
	Native American		Roughly 2% of land in corridor is a part of a Native American reservation, which may force either unique locational concessions on freeway placement or on the final ROW locations to avoid reservation land altogether.
	State	State Trust	Roughly 25% of land in corridor is owned by the Arizona State Land Department (ASLD); will need coordination with ASLD on ROW acquisition. May have restrictions on location of freeway and access points based on potential sale of land in the future.
		State Park	Less than 1% of land in corridor is part of a state park; will need coordination on ROW acquisition. May have restrictions on location of freeway and access points to avoid park structures and trails, or avoid the park property altogether.
	Municipal and County	Park	Less than 1% of land in corridor is part of a municipal or county park; will need coordination on ROW acquisition. May have restrictions on location of freeway and access points to avoid park structures and trails, or avoid the park property altogether.
	Private	Railroad	Several railroad lines are in the vicinity of the illustrative corridor, which would require coordination with ROW owners, and will require the freeway to include overpasses or underpasses across railroad ROW.
	Schools		Several educational institutions are located within the vicinity of the illustrative corridor. Sound attenuation and other mitigation effects may need to be added to the final design for schools in close proximity to the freeway.
Topography	0-15% Slope		Over 90% of land in corridor slopes at 15% or less; while desirable from an engineering design perspective, it creates potential drainage and associated challenges.
	15% - 20% Slope		Roughly 3% of land in corridor slopes at between 15% and 20%, requiring some engineering to achieve desired road design.
	20%+ Slope		Over 5% of land in corridor slopes at more than 20%, requiring extensive engineering to achieve desired road design.

Risk Register (continued)

Subject	Category	Subcategory	Risk Analysis
Land (continued)			
Land Cover	Developed	All	Less than 10% of the land in the corridor is developed, potentially requiring redevelopment plans.
	Forest	All	Less than 1% of the land in the corridor is forest, requiring additional environmental mitigation measures.
	Barren/Scrub/ Grassland		Over 80% of the land in the corridor is barren/scrub/grassland, potentially requiring minimal plans for terrain alteration.
	Pasture/Crops		Roughly 8% of the land in the corridor is pasture or cropland, requiring coordination with land owners and tenants.
	Water/Wetlands	All	Roughly 1% of the land in the corridor is water or wetlands, requiring plans for potential water crossing, requiring coordination with appropriate agencies or avoidance.
Future Land Use	Open Space/ Undevelopable		Roughly 25% of the land in the corridor is designated as open space or undevelopable on future land use plans, requiring coordination with appropriate agencies.
	Remaining Uses	All	Roughly 25% of the land in the corridor has uses that are compatible with transportation infrastructure, requiring coordination with property owners.
Hydro			
Water	Lakes/Rivers/ Streams		Less than 1% of the land in the corridor is lakes, rivers, or streams, requiring coordination with appropriate agencies.
Environmental			
ACEC	Areas of Critical Environmental Concern (ACEC)		Roughly 1% of the land in the corridor is designated ACEC, requiring coordination with BLM and other appropriate agencies to avoid or mitigate impacts.
Critical Habitat	Critical Habitat		Roughly 2% of the land in the corridor is designated ACEC, requiring coordination with the appropriate agencies to avoid or mitigate impacts.
Superfund Sites	Superfund Sites		There is one identified designated Superfund site near the periphery of the illustrative corridor that could require coordination with the Environmental Protection Agency (EPA) and other environmental agencies.
National & State Parks	National & State Parks	All	Roughly 3% of land in corridor is designated national park; highly unlikely ROW will be acquired. May have restrictions on location of freeway and access points.
Herd Management	Herd Management		Roughly 8% of land in the corridor is used for herd management, requiring coordination with ranchers and overseeing bodies to ensure adequate accommodations for future herd management activities.
Cultural	Archaeological		Archaeological surveys will need to be conducted along the proposed route to ensure that no significant historical sites will be disturbed.

Risk Register (continued)

Subject	Category	Subcategory	Risk Analysis
Infrastructure			
Electricity	Electrical lines		The corridor is crossed by a number of power lines (dependent on final design), requiring coordination with electrical utilities to ensure safe crossing of utility easements.
Education Institutions			Several educational institutions are within the vicinity of the illustrative corridor (dependent on final design); could require corridor alignment considerations and mitigation efforts to minimize effect on students and employees.
Economic			
Public Policy	State	Overall Tax Base	Quantitative: The desire is for a broad based tax code and competitive rates. Rates need to be sufficient to generate enough revenue but competitive enough to encourage additional business investment.
	State	Select Tax Credits/ Exemptions	Quantitative: Tax credits and exemptions can provide a means of incentivizing certain areas of base sector development. Excessive use can disrupt the maintenance of an efficient and fair system.
	State	Infrastructure Investment	Quantitative: Physical and intellectual infrastructure investment provides businesses with required inputs and benefits the local population. Economic conditions could be problematic depending on the strength of the economy.
Fiscal Policy	State and Local	Budgeting	Quantitative: Both state and local entities need to balance a budget each year in recognition of tradeoffs between taxing and spending.
	State and Local	Business Cycle	Quantitative: A lack of recognition of the risks of downturns in the business cycle and resulting revenue shortfalls will cause fiscal distress and will negatively impact all states and communities, regardless of past efforts.
Economic Development Policy	State	Organization(s)	Qualitative: The existence of a leading state economic development entity that coordinates both programs and interaction with other groups can be efficient in certain circumstances. Alternative solutions are a state entity that has a more narrowly defined role, and aggressive and efficient supporting entities that have expertise in unique areas and take a leading role as opportunities arise.
	State and Local	Regulatory Policy	Qualitative: Excessive regulations could impact economic growth and tax revenues that would be needed for infrastructure development.
Economic Conditions	State and Local	Employment Base/ Diversification	Quantitative: The health and diversity of the current employment base is the best predictor of current and future employment opportunities that could arise from enhanced transportation infrastructure investment. Diversification of the base allows for a more resilient local business cycle and healthy fiscal conditions. Local regions that have a strong base in transportation-related industries will have a more direct benefit from enhanced infrastructure investment. However, all areas can benefit with proper planning.
	State and Local	Employment Growth Potential	Quantitative: Recent growth, especially if in higher value-added industries, results in higher incomes, more tax revenue, and better fiscal conditions. At the local level this increases the likelihood of a community maintaining adequate infrastructure. Recent growth is also a predictor of future growth, or at a minimum is a major input into forecasts. Politics and economic development policies also significantly impact growth opportunities.
	State and Local	Population Base	Quantitative: Larger communities, when combined with an economic base that is stable or growing, tend to be less cyclical under normal business cycle swings.

Risk Register (continued)

Subject	Category	Subcategory	Risk Analysis
Economic (continued)			
Geographical Location/ Economic	State	Proximity to International Markets	Quantitative: Physical location within the U.S. will partly dictate the extent international trade opportunities will develop under the right conditions.
	State	Proximity to U.S. Markets	Quantitative: Physical location within the U.S. will partly dictate the extent domestic trade opportunities will develop under the right conditions.
	State	Connectivity to International Markets	Quantitative: The extent the state and local economic regions are physically linked with international markets will influence economic opportunities.
	Local	Proximity to Interstate	Quantitative: More remote locations tend to have a less diverse economic base and lower incomes with the exception of mining-dependent communities and specialized tourism destinations. More proximate linkages with trade routes increases trade-related business opportunities as well as other base sector businesses that require the efficient distribution of products.
	Local	Connectivity to Interstate	Quantitative: The ability of a local community to physically link local roadways to enhanced state and regional infrastructure enhancements. Deteriorating local road conditions will put some areas at a disadvantage if alternatives are viable.

11. Stakeholder Engagement and Communications Best Practices and Lessons Learned

In a project of this scope, many best practices and lessons have been learned that MAG believes should be memorialized so that others may be informed from MAG's experience.

Some of the lessons learned from this project include:

- The importance of bringing the right agencies together early on and build or continue a trusted relationship to best leverage efforts.
- Recognize that agencies are incredibly busy and resource-constrained; therefore, communication must be efficient. Much of the communication was conducted through emails, webinars and phone calls to be most mindful of people's time.
- Agency staff appreciated the forum established through this SHRP2 project and the opportunities to share information on their agency efforts as well as an opportunity to share information on challenges for potential solutions from other agencies.
- If a staff member changes positions, follow up with the new staffer to ensure continuity and that the agency still participated in the project.
- Recognize that some staff members will immediately appreciate the value of such a project and others may need more information on the tangible benefits of active participation.
- The value of a forum for GIS professionals, given the speed by which technology changes, enabled greater leveraging to better support agency in-house decisions.
- Project fact sheets and project updates are helpful to keep the team informed.
- Designating a project webpage capturing all relevant project updates was an efficient way to document the progress of this project and communicate efforts. Additionally, if a team member was unable to participate in a particular webinar, all webinars were recorded and made available.
- It is important to provide SHRP2 project updates at other relevant forums to be most efficient of time and resources.
- A robust cooperation among various affected entities was necessary to make this project a reality.

The considerable effort to engage and involve stakeholder entities in this project is readily demonstrable. That engagement and involvement has been largely responsible for the success of the project in meeting its stated goals and preparing the region for further coordination and cooperation among the stakeholders, the public, and the policymakers as they go forward with transportation projects both large scale and local.

12. IMW Recommendations and Findings

As the IMW continues to grow in population and economic activity, the need to maintain, expand, and introduce new transportation options and travel modes will continue to increase. With the lack of transportation funds locally and nationally, planning agencies will need to focus their investment on specific transportation corridors to accommodate growth, keeping their local economies competitive and helping move the nation's freight. Projects like the designated Interstate 11 could be potentially extended through the IMW creating an additional vital north-south transportation corridor.

The communities of the IMW face several issues when planning transportation corridors, including significant maintenance costs, environmental impacts, rights-of-way, safety, lack of resources, congestion/bottlenecks, weather, and national security issues. It is important for IMW planning agencies to continue to meet regularly after this project concludes and build on understanding and awareness of transportation needs and major transportation projects in the IMW. This will enable the region to better organize around the needed transportation infrastructure and continue to share data and best practices. Ultimately, IMW transportation corridors could be strategically prioritized to better connect major population and economic centers and support the national freight network.

If the appropriate funding becomes available and IMW partners approve specific corridors, the project team recommends that a transportation corridor profile study be conducted to document current and future planning efforts, including, but not limited to, conducting a freight corridor profile study illustrating the demand and opportunities of the corridor. Once the IMW is organized and priorities set, the coalition could pursue a variety of planning grants, including FASTLANE and TIGER grants, as a collective whole.

To improve the likelihood of success for these future collective efforts, consideration should be given to formalizing the relationship among the stakeholder agencies. A model for this would be the I-95 Corridor Coalition, which began as an informal group of transportation professionals and over the last two decades evolved to become a more formal, active force serving its members and the traveling public in addressing multimodal transportation systems on the East Coast.

When planning future or expanding existing transportation corridors, transportation agencies at local, regional, and state levels should engage with the railroad industry to identify opportunities to create multimodal corridors and encourage economic development. With limited resources and rights-of-way, planning agencies should look for ways to maximize rights-of-way by looking at innovative alternatives to include all modes of transportation (rail, road, bicycle, and pedestrian). In addition to evaluating the options for a multimodal corridor, planners should use rights-of-way as a "multiuse" corridor by evaluating inclusion of utilities such as gas, water, electric transmission lines, and telecommunications.

Other Specific Recommendations to Come from the Project:

- Additional resources are necessary to more fully bring in authoritative data layers to assist with project delivery in a IMW GIS common operating platform.
- There are many various datasets in the IMW that can be linked better.
- There are significant benefits to this project's geospatial coordination including:
  - Improved ability to geospatially visualize projects and identify their broader impacts.
  - Provided assessment of available IMW data as well as data gaps.
- Continue efforts that began with this SHRP2 project.
- Hold a meeting of transportation IMW transportation planning staff to continue to refine the IMW transportation vision to better understand regionally significant transportation projects needed in the near and longer planning horizon. Have a follow-up meeting with IMW policy directors to present a refined IMW transportation vision for their further review and consideration. Determine what projects might be supported regionally and identify additional recommendations on how best to move transportation and goods in the IMW region.
- Continue dialogue between planning and economic development agencies.
- Continue to improve infrastructure at ports of entry.
- Continue to increase U.S. Customs and Border Protection staffing at ports of entry.
- Continue to reduce commercial vehicle wait times and wait times for rail inspections and processing.
- Create an IMW freight coalition to develop an international trade plan for the IMW states and an outreach plan for Mexico and Canada.
- Open trade offices/initiate trade missions.
- Initiate border infrastructure planning.
- Seek dedicated and sustainable sources of funding.

13. SHRP2 Project Conclusion

The Maricopa Association of Governments applied for this SHRP2 grant to expand its existing cooperative efforts with the Western Regional Alliance and various agencies throughout the IMW region in order to advance the deployment of solutions that expedite transportation project delivery across the region by working with key stakeholders through:

- Outreach to identify needs and potential gaps related to transportation and data resources.
- Developing common operating vision/platform for GIS to enhance data sharing.
- Aligning expectations for a long-range vision to move people and goods in the region.
- Developing a report with risk register.

This report is the culmination of that effort. In addition to fulfilling the final requirement of a report with a risk register, it details the numerous activities of MAG and the other associations of governments, departments of transportation, metropolitan planning organizations, and other transportation planning entities in the Intermountain West. As the report shows, there was considerable outreach to, and participation by, virtually every significant transportation planning stakeholder in the nine-state region.

That outreach has led to a sharing of information on a scale previously unknown in the region. This has helped define resources already available, identify existing resource gaps, and determine potential methods of filling those gaps in an efficient manner for the stakeholder agencies and their constituent taxpayers.

Although each stakeholder does not have the same needs, resources, or policies and processes, the significance of aligning resources to the extent feasible has been realized through this project. Further cooperation and coordination among the stakeholders will lead to enhanced data sharing and streamlined development of projects going forward. The interdependency among stakeholders across the region has made it evident that aligning expectations regionwide will be of benefit to all.

The ongoing Environmental Impact Statement process with respect to the Interstate 11 corridor prevented the development of a detailed risk register for that project and only allowed one to be done at a higher level of abstraction. However, the risk register proof of concept for the corridor has been an educational process for all the stakeholders as they plan for large-scale transportation projects in the region. Lessons learned in that process will assist transportation planners in the future.

The next steps for MAG and its IMW partners are to work to more fully align their resources to better share data, including existing and projected needs for transportation projects going forward. There is a need for additional financial resources to complete that task, but the positive economic returns for such an effort suggest that investment in those resources will result in numerous added benefits to the region. This includes improved economic development directly related to transportation improvements. It also encompasses indirect benefits by acting as a conduit for transport through the region, not only within the U.S. but also in imports and exports to Canada and Mexico. This transport includes commerce coming from and going to the west coast ports. The IMW is uniquely positioned to reap the benefit of this increased activity if its infrastructure is properly and efficiently built out.

This project has assisted in achieving that important goal.

14. Appendices

Appendix A: Northwest Seaport Alliance Statistics[121]

Top Trade Partners:

1. China/Hong Kong - $33 billion
2. Japan - $16.2 billion
3. Republic of Korea - $6.3 billion
4. Taiwan - $3.8 billion
5. Vietnam - $1.5 billion
6. Thailand - $1.2 billion
7. Canada - $1.1 billion
8. Australia - $1.1 billion
9. Malaysia - $905 million
10. Indonesia - $872 million

Top Imported Goods:

1. Industrial machinery and computers - $10 billion
2. Electrical machinery and electronics - $8.3 billion
3. Vehicles and parts - $7.4 billion
4. Furniture - $2.6 billion
5. Toys, games and sports equipment - $2.5 billion
6. Aircraft, spacecraft and parts - $1.9 billion
7. Plastic and plastic articles - $1.9 billion
8. Articles of iron or steel - $1.8 billion
9. Knit or crocheted apparel - $1.6 billion
10. Footwear - $1.6 billion

Top exported goods:

1. Oil seeds and grains - $3 billion
2. Industrial machinery and computers - $1.7 billion
3. Prepared vegetables, fruits and nuts - $978 million
4. Meat and meat products - $935 million
5. Fish and seafood - $906 million
6. Cereals - $778 million
7. Eggs and dairy products - $743 million
8. Paper and paperboard - $704 million
9. Inorganic chemicals and rare earth metals - $691 million
10. Edible fruits and nuts, citrus fruits and melon peel - $683 million

[121] Source: https://www.nwseaportalliance.com/#/maps/overview

Appendix B: Port of Oakland CA Statistics[122]

Top 10 Trading Partners by Tonnage - Imports
CALENDAR YEAR 2015

COUNTRY	METRIC TONS	% SHARE
China	2,304,625	34.0%
Taiwan	302,321	4.5%
Thailand	297,497	4.4%
Australia	268,966	4.0%
Hong Kong	233,558	3.4%
Italy	225,852	3.3%
India	222,912	3.3%
Vietnam	221,485	3.3%
South Korea	189,989	2.8%
Chile	178,541	2.6%

Top 10 Trading Partners by Tonnage - Exports
CALENDAR YEAR 2015

COUNTRY	METRIC TONS	% SHARE
China	2,566,240	32.4%
Japan	849,702	12.5%
South Korea	836,325	12.3%
Hong Kong	591,249	8.7%
Taiwan	568,961	8.4%
Italy	169,146	2.5%
United Kingdom	145,704	2.1%
Thailand	122,507	1.8%
Belgium	108,512	1.6%
Germany	107,132	1.6%

[122] Source: U.S. Department of Commerce, Bureau of Census

Top 10 Commodities by Tonnage - Imports (Containerized)
Calendar Year 2015

COMMODITY	METRIC TONS	% SHARE
Beverages & Spirits	626,523	9.2%
Miscellaneous	528,557	7.8%
Furniture	477,171	7.0%
Glass & Glassware	403,382	6.0%
Plastics	247,902	3.7%
Electrical Machinery	225,906	3.3%
Wood and Articles of Wood	235,636	3.46%
Preparations of Vegetables	222,470	3.3%
Articles of Iron & Steel	222,406	3.3%
Coffee, Tea & Spices	206,990	3.1%

Top 10 Commodities by Tonnage - Exports (Containerized)
Calendar Year 2015

COMMODITY	METRIC TONS	% SHARE
Wood Pulp	1,453,081	21.4%
Edible Fruits and Nuts	799,296	11.8%
Beverages & Spirits	438,357	6.5%
Meats	369,978	5.5%
Cereals	349,222	5.2%
Oil Seeds & Oleaginous Fruits	301,290	4.4%
Iron & Steel	286,943	4.2%
Wood	281,973	4.2%
Miscellaneous	258,661	3.8%
Preparations of Vegetables	252,521	3.7%

Appendix C: Ports of Long Beach and Los Angeles Statistics[123]

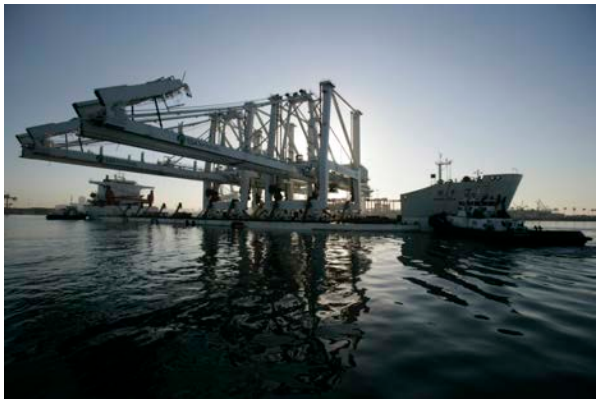
Port of Long Beach

Trading partners

- East Asian trade accounts for more than 90% of the shipments through the port
- Top trading partners by tonnage are; China, South Korea, Japan, Hong Kong, Taiwan, Vietnam, Iraq, Australia, Ecuador and Indonesia.

Top Imports

- Crude oil
- Electronics
- Plastics
- Furniture
- Clothing



Top Exports

- Petroleum coke
- Petroleum bulk
- Chemicals
- Waste paper
- Foods

Port of Los Angeles

Top Exports from Port of Los Angeles, CA
January – April 2016: Total Exports: $10.5 billion

Rank	Commodity	Total YTD
1	Cotton	$373,532,339
2	Motor vehicle parts	$312,792,433
3	Prepared foods, beverages	$202,632,906
4	Frozen beef from cows	$201,820,159
5	Motor vehicles for transporting people	$189,518,318
6	Paper, paperboard scrap	$186,459,309
7	Centrifuges, filters, machines and parts	$182,288,575
8	Almonds, walnuts, pistachios, hazelnuts, etc.	$174,424,320
9	Sheets of drawn, blown glass	$144,613,577
10	Scrap iron, steel	$130,912,587

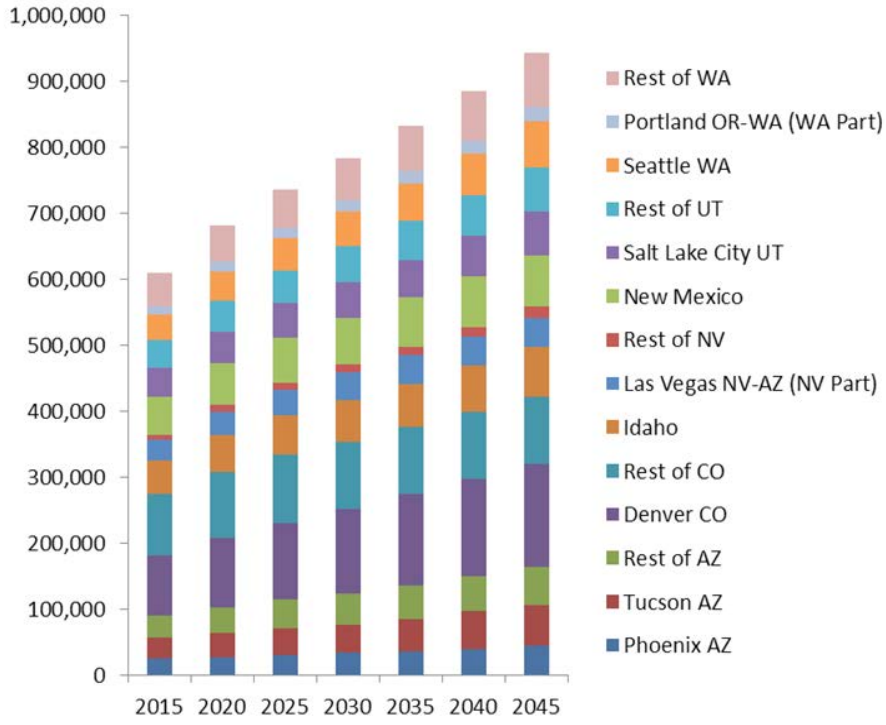
[123] Sources: http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/ ; World City Trade Numbers

Top Imports from Port of Los Angeles, CA
January – April 2016: Total Imports: $73.47 billion

Rank	Commodity	Total YTD
1	Motor vehicle parts	$3,131,778,941
2	Motor vehicles for transporting people	$3,130,852,651
3	Computers	$2,120,353,139
4	Printers, all types, parts	$2,008,131,687
5	TVs, computer monitors	$1,691,439,587
6	Furniture, parts	$1,559,534,854
7	Landline, cellular phone equipment	$1,506,096,026
8	Seats, excluding barber, dental	$1,320,746,240
9	Leather shoes	$1,269,084,307
10	Women's or girls' suits, not knit	$1,200,237,971

Appendix D: Intermountain Forecast for Freight-800 Million New Tons by Subregion[124]

Outbound



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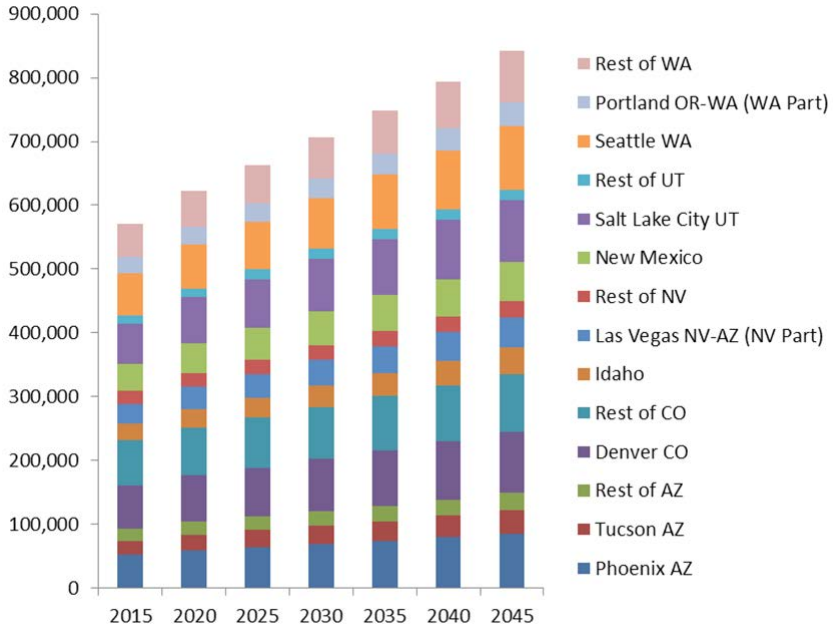
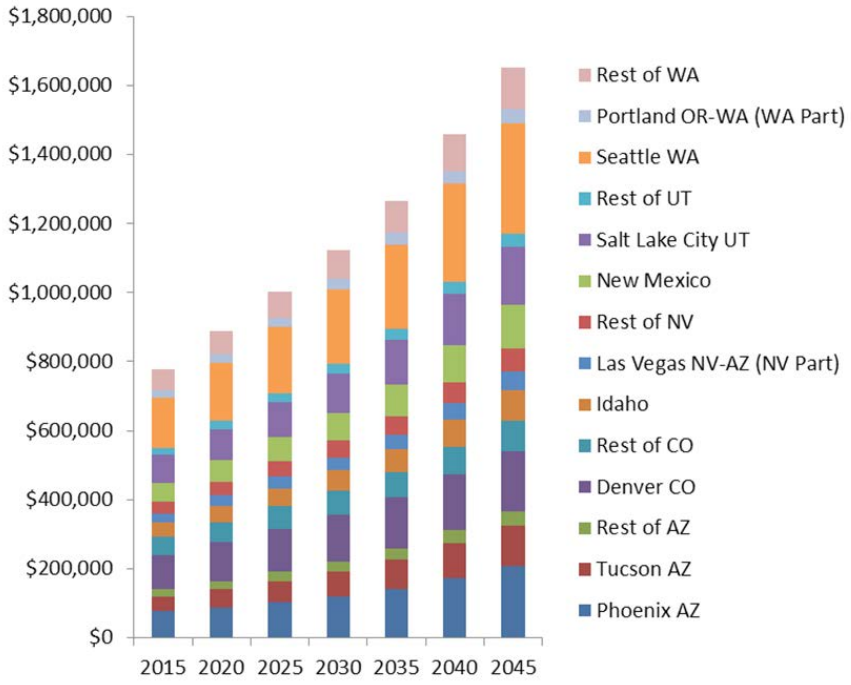


[124] Source: Federal Highway Administration, Freight Analysis Framework (FAF) version 4.1, 2/24/2016

$1.9 Trillion New Value by Sub-Region

Outbound



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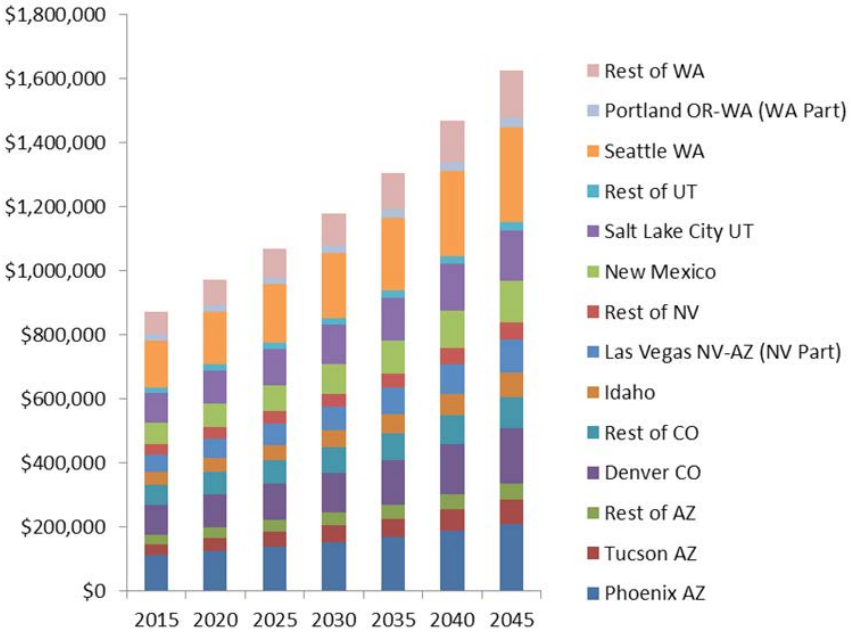


Appendix E: Trade with Canada and Mexico[125]

CANADA

Exports

- Canada was the United States' largest goods export market in 2015.
- U.S. goods exports to Canada in 2015 were $280 billion, down 10% ($32 billion) from 2014 but up 32 percent from 2005. U.S. exports to Canada are up 179 percent from 1993 (pre-NAFTA). U.S. exports to Canada account for 18.6 percent of overall U.S. exports in 2015.
- The top export categories in 2015:
  - Vehicles ($48 billion)
  - Machinery ($43 billion)
  - Electrical machinery ($25 billion)
  - Mineral fuels ($21 billion)
  - Plastics ($13 billion)
- U.S. exports of agricultural products to Canada totaled $24 billion in 2015, our largest agricultural export market. Leading categories include:
  - Prepared food ($1.9 billion)
  - Fresh vegetables ($1.9 billion)
  - Fresh fruit ($1.6 billion)
  - Snack foods ($1.3 billion)
  - Non-alcoholic beverages ($1.2 billion)
- U.S. exports of services to Canada were an estimated $57.3 billion in 2015, 6.6 percent ($4.0 billion) less than 2014, but 74.8 percent greater than 2005 levels. These services exports were up roughly 237 percent from 1993 (pre-NAFTA). Based on 2014, leading services exports from the U.S. to Canada were in the travel, intellectual property (software and audio-visual), and transportation sectors.

Imports

- Canada was the United States' 2nd largest supplier of goods imports in 2015.
- U.S. goods imports from Canada totaled $295 billion in 2015, down 15 percent ($53 billion) from 2014, but up 1.7 percent from 2005. U.S. imports from Canada are up 165 percent from 1993 (pre-NAFTA).
- The top import categories in 2015:
  - Mineral fuels ($70 billion)
  - Vehicles ($55 billion)
  - Machinery ($20 billion)
  - Special other (returns) ($14 billion)
  - Plastics ($11 billion)
- U.S. imports of agricultural products from Canada totaled $22 billion in 2015, our largest supplier of agricultural imports. Leading categories include:
  - Snack foods ($3.7 billion)
  - Red meats ($2.2 billion)
  - Live animals ($1.8 billion)
  - Other vegetable oils ($1.6 billion)
  - Processed fruit & vegetables ($1.4 billion).
- U.S. imports of services from Canada were an estimated $30.2 billion in 2015, 0.5 percent ($139 million) more than 2014, and 33.8 percent greater than 2005 levels. These services imports were up roughly 232 percent from 1993 (pre-NAFTA). Based on 2014, leading services imports from Canada to the U.S. were in the travel, transportation, and telecommunications, computer, and information services sectors.

[125] Source: U.S. Trade Representative

MEXICO

Exports

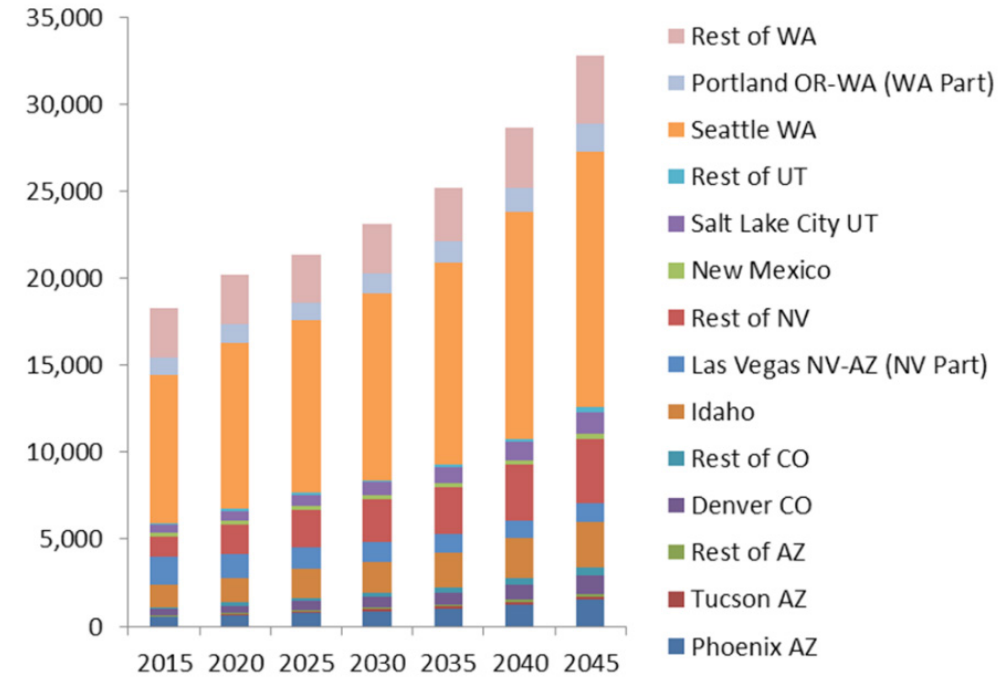
- Mexico was the United States' 2nd largest goods export market in 2015.
- U.S. goods exports to Mexico in 2015 were $236 billion, down 1.6 percent ($3.9 billion) from 2014 but up 97 percent from 2005. U.S. exports to Mexico are up 468 percent from 1993 (pre-NAFTA). U.S. exports to Mexico account for 15.7 percent of overall U.S. exports in 2015.
- The top export categories in 2015
  - Machinery ($42 billion)
  - Electrical machinery ($41 billion)
  - Vehicles ($22 billion)
  - Mineral fuels ($19 billion)
  - Plastics ($17 billion)
- U.S. exports of agricultural products to Mexico totaled $18 billion in 2015, our 3th largest agricultural export market. Leading categories include:
  - Corn ($2.3 billion)
  - Soybeans ($1.4 billion)
  - Dairy products ($1.3 billion)
  - Pork & pork products ($1.3 billion)
  - Beef & beef products ($1.1 billion).
- U.S. exports of services to Mexico were an estimated $30.8 billion in 2015, 2.7 percent ($807 million) more than 2014, and 36.7 percent greater than 2005 levels. These exports were up roughly 196 percent from 1993 (pre-NAFTA). Based on 2014, leading services exports from the U.S. to Mexico were in the travel, transportation, and intellectual property (computer software) sectors.

Imports

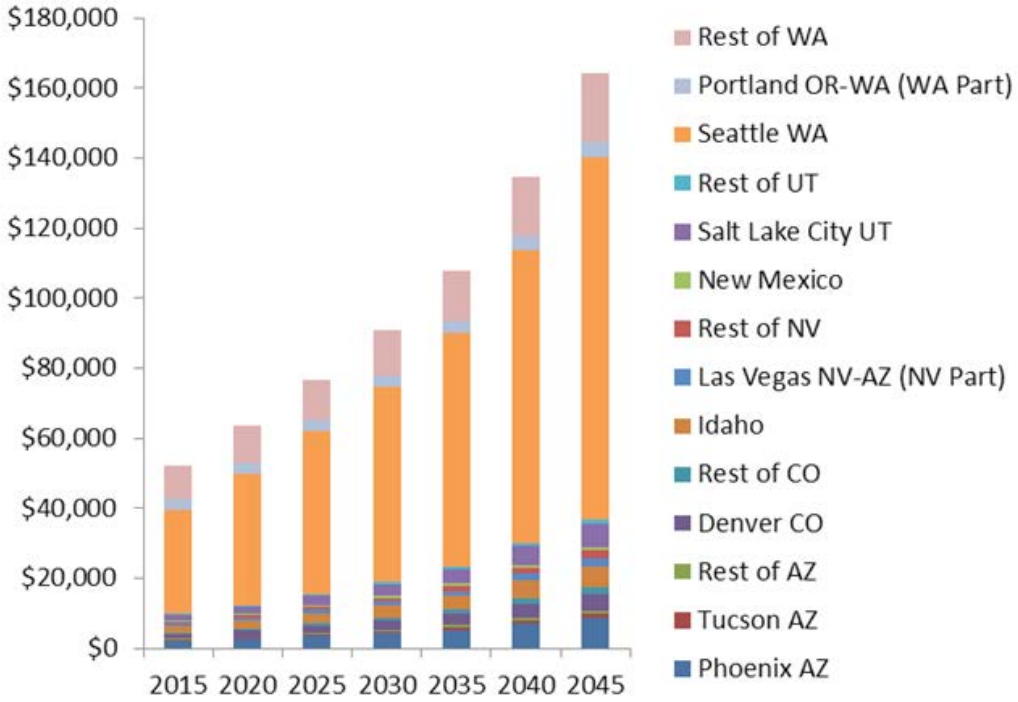
- Mexico was the United States' 3rd largest supplier of goods imports in 2015.
- U.S. goods imports from Mexico totaled $295 billion in 2015, up 0.2 percent ($667 million) from 2014, and up 73 percent from 2005. U.S. imports from Mexico are up 638 percent from 1993 (pre-NAFTA). U.S. imports from Mexico are up 638 percent from 1993 (pre-NAFTA).
- The top import categories in 2015:
  - Vehicles ($74 billion)
  - Electrical machinery ($63 billion)
  - Machinery ($49 billion)
  - Mineral fuels ($14 billion)
  - Optical and medical instruments ($12 billion).
- U.S. imports of agricultural products from Mexico totaled $21 billion in 2015, our 2nd largest supplier of agricultural imports. Leading categories include:
  - Fresh vegetables ($4.8 billion)
  - Other fresh fruit ($4.3 billion)
  - Wine and beer ($2.7 billion)
  - Snack foods ($1.7 billion)
  - Processed fruit & vegetables ($1.4 billion).
- U.S. imports of services from Mexico were an estimated $21.6 billion in 2015, 11.0 percent ($2.1 billion) more than 2014, and 50.0 percent greater than 2005 levels. These imports were up roughly 191 percent from 1993 (pre-NAFTA). Based on 2014, leading services imports from Mexico to the U.S. were in the travel, transportation, and technical and other services sectors.

Appendix F: Forecasts of Freight by IMW Subregion-Trade with Canada and Mexico[126]

Canada-Tonnage

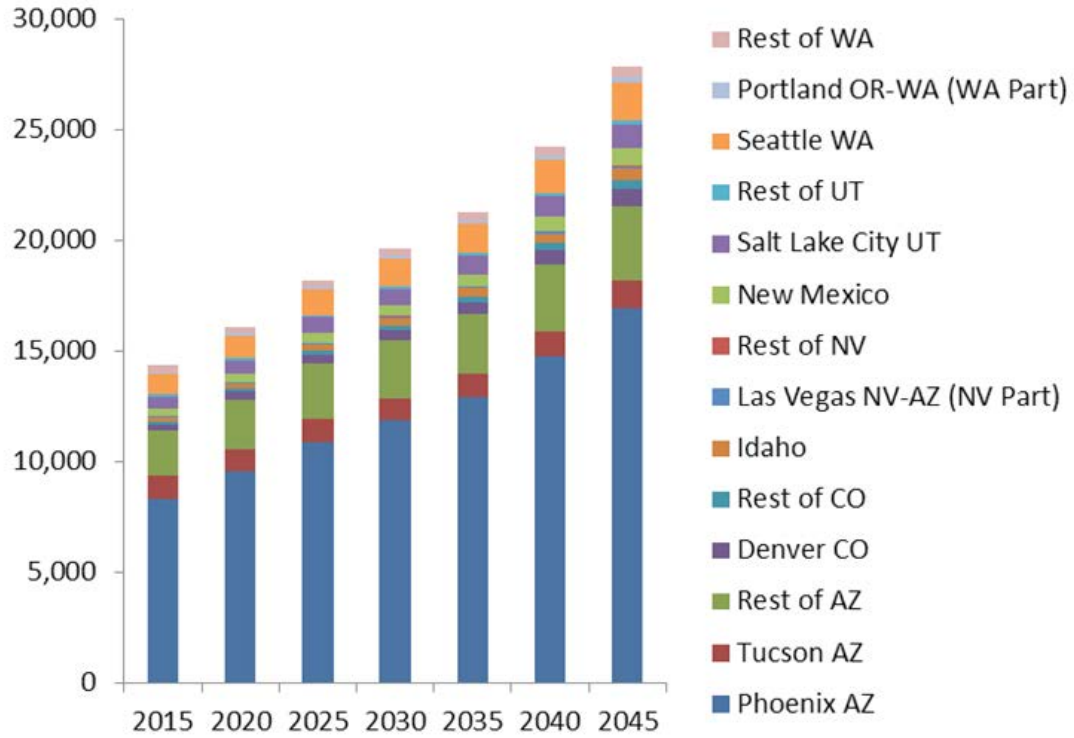


Canada-Value

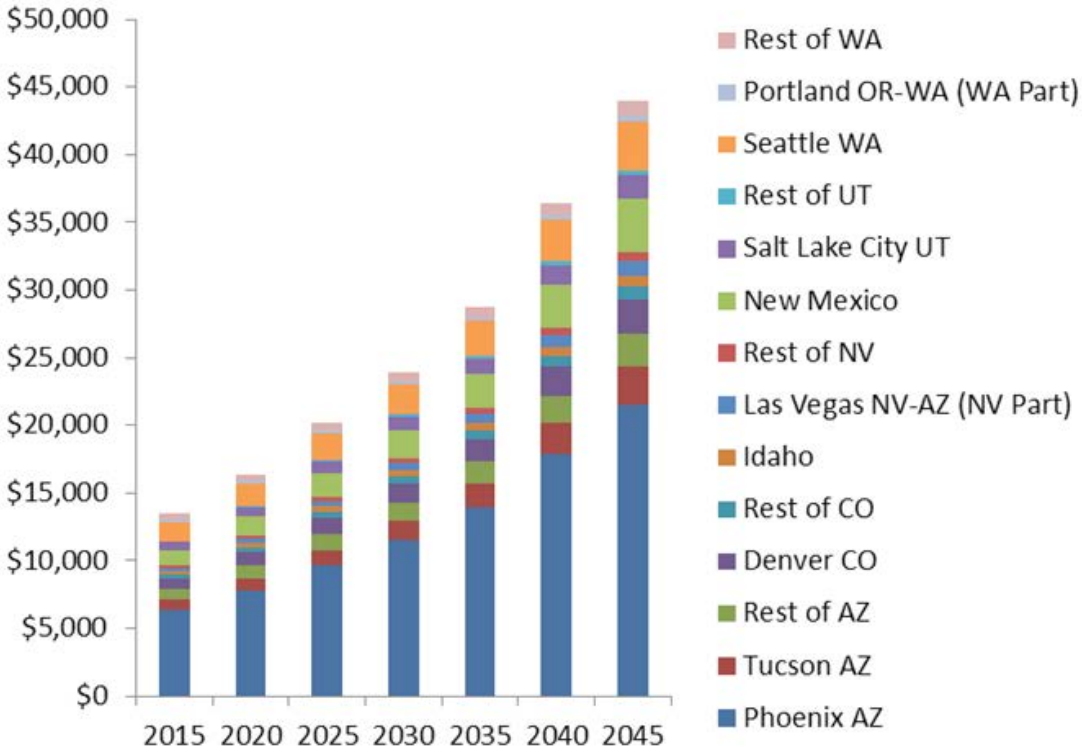


[126] Source: Federal Highway Administration, Freight Analysis Framework (FAF) version 4.1, 2/24/2016

Mexico-Tonnage

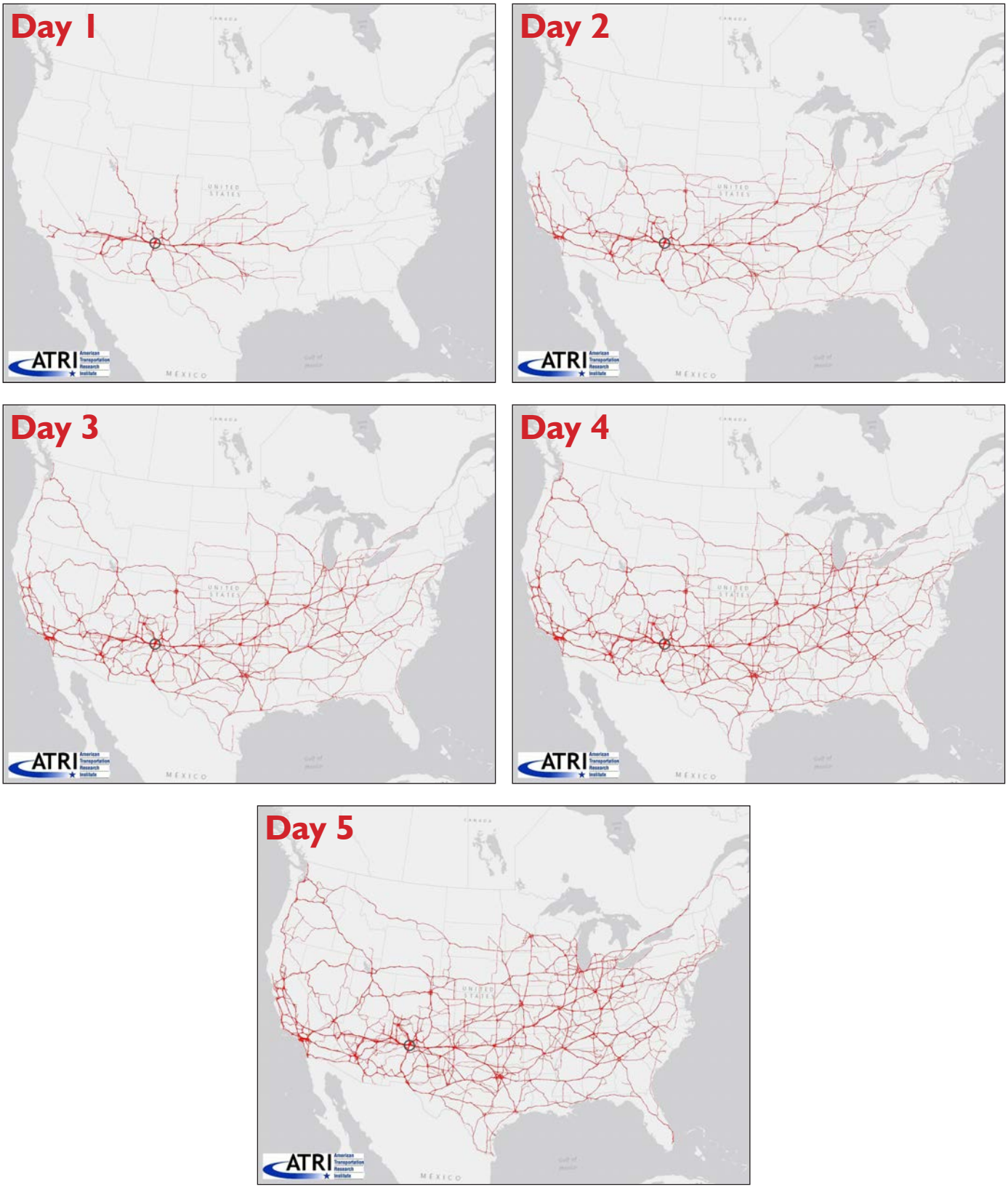


Mexico-Value



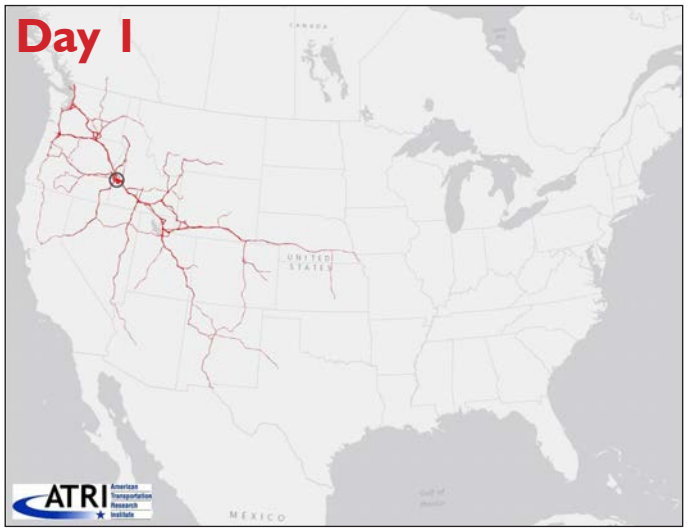
Appendix G: 5-Day Truck Flows[127]

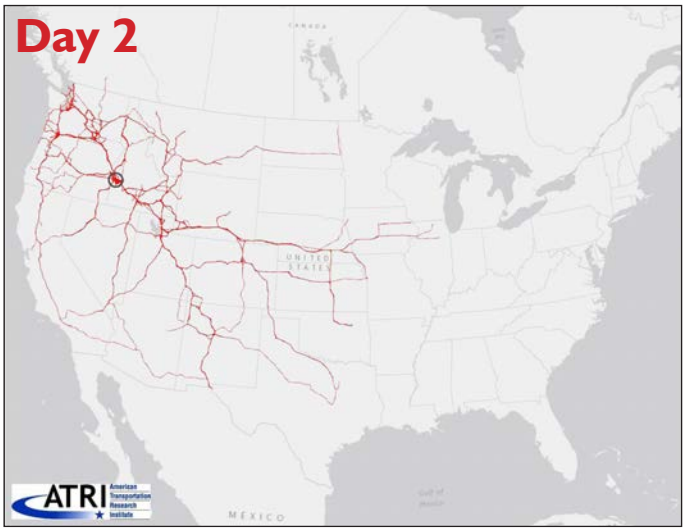
Albuquerque, NM 5-Day Truck Flows

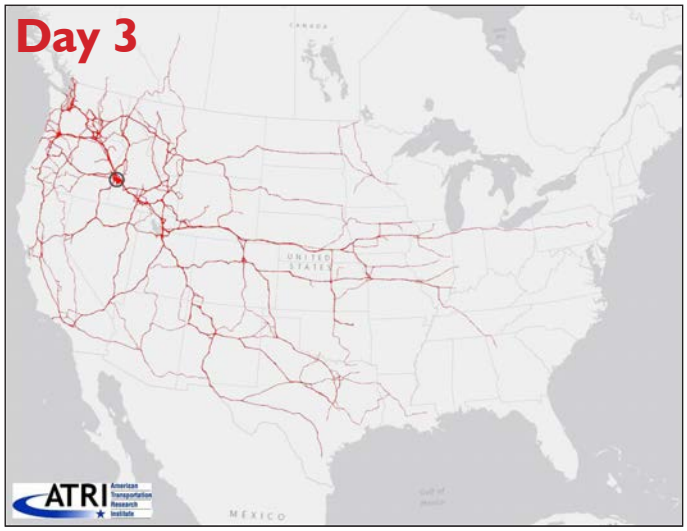


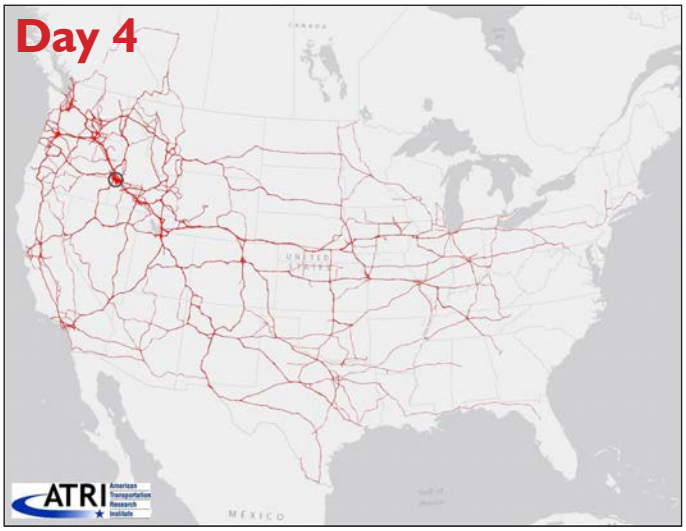
[127] Source: American Transportation Research Institute

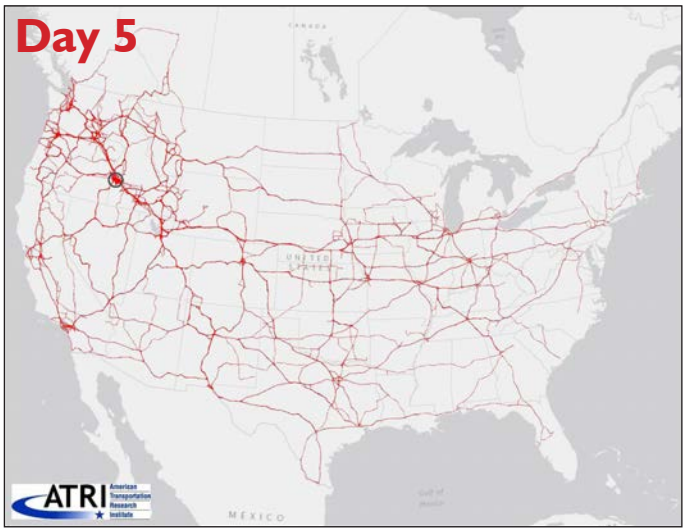
Boise, ID 5-Day Truck Flows



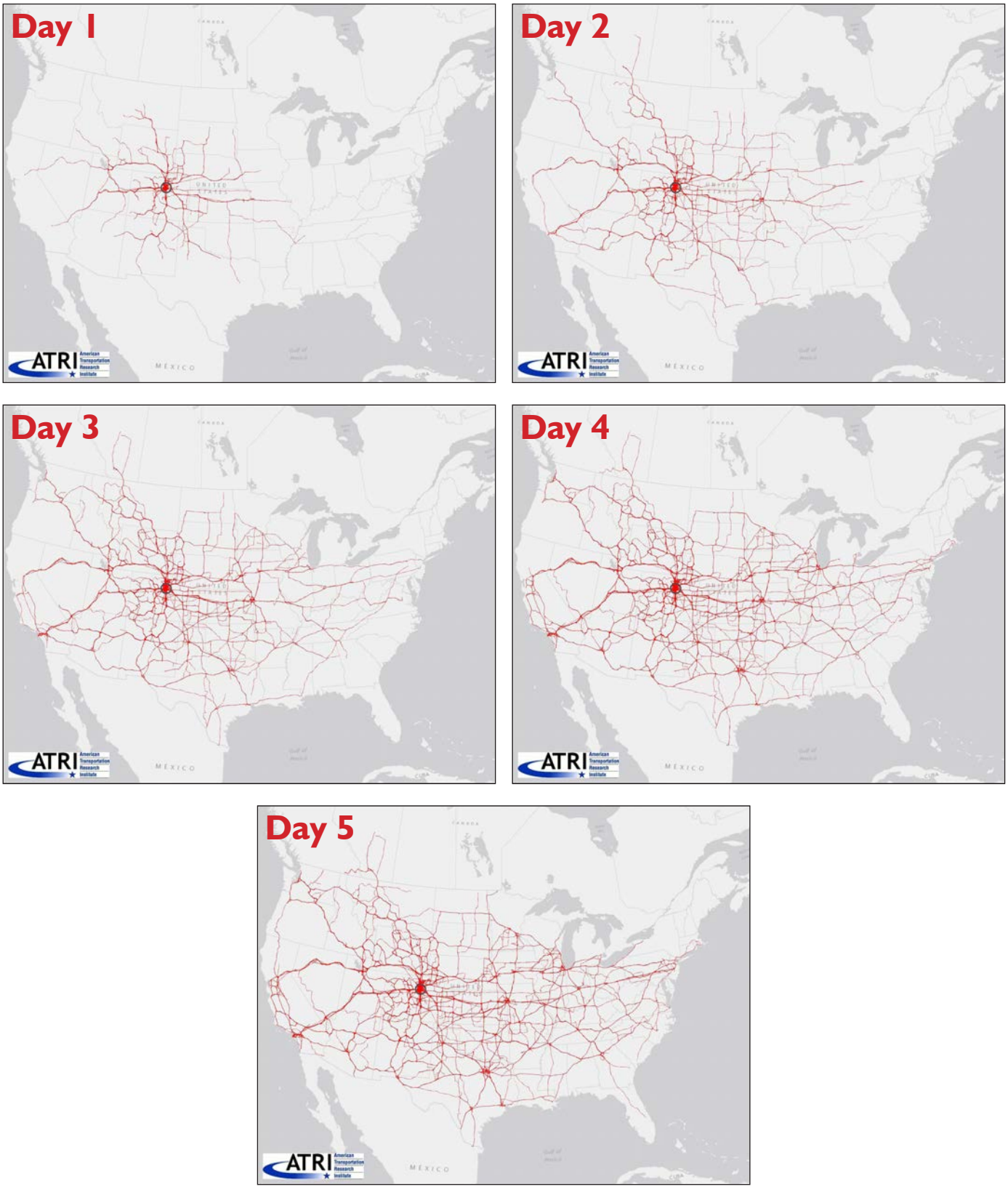




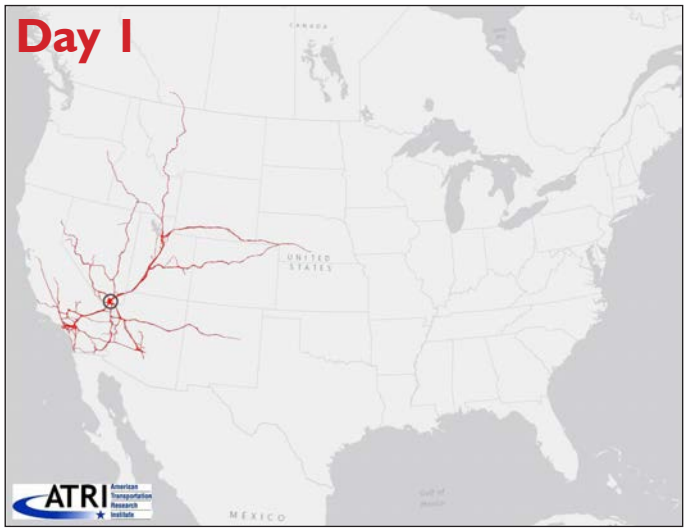


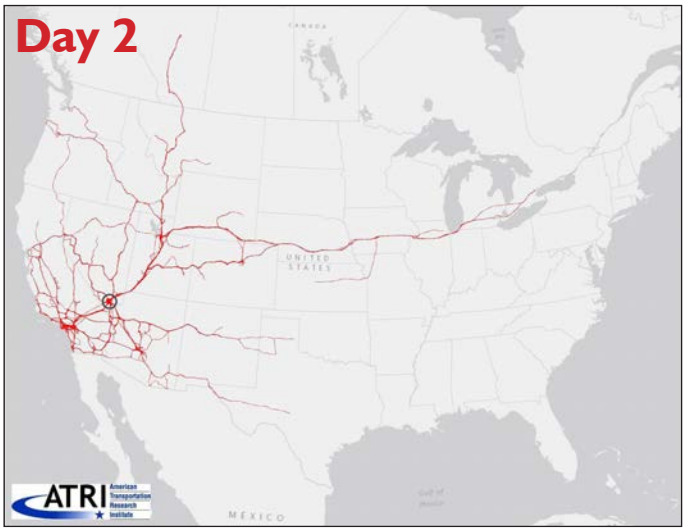


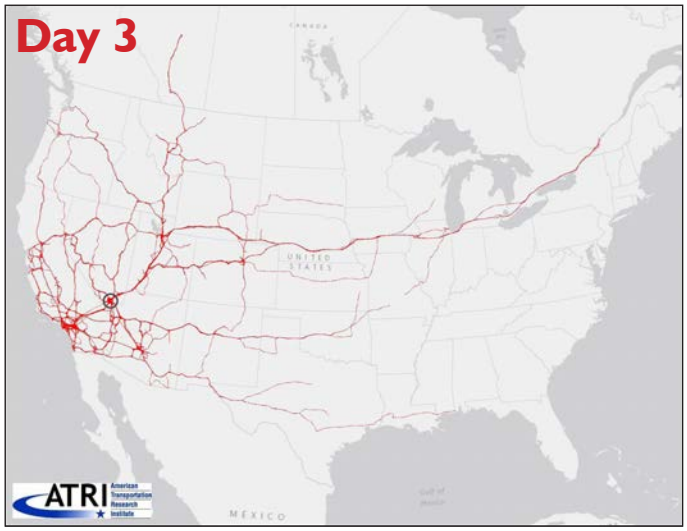
Denver, CO 5-Day Truck Flows

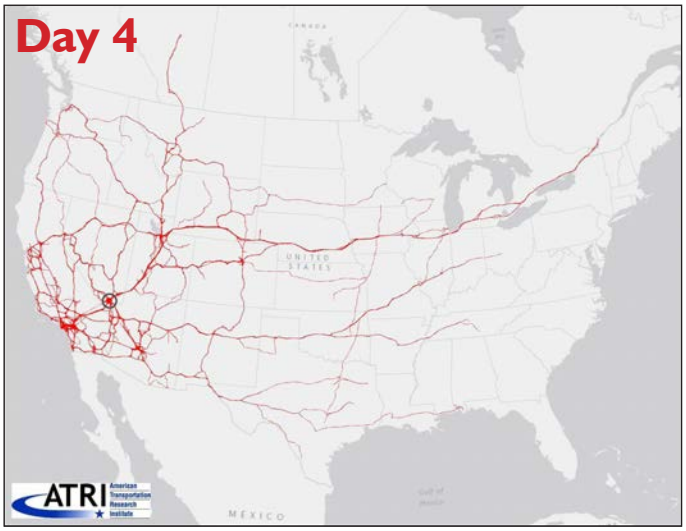


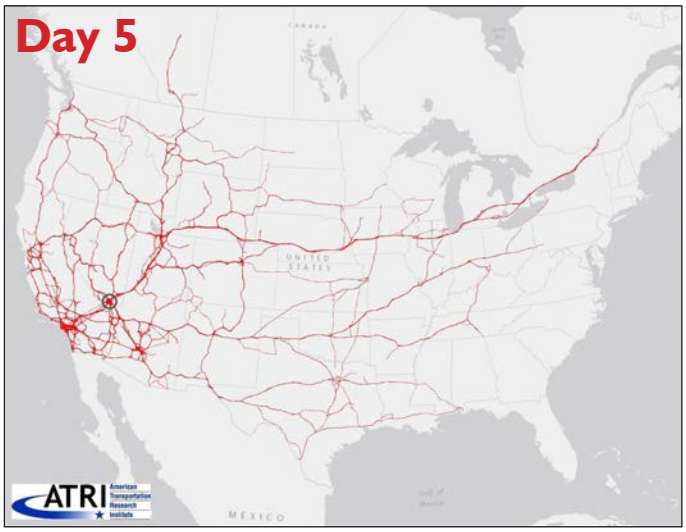
Las Vegas, NV 5-Day Truck Flows



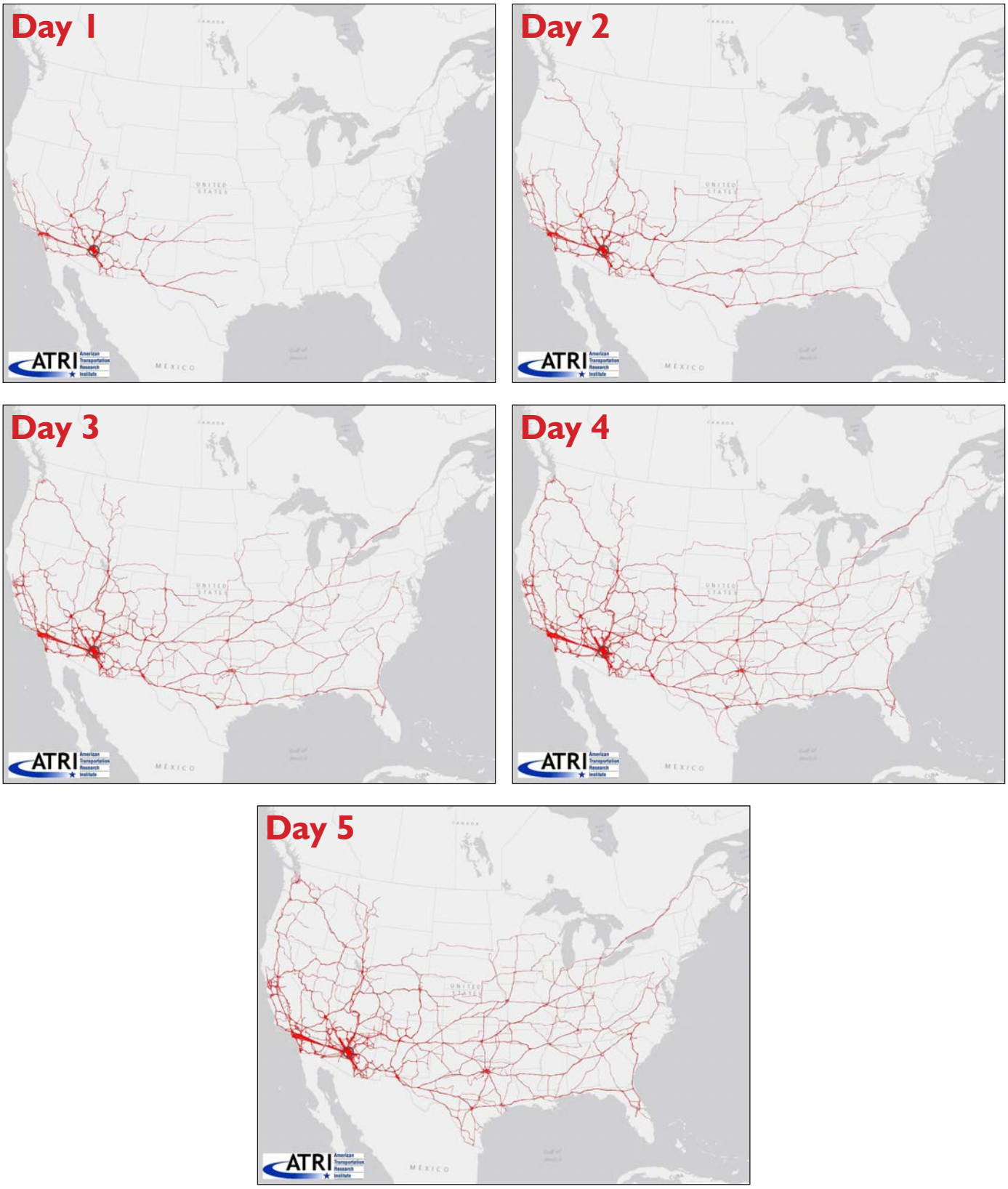




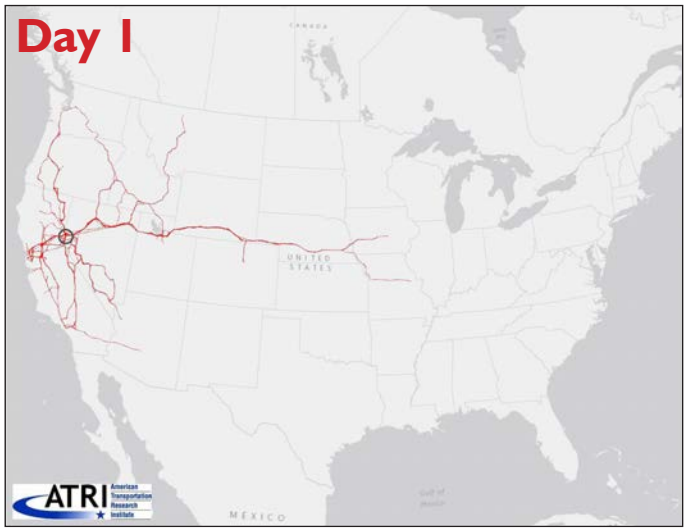


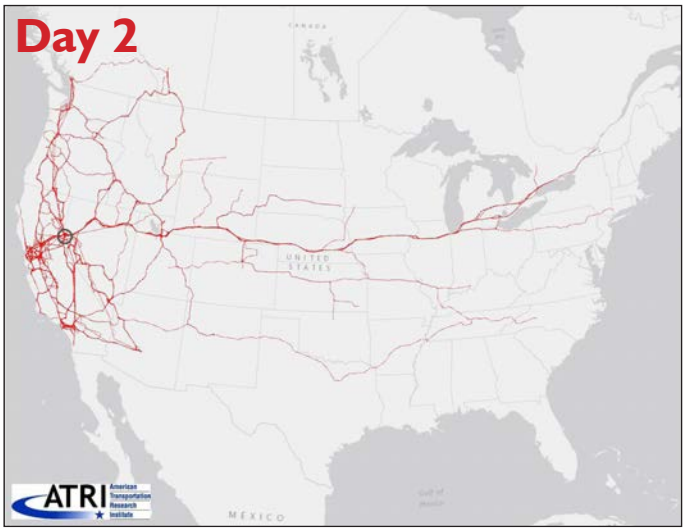


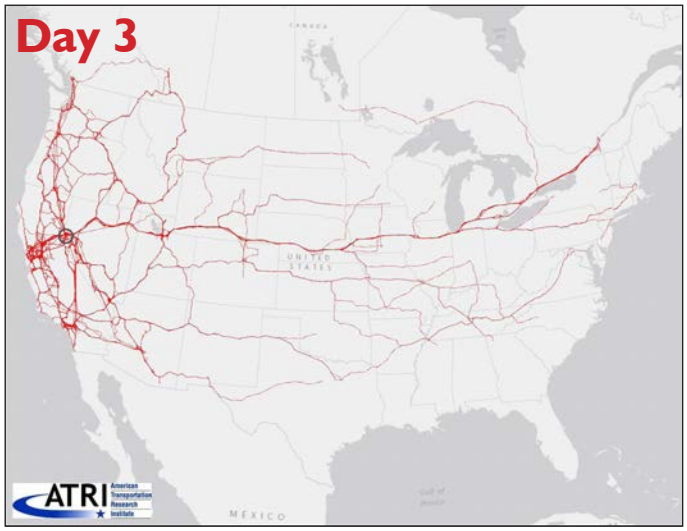
Phoenix, AZ 5-Day Truck Flows

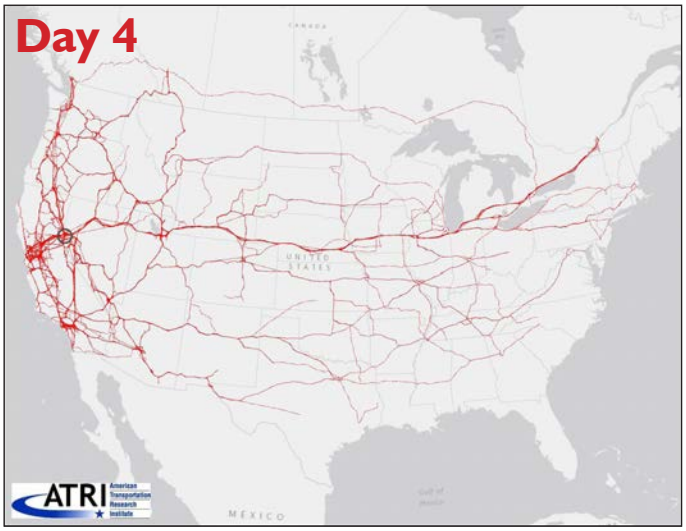


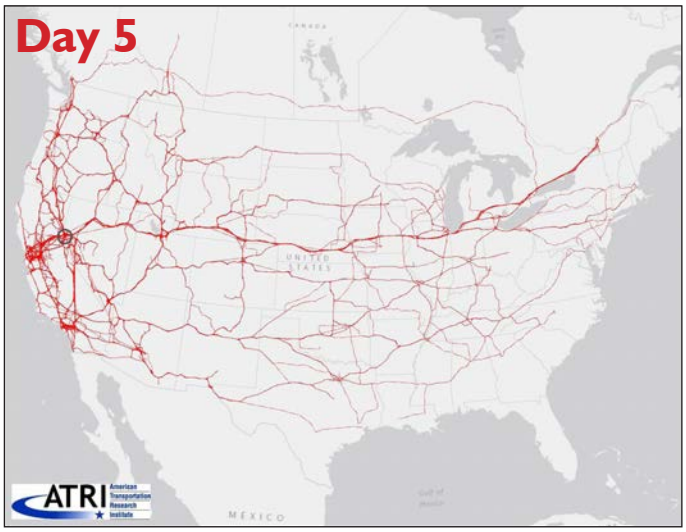
Reno, NV 5-Day Truck Flows



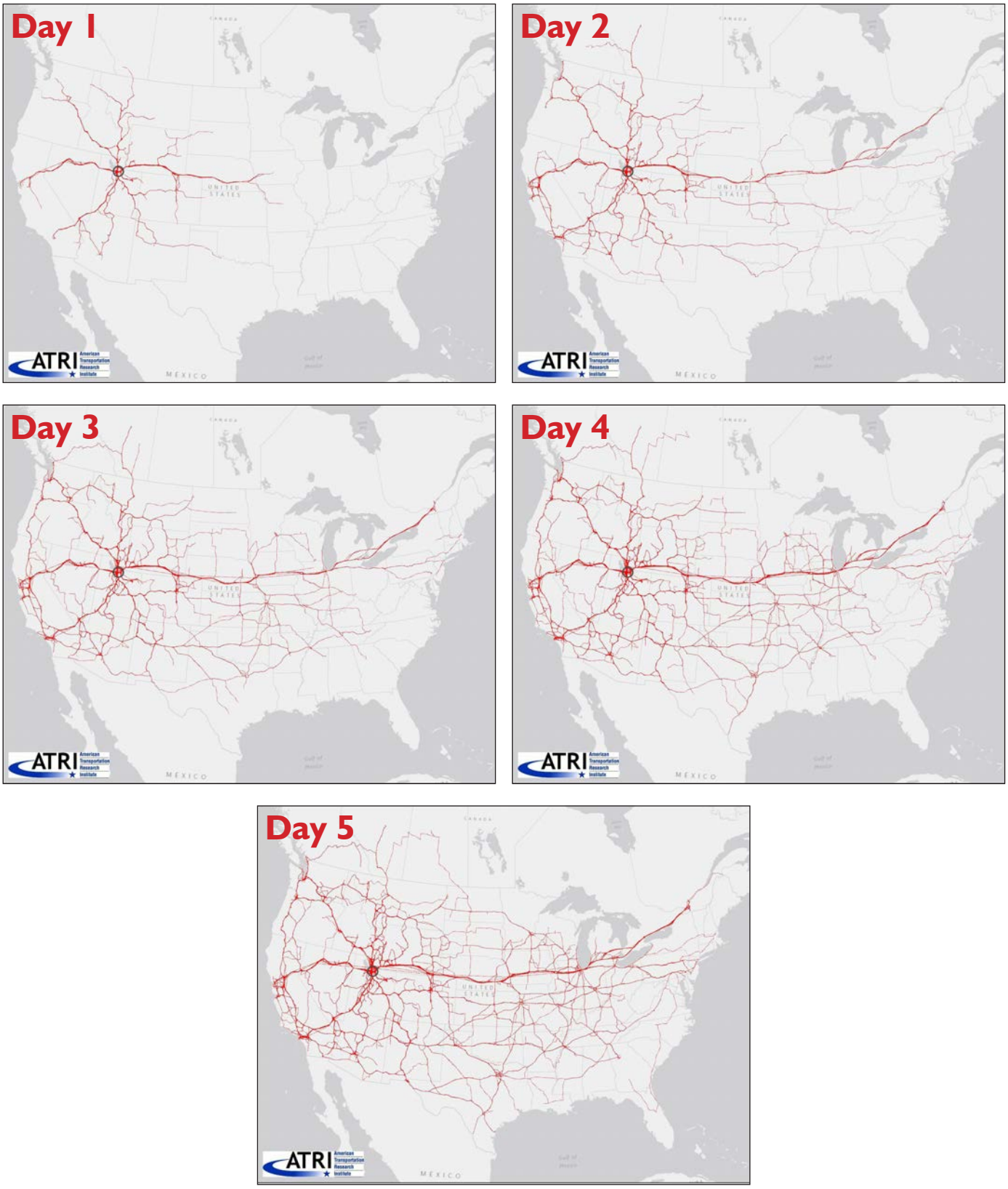




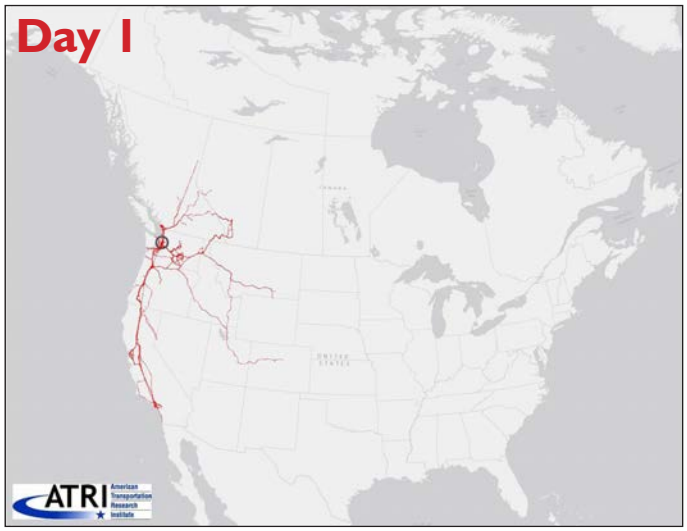


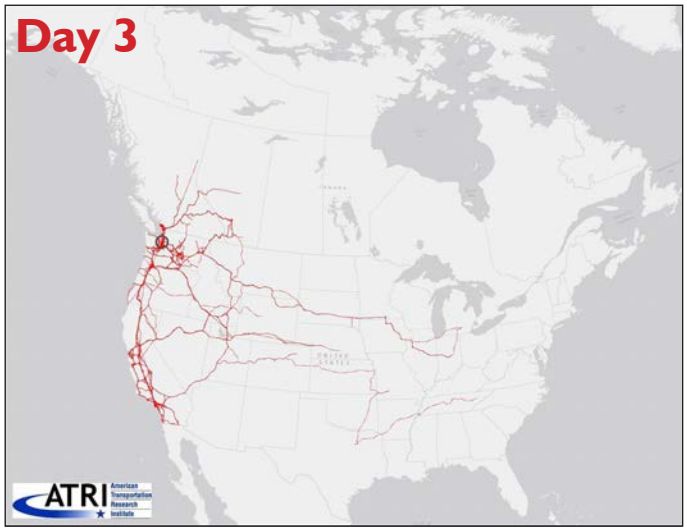


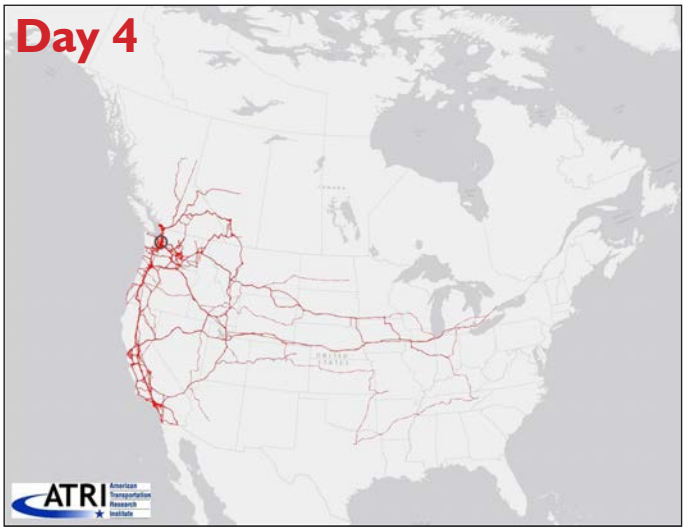
Salt Lake City, UT 5-Day Truck Flows

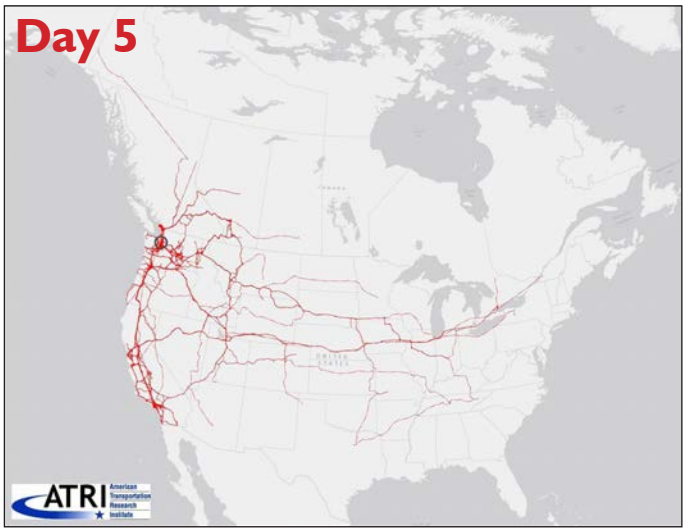


Seattle, WA 5-Day Truck Flows

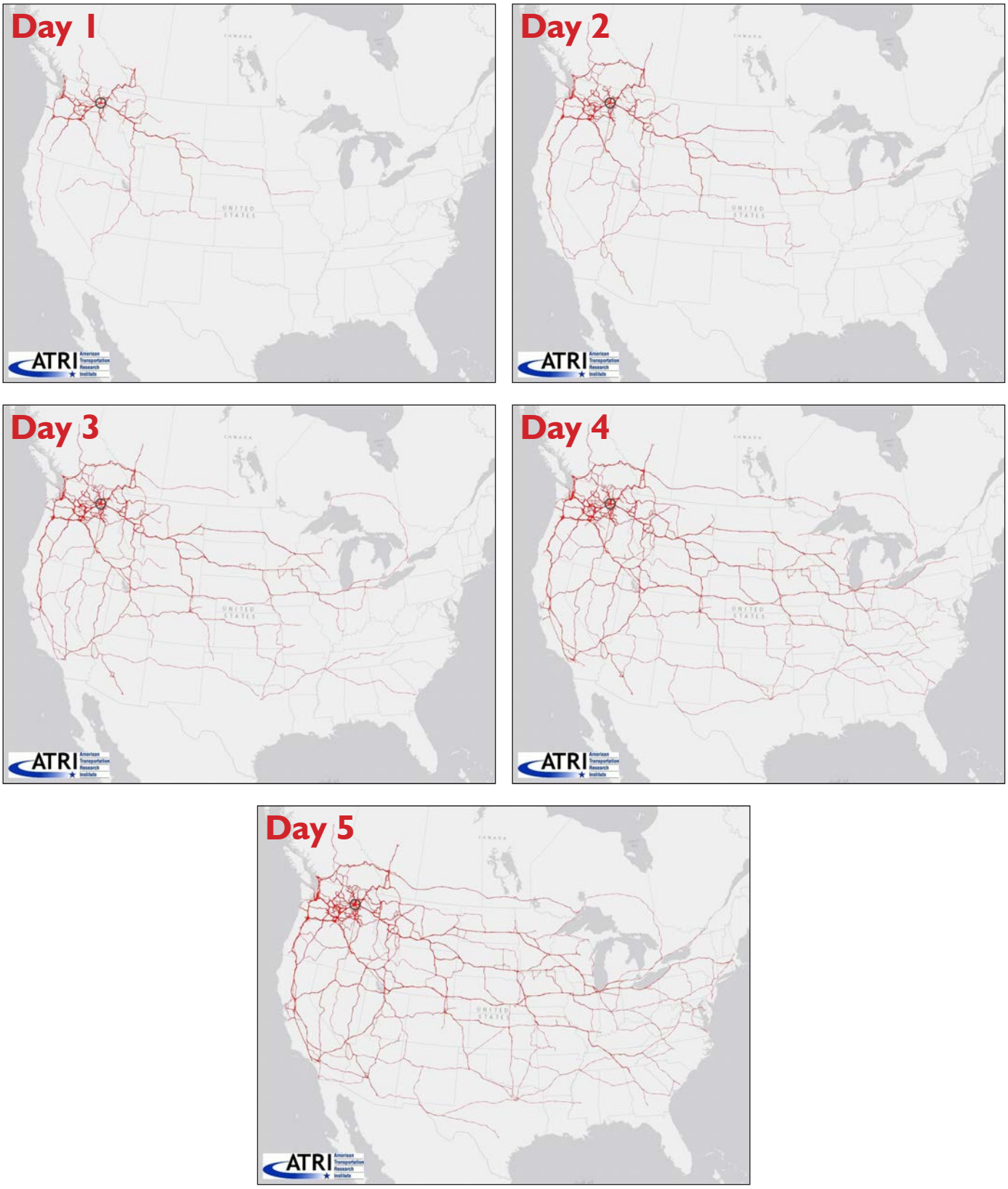




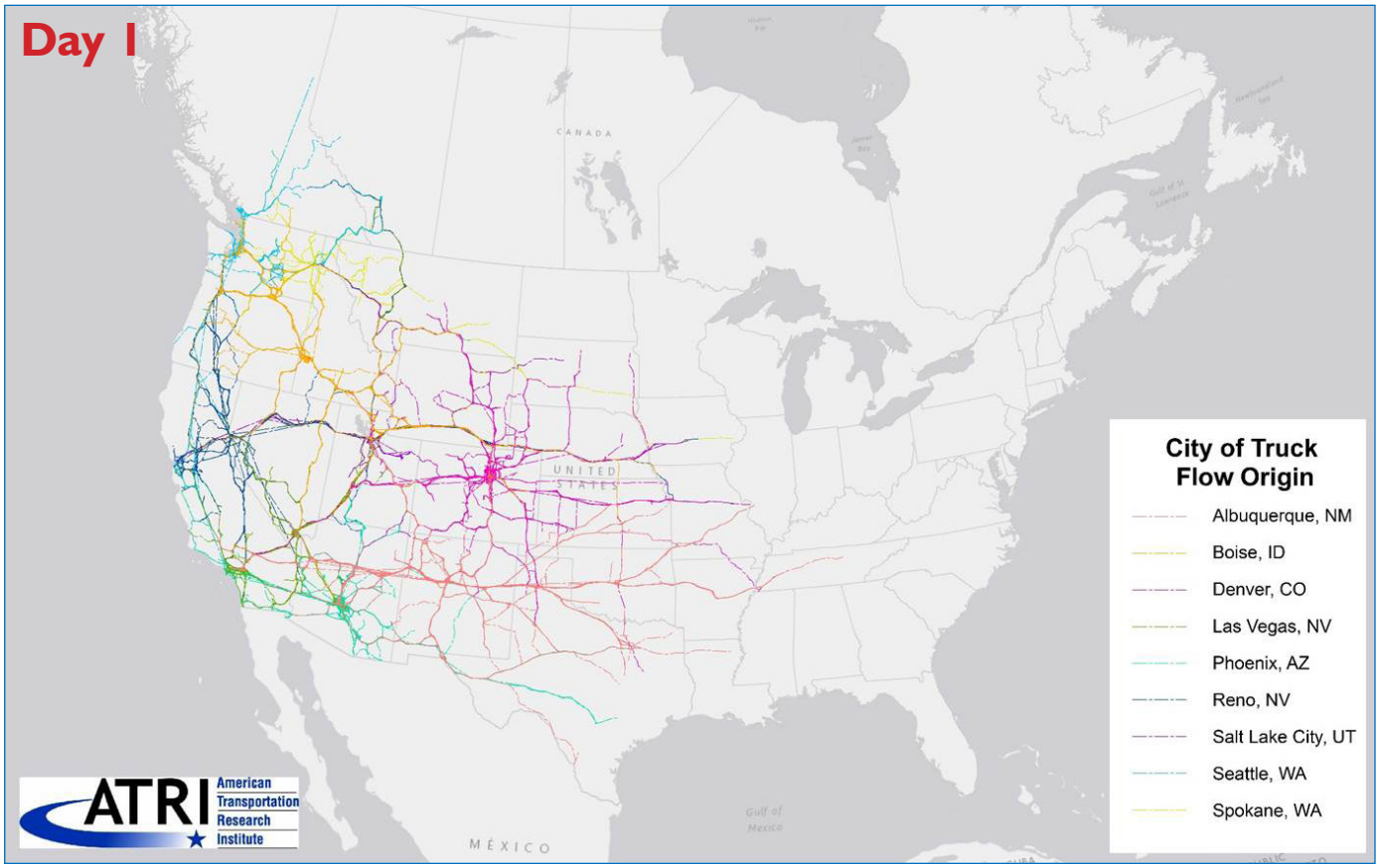


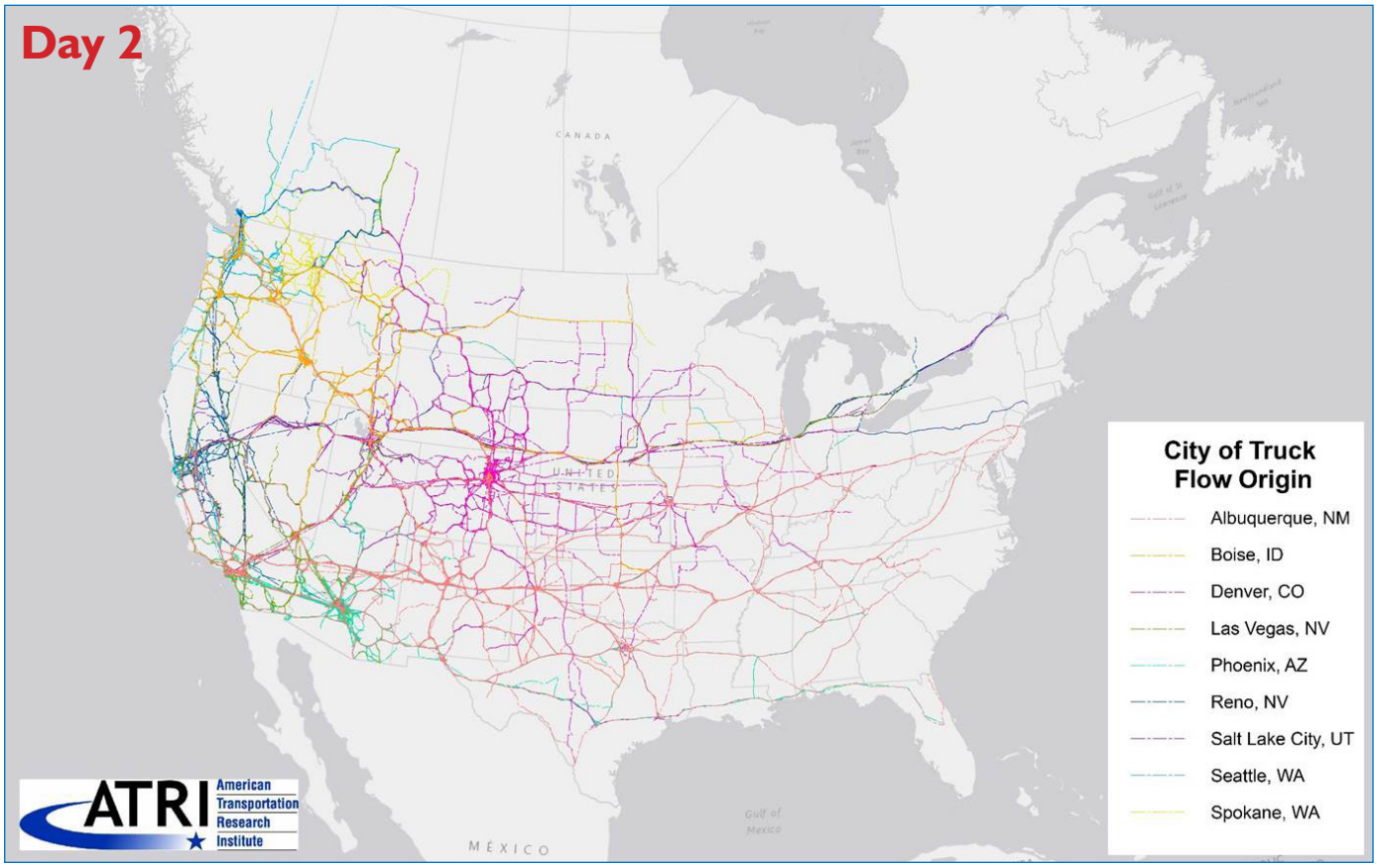


Spokane, WA 5-Day Truck Flows

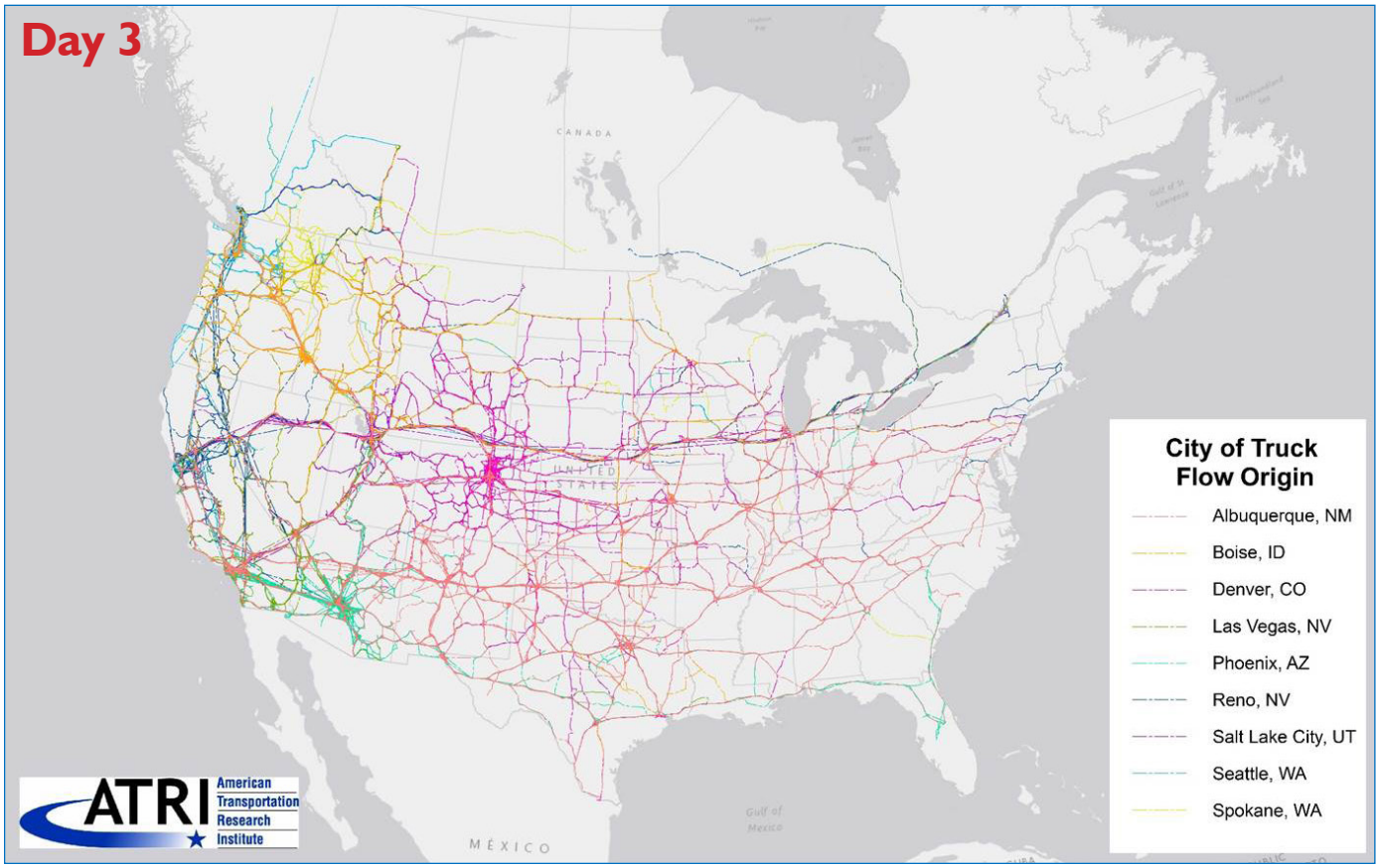


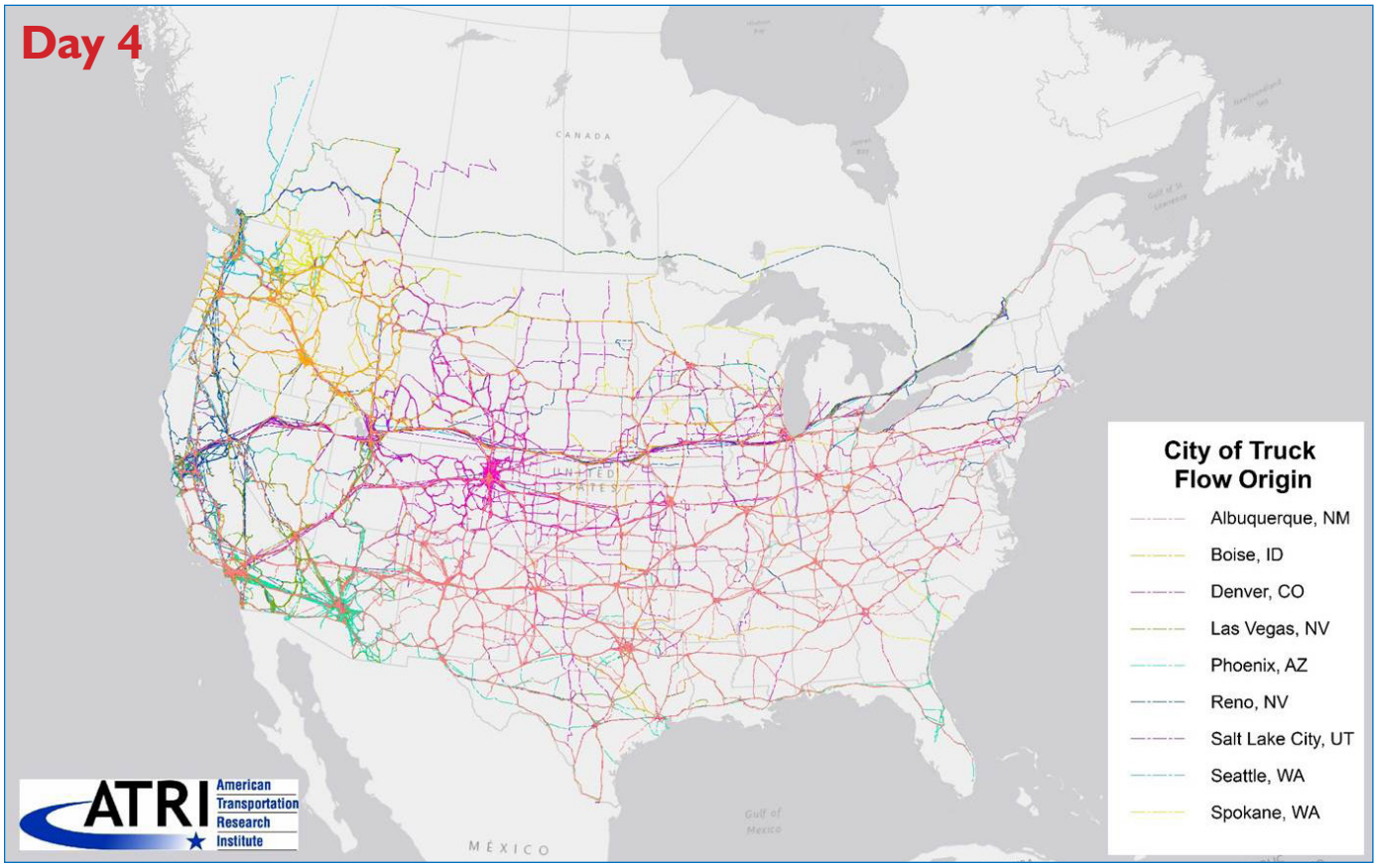
All Cities: 5-Day Truck Flows



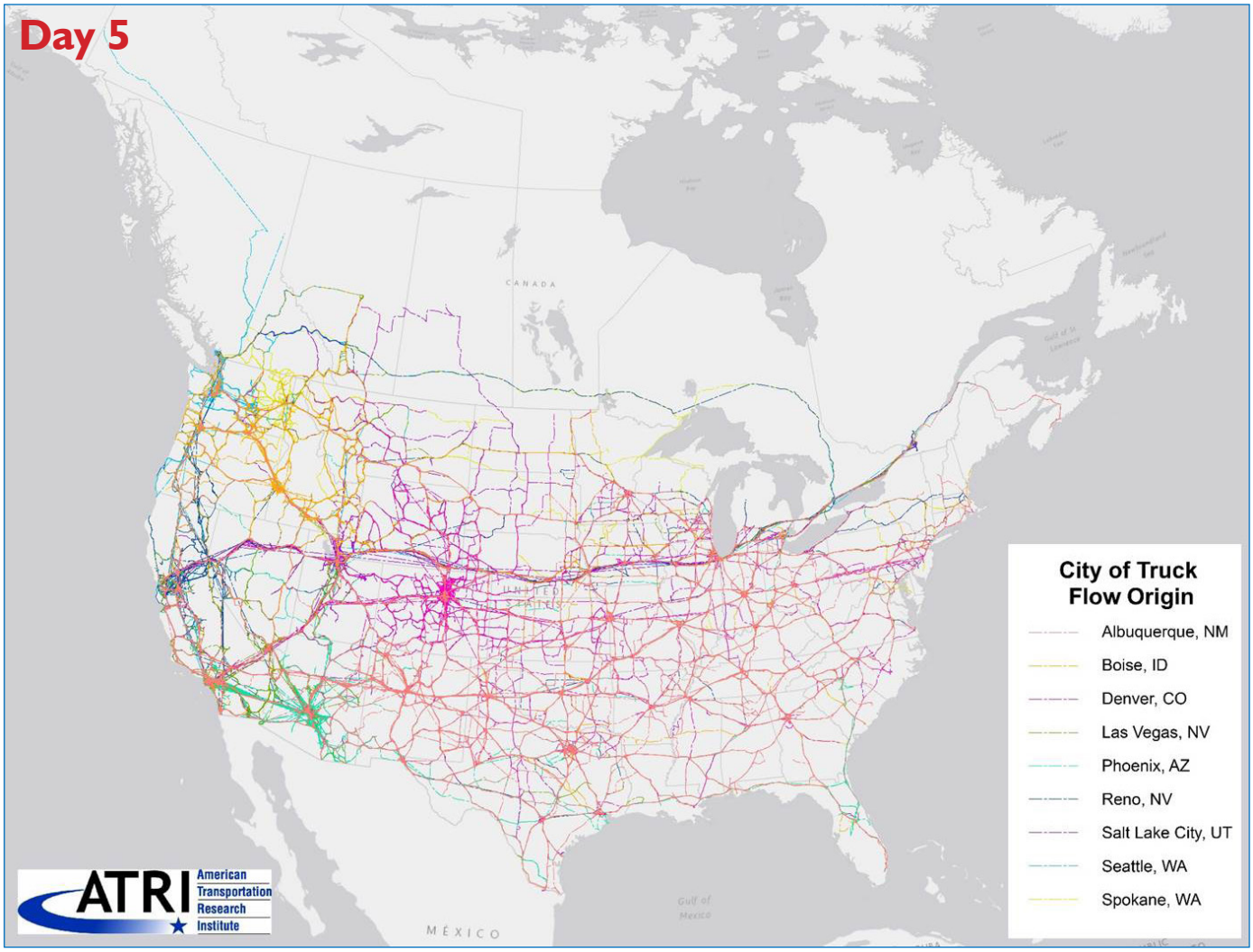


All Cities: 5-Day Truck Flows (continued)





All Cities: 5-Day Truck Flows (continued)



Appendix H: General Aviation Airports in the Intermountain West[128]

State	Public Use	Public	NPIAS Airports			New ASSET Categories				Not Classified
		in SASP	Total	Primary	Non-primary	National	Regional	Local	Basic	
Arizona	79	78	58	9	49	2	10	18	14	5
Colorado	76	65	49	11	38	2	2	27	7	
Idaho	119	73	37	6	31		1	16	8	6
Montana	120	114	70	7	63		1	25	33	4
Nevada	49	44	30	5	25	1	2	6	15	1
New Mexico	62	50	50	4	46		9	11	13	13
Utah	46	44	36	2	34	1	7	8	12	6
Washington	137	131	64	11	53	1	10	21	11	10
Wyoming	41	33	33	8	25		1	11	12	1
Total	**729**	**632**	**427**	**63**	**364**	**7**	**43**	**143**	**125**	**46**

[128] Federal Aviation Administration, http://www.faa.gov/airports/planning_capacity/ga_study/media/2012AssetReportAppB.xlsx

Appendix I: Threatened and Endangered Species in the Intermountain West (by State)[129]

Status[130]	Species/Listing Name
Arizona: 65 listings	
	Animals
E	Ambersnail, Kanab (Oxyloma haydeni kanabensis)
E	Bat, lesser long-nosed (Leptonycteris curasoae yerbabuenae)
E	Bobwhite, masked (quail) (Colinus virginianus ridgwayi)
T	Catfish, Yaqui (Ictalurus pricei)
E	Chub, bonytail (Gila elegans)
E	Chub, Gila (Gila intermedia)
E	Chub, humpback (Gila cypha)
T	Chub, Sonora (Gila ditaenia)
E	Chub, Virgin River (Gila seminuda (=robusta))
E	Chub, Yaqui (Gila purpurea)
E	Condor, California (Gymnogyps californianus)
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Ferret, black-footed population, except where EXPN (Mustela nigripes)
E	Flycatcher, southwestern willow (Empidonax traillii extimus)
T	Frog, Chiricahua leopard (Rana chiricahuensis)
T	Gartersnake, narrow-headed (Thamnophis rufipunctatus)
T	Gartersnake, northern Mexican (Thamnophis eques megalops)
E	Jaguar (Panthera onca)
E	Minnow, loach (Tiaroga cobitis)
E	Mouse, New Mexico meadow jumping (Zapus hudsonius luteus)
E	Ocelot, wherever found (Leopardus (=Felis) pardalis)
T	Owl, Mexican spotted (Strix occidentalis lucida)
E	Pikeminnow (=squawfish), Colorado (Ptychocheilus lucius)
E	Pronghorn, Sonoran (Antilocapra americana sonoriensis)
E	Pupfish, desert (Cyprinodon macularius)
E	Rail, Yuma clapper (Rallus longirostris yumanensis)
T	Rattlesnake, New Mexican ridge-nosed (Crotalus willardi obscurus)
E	Salamander, Sonora tiger (Ambystoma tigrinum stebbinsi)
T	Shiner, beautiful (Cyprinella formosa)
E	Spikedace (Meda fulgida)
T	Spinedace, Little Colorado (Lepidomeda vittata)
T	Springsnail, San Bernardino (Pyrgulopsis bernardina)
E	Springsnail, Three Forks (Pyrgulopsis trivialis)
E	Squirrel, Mount Graham red (Tamiasciurus hudsonicus grahamensis)
E	Sucker, razorback (Xyrauchen texanus)
E	Sucker, Zuni bluehead (Catostomus discobolus yarrowi)

[129] Source: U.S. Fish and Wildlife Service
[130] Endangered (E) or Threatened (T)

Status[130]	Species/Listing Name
E	Tern, California least (Sterna antillarum browni)
E	Topminnow, Gila (incl. Yaqui) (Poeciliopsis occidentalis)
T	Tortoise, desert , except in Sonoran Desert (Gopherus agassizii)
T	Trout, Apache (Oncorhynchus apache)
T	Trout, Gila (Oncorhynchus gilae)
E	Vole, Hualapai Mexican (Microtus mexicanus hualpaiensis)
E	Wolf, Mexican (Canis lupus baileyi)
E	Woundfin, except EXPN (Plagopterus argentissimus)
	Plants
E	Blue-star, Kearney's (Amsonia kearneyana)
E	Cactus, Acuna (Echinomastus erectocentrus var. acunensis)
E	Cactus, Arizona hedgehog (Echinocereus triglochidiatus var. arizonicus)
E	Cactus, Brady pincushion (Pediocactus bradyi)
T	Cactus, Cochise pincushion (Coryphantha robbinsiorum)
E	Cactus, Fickeisen plains (Pediocactus peeblesianus fickeiseniae)
E	Cactus, Nichol's Turk's head (Echinocactus horizonthalonius var. nicholii)
E	Cactus, Peebles Navajo (Pediocactus peeblesianus var. peeblesianus)
E	Cactus, Pima pineapple (Coryphantha scheeri var. robustispina)
T	Cactus, Siler pincushion (Pediocactus (=Echinocactus, =Utahia) sileri)
E	Cliffrose, Arizona (Purshia (=Cowania) subintegra)
T	Cycladenia, Jones (Cycladenia humilis var. jonesii)
T	Fleabane, Zuni (Erigeron rhizomatus)
E	Ladies'-tresses, Canelo Hills (Spiranthes delitescens)
E	Mallow, Gierisch (Sphaeralcea gierischii)
E	Milk-vetch, Holmgren (Astragalus holmgreniorum)
E	Milk-vetch, Sentry (Astragalus cremnophylax var. cremnophylax)
T	Milkweed, Welsh's (Asclepias welshii)
T	Ragwort, San Francisco Peaks (Packera franciscana)
T	Sedge, Navajo (Carex specuicola)
E	Water-umbel, Huachuca (Lilaeopsis schaffneriana var. recurva)
Colorado: 33 listings	
	Animals
E	Butterfly, Uncompahgre fritillary (Boloria acrocnema)
E	Chub, bonytail (Gila elegans)
E	Chub, humpback (Gila cypha)
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Flycatcher, southwestern willow (Empidonax traillii extimus)
T	Lynx, Canada (Lynx canadensis)
E	Mouse, New Mexico meadow jumping (Zapus hudsonius luteus)
T	Mouse, Preble's meadow jumping (Zapus hudsonius preblei)
T	Owl, Mexican spotted (Strix occidentalis lucida)
E	Pikeminnow (=squawfish), Colorado (Ptychocheilus lucius)
T	Plover, piping except Great Lakes watershed (Charadrius melodus)

Status[130]	Species/Listing Name
T	Prairie-chicken, lesser (Tympanuchus pallidicinctus)
T	Sage-grouse, Gunnison (Centrocercus minimus)
T	Skipper, Pawnee montane (Hesperia leonardus montana)
E	Sucker, razorback (Xyrauchen texanus)
E	Tern, least interior pop. (Sterna antillarum)
T	Trout, Greenback Cutthroat (Oncorhynchus clarki stomias)
	Plants
T	Beardtongue, Parachute (Penstemon debilis)
E	Beardtongue, Penland (Penstemon penlandii)
T	Bladderpod, Dudley Bluffs (Lesquerella congesta)
T	Butterfly plant, Colorado (Gaura neomexicana var. coloradensis)
T	Cactus, Colorado hookless (Sclerocactus glaucus)
E	Cactus, Knowlton's (Pediocactus knowltonii)
T	Cactus, Mesa Verde (Sclerocactus mesae-verdae)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
E	Milkvetch, Mancos (Astragalus humillimus)
E	Milkvetch, Osterhout (Astragalus osterhoutii)
T	Mustard, Penland alpine fen (Eutrema penlandii)
T	Phacelia, DeBeque (Phacelia submutica)
E	Phacelia, North Park (Phacelia formosula)
E	Skyrocket, Pagosa (Ipomopsis polyantha)
T	Twinpod, Dudley Bluffs (Physaria obcordata)
E	Wild buckwheat, clay-loving (Eriogonum pelinophilum)
Idaho: 15 listings	
	Animals
T	Bear, grizzly (Ursus arctos horribilis)
E	Caribou, woodland Selkirk Mountain population (Rangifer tarandus caribou)
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Limpet, Banbury Springs (Lanx sp.)
T	Lynx, Canada Contiguous U.S. DPS (Lynx canadensis)
T	Snail, Bliss Rapids (Taylorconcha serpenticola)
E	Snail, Snake River physa (Physa natricina)
E	Springsnail, Bruneau Hot (Pyrgulopsis bruneauensis)
T	Squirrel, Northern Idaho Ground (Urocitellus brunneus)
E	Sturgeon, white (Acipenser transmontanus)
T	Trout, bull (Salvelinus confluentus)
	Plants
T	Catchfly, Spalding's (Silene spaldingii)
T	Four-o'clock, MacFarlane's (Mirabilis macfarlanei)
T	Howellia, water (Howellia aquatilis)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)

Status[130]	Species/Listing Name
Montana: 15 listings	
	Animals
T	Bat, Northern long-eared (Myotis septentrionalis)
T	Bear, grizzly (Ursus arctos horribilis)
E	Crane, whooping (Grus americana)
T	Cuckoo, yellow-billed (Coccyzus americanus)
E	Ferret, black-footed (Mustela nigripes)
T	Knot, red (Calidris canutus rufa)
T	Lynx, Canada (Lynx canadensis)
T	Plover, piping except Great Lakes watershed (Charadrius melodus)
E	Sturgeon, pallid (Scaphirhynchus albus)
E	Sturgeon, white (Acipenser transmontanus)
E	Tern, least interior pop. (Sterna antillarum)
T	Trout, bull (Salvelinus confluentus)
	Plants
T	Catchfly, Spalding's (Silene spaldingii)
T	Howellia, water (Howellia aquatilis)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
Nevada: 38 listings	
	Animals
E	Butterfly, Mount Charleston blue (Icaricia (Plebejus) shasta charlestonensis)
E	Chub, bonytail (Gila elegans)
E	Chub, Pahranagat roundtail (Gila robusta jordani)
E	Chub, Virgin River (Gila seminuda (=robusta))
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Cui-ui (Chasmistes cujus)
E	Dace, Ash Meadows speckled (Rhinichthys osculus nevadensis)
E	Dace, Clover Valley speckled (Rhinichthys osculus oligoporus)
T	Dace, desert (Eremichthys acros)
E	Dace, Independence Valley speckled (Rhinichthys osculus lethoporus)
E	Dace, Moapa (Moapa coriacea)
E	Flycatcher, southwestern willow (Empidonax traillii extimus)
T	Naucorid, Ash Meadows (Ambrysus amargosus)
E	Poolfish, Pahrump (Empetrichthys latos)
E	Pupfish, Ash Meadows Amargosa (Cyprinodon nevadensis mionectes)
E	Pupfish, Devils Hole (Cyprinodon diabolis)
E	Pupfish, Warm Springs (Cyprinodon nevadensis pectoralis)
E	Skipper, Carson wandering (Pseudocopaeodes eunus obscurus)
T	Spinedace, Big Spring (Lepidomeda mollispinis pratensis)
E	Spinedace, White River (Lepidomeda albivallis)
E	Springfish, Hiko White River (Crenichthys baileyi grandis)
T	Springfish, Railroad Valley (Crenichthys nevadae)

Status[130]	Species/Listing Name
E	Springfish, White River (Crenichthys baileyi baileyi)
E	Sucker, razorback (Xyrauchen texanus)
T	Sucker, Warner (Catostomus warnerensis)
T	Trout, bull (Salvelinus confluentus)
T	Trout, Lahontan cutthroat (Oncorhynchus clarkii henshawi)
E	Woundfin (Plagopterus argentissimus)
	Plants
T	Blazingstar, Ash Meadows (Mentzelia leucophylla)
E	Buckwheat, steamboat (Eriogonum ovalifolium var. williamsiae)
T	Centaury, spring-loving (Centaurium namophilum)
T	Gumplant, Ash Meadows (Grindelia fraxinipratensis)
T	Ivesia, Ash Meadows (Ivesia kingii var. eremica)
T	Ivesia, Webber (Ivesia webberi)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
T	Milk-vetch, Ash meadows (Astragalus phoenix)
E	Niterwort, Amargosa (Nitrophila mohavensis)
T	Sunray, Ash Meadows (Enceliopsis nudicaulis var. corrugata)
New Mexico: 53 listings	
	Animals
E	Amphipod, Noel's (Gammarus desperatus)
E	Bat, lesser long-nosed (Leptonycteris curasoae yerbabuenae)
E	Bat, Mexican long-nosed (Leptonycteris nivalis)
T	Chub, Chihuahua (Gila nigrescens)
E	Chub, Gila (Gila intermedia)
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Ferret, black-footed population, except where EXPN (Mustela nigripes)
E	Flycatcher, southwestern willow (Empidonax traillii extimus)
T	Frog, Chiricahua leopard (Rana chiricahuensis)
E	Gambusia, Pecos (Gambusia nobilis)
T	Gartersnake, narrow-headed (Thamnophis rufipunctatus)
T	Gartersnake, northern Mexican (Thamnophis eques megalops)
E	Isopod, Socorro (Thermosphaeroma thermophilus)
E	Jaguar, wherever found (Panthera onca)
T	Lynx, Canada Contiguous U.S. DPS (Lynx canadensis)
E	Minnow, loach (Tiaroga cobitis)
E	Minnow, Rio Grande Silvery (Hybognathus amarus)
E	Mouse, New Mexico meadow jumping (Zapus hudsonius luteus)
T	Owl, Mexican spotted (Strix occidentalis lucida)
E	Pikeminnow (=squawfish), Colorado (Ptychocheilus lucius)
T	Plover, piping except Great Lakes watershed (Charadrius melodus)
T	Prairie-chicken, lesser (Tympanuchus pallidicinctus)
T	Rattlesnake, New Mexican ridge-nosed (Crotalus willardi obscurus)
E	Salamander, Jemez Mountains (Plethodon neomexicanus)

Status[130]	Species/Listing Name
T	Shiner, Arkansas River Arkansas R. Basin (Notropis girardi)
T	Shiner, beautiful (Cyprinella formosa)
T	Shiner, Pecos bluntnose (Notropis simus pecosensis)
E	Snail, Pecos assiminea (Assiminea pecos)
E	Spikedace (Meda fulgida)
E	Springsnail, Alamosa (Tryonia alamosae)
E	Springsnail, Chupadera (Pyrgulopsis chupaderae)
E	Springsnail, Koster's (Juturnia kosteri)
E	Springsnail, Roswell (Pyrgulopsis roswellensis)
E	Springsnail, Socorro (Pyrgulopsis neomexicana)
E	Sucker, razorback (Xyrauchen texanus)
E	Sucker, Zuni bluehead (Catostomus discobolus yarrowi)
E	Tern, least interior pop. (Sterna antillarum)
E	Topminnow, Gila (incl. Yaqui) (Poeciliopsis occidentalis)
T	Trout, Gila (Oncorhynchus gilae)
E	Wolf, Mexican (Canis lupus baileyi)
	Plants
E	Cactus, Knowlton's (Pediocactus knowltonii)
E	Cactus, Kuenzler hedgehog (Echinocereus fendleri var. kuenzleri)
T	Cactus, Lee pincushion (Coryphantha sneedii var. leei)
T	Cactus, Mesa Verde (Sclerocactus mesae-verdae)
E	Cactus, Sneed pincushion (Coryphantha sneedii var. sneedii)
T	Fleabane, Zuni (Erigeron rhizomatus)
E	Ipomopsis, Holy Ghost (Ipomopsis sancti-spiritus)
E	Milk-vetch, Mancos (Astragalus humillimus)
E	Pennyroyal, Todsen's (Hedeoma todsenii)
E	Poppy, Sacramento prickly (Argemone pleiacantha ssp. pinnatisecta)
T	Sunflower, Pecos (=puzzle, =paradox) (Helianthus paradoxus)
T	Thistle, Sacramento Mountains (Cirsium vinaceum)
T	Wild-buckwheat, gypsum (Eriogonum gypsophilum)
Utah: 42 listings	
	Animals
E	Ambersnail, Kanab (Oxyloma haydeni kanabensis)
E	Chub, bonytail (Gila elegans)
E	Chub, humpback (Gila cypha)
E	Chub, Virgin River (Gila seminuda (=robusta))
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Flycatcher, southwestern willow (Empidonax traillii extimus)
T	Lynx, Canada Contiguous U.S. DPS (Lynx canadensis)
T	Owl, Mexican spotted (Strix occidentalis lucida)
E	Pikeminnow (squawfish), Colorado , except EXPN (Ptychocheilus lucius)
T	Prairie dog, Utah (Cynomys parvidens)
T	sage-grouse, Gunnison (Centrocercus minimus)

Status[130]	Species/Listing Name
E	Sucker, June (Chasmistes liorus)
E	Sucker, razorback (Xyrauchen texanus)
T	Tortoise, desert, except in Sonoran Desert (Gopherus agassizii)
T	Trout, Greenback Cutthroat (Oncorhynchus clarki stomias)
T	Trout, Lahontan cutthroat (Oncorhynchus clarkii henshawi)
E	Woundfin, except EXPN (Plagopterus argentissimus)
	Plants
E	Bear-poppy, Dwarf (Arctomecon humilis)
E	Bladderpod, kodachrome (Lesquerella tumulosa)
E	Buttercup, autumn (Ranunculus aestivalis (=acriformis))
T	Cactus, Pariette (Sclerocactus brevispinus)
E	Cactus, San Rafael (Pediocactus despainii)
T	Cactus, Siler pincushion (Pediocactus (=Echinocactus, =Utahia) sileri)
T	Cactus, Uinta Basin hookless (Sclerocactus wetlandicus)
T	Cactus, Winkler (Pediocactus winkleri)
E	Cactus, Wright fishhook (Sclerocactus wrightiae)
T	Cycladenia, Jones (Cycladenia humilis var. jonesii)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
E	Mallow, Gierisch (Sphaeralcea gierischii)
T	Milk-vetch, Deseret (Astragalus desereticus)
T	Milk-vetch, heliotrope (Astragalus montii)
E	Milk-vetch, Holmgren (Astragalus holmgreniorum)
E	Milk-vetch, Shivwits (Astragalus ampullarioides)
T	Milkweed, Welsh's (Asclepias welshii)
E	Phacelia, clay (Phacelia argillacea)
T	Primrose, Maguire (Primula maguirei)
E	Reed-mustard, Barneby (Schoenocrambe barnebyi)
T	Reed-mustard, clay (Schoenocrambe argillacea)
E	Reed-mustard, shrubby (Schoenocrambe suffrutescens)
E	Ridge-cress, Barneby (Lepidium barnebyanum)
T	Sedge, Navajo (Carex specuicola)
T	Townsendia, Last Chance (Townsendia aprica)
Washington: 48 listings	
	Animals
E	Albatross, short-tailed (Phoebastria (=Diomedea) albatrus)
T	Bear, grizzly (Ursus arctos horribilis)
T	Butterfly, Oregon silverspot (Speyeria zerene hippolyta)
E	Caribou, woodland Selkirk Mountain population (Rangifer tarandus caribou)
E	Checkerspot, Taylor's (whulge) (Euphydryas editha taylori)
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Deer, Columbian white-tailed Columbia River DPS (Odocoileus virginianus leucurus)
T	Frog, Oregon spotted (Rana pretiosa)
T	Horned lark, streaked (Eremophila alpestris strigata)

Status[130]	Species/Listing Name
T	Lynx, Canada Contiguous U.S. DPS (Lynx canadensis)
T	Murrelet, marbled CA, OR, WA (Brachyramphus marmoratus)
T	Owl, northern spotted (Strix occidentalis caurina)
T	Plover, western snowy Pacific coastal pop. (Charadrius alexandrinus nivosus)
T	Pocket gopher, Olympia (Thomomys mazama pugetensis)
T	Pocket gopher, Roy Prairie (Thomomys mazama glacialis)
T	Pocket gopher, Tenino (Thomomys mazama tumuli)
T	Pocket gopher, Yelm (Thomomys mazama yelmensis)
E	Rabbit, Columbia Basin Pygmy Columbia Basin DPS (Brachylagus idahoensis)
T	Salmon, Chinook Lower Columbia River ESU (Oncorhynchus (Salmo) tshawytscha)
T	Salmon, Chinook Puget Sound ESU (Oncorhynchus (Salmo) tshawytscha)
T	Salmon, Chinook Snake River fall-run ESU (Oncorhynchus (Salmo) tshawytscha)
T	Salmon, Chinook Snake River spring/summer-run ESU (Oncorhynchus (Salmo) tshawytscha)
E	Salmon, Chinook Upper Columbia spring-run ESU (Oncorhynchus (Salmo) tshawytscha)
T	Salmon, chum Columbia River ESU (Oncorhynchus keta)
T	Salmon, chum Hood Canal summer-run ESU (Oncorhynchus keta)
T	Salmon, sockeye Ozette Lake ESU (Oncorhynchus (Salmo) nerka)
E	Salmon, sockeye Snake River ESU (Oncorhynchus (Salmo) nerka)
E	Sea turtle, leatherback (Dermochelys coriacea)
T	Steelhead Lower Columbia River DPS (Oncorhynchus (Salmo) mykiss)
T	Steelhead Puget Sound DPS (Oncorhynchus (Salmo) mykiss)
T	Steelhead Snake River Basin DPS (Oncorhynchus (Salmo) mykiss)
T	Steelhead Upper Columbia River DPS (Oncorhynchus (Salmo) mykiss)
T	Steelhead Upper Willamette River DPS (Oncorhynchus (Salmo) mykiss)
T	Trout, bull (Salvelinus confluentus)
E	Whale, humpback (Megaptera novaeangliae)
E	Whale, killer Southern Resident DPS (Orcinus orca)
E	Wolf, gray (Canis lupus)
	Plants
T	Bladderpod, White Bluffs (Physaria douglasii ssp. tuplashensis)
T	Buckwheat, Umtanum Desert (Eriogonum codium)
T	Catchfly, Spalding's (Silene spaldingii)
T	Checker-mallow, Nelson's (Sidalcea nelsoniana)
E	Checkermallow, Wenatchee Mountains (Sidalcea oregana var. calva)
E	Desert-parsley, Bradshaw's (Lomatium bradshawii)
T	Howellia, water (Howellia aquatilis)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
T	Lupine, Kincaid's (Lupinus sulphureus ssp. kincaidii)
T	Paintbrush, golden (Castilleja levisecta)
E	Stickseed, showy (Hackelia venusta)

Status[130]	Species/Listing Name
Wyoming: 12 listings	
	Animals
T	Bat, Northern long-eared (Myotis septentrionalis)
T	Bear, grizzly (Ursus arctos horribilis)
T	Cuckoo, yellow-billed Western U.S. DPS (Coccyzus americanus)
E	Dace, Kendall Warm Springs (Rhinichthys osculus thermalis)
E	Ferret, black-footed population, except where EXPN (Mustela nigripes)
T	Lynx, Canada Contiguous U.S. DPS (Lynx canadensis)
T	Mouse, Preble's meadow jumping wherever found (Zapus hudsonius preblei)
E	Toad, Wyoming (Bufo hemiophrys baxteri)
	Plants
T	Butterfly plant, Colorado (Gaura neomexicana var. coloradensis)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
E	Penstemon, blowout (Penstemon haydenii)
T	Yellowhead, desert (Yermo xanthocephalus)

Appendix J: Recent Candidate Species for Listing as Threatened or Endangered in the Intermountain West (by State)[131]

Arizona
Bartram stonecrop (Graptopetalum bartramii)
Beardless chinch weed (Pectis imberbis)
Bumble bee, Western (Bombus occidentalis)
Butterfly, Monarch (Danaus plexippus plexippus)
Frog, relict leopard (Rana onca)
Ocelot (Leopardus pardalis)
Patagonia Eyed Silkmoth
Pipit, Sprague's (Anthus spragueii)
Scurfpea, Chihuahua (Pediomelum pentaphyllum)
Spinedace, Virgin River (Lepidomeda mollispinis mollispinis)
Thistle, Wright's marsh (Cirsium wrightii)
Tiger beetle, Arizona Wetsalts (Cicindela haemorrhagica ssp. arizonae)
Tortoise, desert (Gopherus agassizii)
Tree, Joshua (Yucca brevifolia)
Yellowtops, McDougall's (Flaveria mcdougallii)
Colorado
Pika, American (Ochotona princeps)
Bumble bee, Western (Bombus occidentalis)
Butterfly, Monarch (Danaus plexippus plexippus)
Chub, Rio Grande (Gila pandora)
Fritillary, Regal (Speyeria idalia)
Massasauga, desert (Sistrurus catenatus edwardsii)
Monkeyflower, Rocky Mountain (Mimulus gemmiparus)
Ptarmigan, white-tailed (Lagopus leucura altipetens and L. l. rainierensis)
Rio Grande Sucker (Catostomus plebeius)
Silverspot, Great Basin (Speyeria nokomis nokomis)
Snowfly, Arapahoe (Capnia arapahoe)
Toad, boreal ((Anaxyrus boreas boreas)
Wild-buckwheat, clay-loving (Eriogonum pelinophilum)
Yellowstone Bison DPS (Bison bison)
Idaho
Bumble bee, Western (Bombus occidentalis)
Butterfly, Monarch (Danaus plexippus plexippus)
Fisher (Martes (Pekania) pennanti
Grizzly bear (Ursus arctos "stikeenensis")
Grizzly bear, Cabinet-Yaak dps (Ursus arctos horribilis)

[131] Source: U.S. Fish and Wildlife Service

Idaho (continued)
Limpet, Banbury Springs (Lanx sp)
Pine, whitebark (Pinus albicaulis)
Snail, Bliss Rapids (Taylorconcha serpenticola)
Montana
Bumble bee, Western (Bombus occidentalis)
Bumble bee, Yellow banded (Bombus terricola)
Butterfly, Monarch (Danaus plexippus plexippus)
Fisher (Martes (Pekania) pennanti
Fritillary, Regal (Speyeria idalia)
Grizzly bear (Ursus arctos "stikeenensis")
Grizzly bear, Cabinet-Yaak dps (Ursus arctos horribilis)
Pine, whitebark (Pinus albicaulis)
Pipit, Sprague's (Anthus spragueii)
Stonefly, western glacier (Zapada glacier)
Yellowstone Bison DPS (Bison bison)
New Mexico
Bumble bee, Western (Bombus occidentalis)
Butterfly, Monarch (Danaus plexippus plexippus)
Chipmunk, Penasco least (Tamias minimus atristriatus)
Chub, Rio Grande (Gila pandora)
False-foxglove, Leoncita (Agalinis calycina)
Mayfly, Gila (Lachlania dencyanna)
Pipit, Sprague's (Anthus spragueii)
Rio Grande Sucker (Catostomus plebeius)
Scurfpea, Chihuahua (Pediomelum pentaphyllum)
Thistle, Wright's marsh (Cirsium wrightii)
Nevada
Bumble bee, Western (Bombus occidentalis)
Butterfly, Monarch (Danaus plexippus plexippus)
California Spotted Owl (Strix occidentalis occidentalis)
Euphilotes ancilla cryptica
Euphilotes ancilla purpura
Frog, relict leopard (Rana onca)
Pine, whitebark (Pinus albicaulis)
Relict Dace (Relictus solitarius), Big Spring DPS
Spinedace, Virgin River (Lepidomeda mollispinis mollispinis)
Tree, Joshua (Yucca brevifolia)
Tricolored Blackbird (Agelaius tricolor)

Utah
Butterfly, Monarch (Danaus plexippus plexippus)
Cactus, Pariette (Sclerocactus brevispinus)
Silverspot, Great Basin (Speyeria nokomis nokomis)
Spinedace, Virgin River (Lepidomeda mollispinis mollispinis)
Tortoise, desert (Gopherus agassizii)
Tree, Joshua (Yucca brevifolia)
Yellowstone Bison DPS (Bison bison)
Washington
Bumble bee, Western (Bombus occidentalis)
Butterfly, island marble (Euchloe ausonides insulanus)
Butterfly, Monarch (Danaus plexippus plexippus)
Grizzly bear (Ursus arctos "stikeenensis")
Grizzly bear, Cabinet-Yaak dps (Ursus arctos horribilis)
Moth, sand-verbena (Copablepharon fuscum)
Owl, Northern spotted (Strix occidentalis caurina)
Pine, whitebark (Pinus albicaulis)
Sea turtle, leatherback (Dermochelys coriacea)
Tufted Puffin U.S. DPS
Washington Ground Squirrel (Spermophilus washington)
Yellow-cedar (Callitropsis nootkatensis)
Wyoming
Bumble bee, Western (Bombus occidentalis)
Butterfly, Monarch (Danaus plexippus plexippus)
Fisher (Martes (Pekania) pennanti)
Grizzly bear (Ursus arctos "stikeenensis")
Narrow-foot Hygrotus Diving Beetle (Hygrotus diversipes)
Pine, whitebark (Pinus albicaulis)
Toad, boreal (Anaxyrus boreas boreas)
Yellowstone Bison DPS (Bison bison)

Appendix K: Economic Example of Tabulation of Multiplier Effects[132]

Impact by Industry: Number of Total Jobs Created (Based on 1,000 direct jobs)		
	Miscellaneous manufacturing	Wholesale trade
Natural resources and mining		
Crop production	0.66	0.57
Animal production and aquaculture	1.72	1.90
Forestry and logging	0.35	0.03
Fishing, hunting and trapping	0.05	0.05
Agriculture and forestry support activities	0.66	0.53
Oil and gas extraction	0.45	0.49
Mining and support activities	0.90	0.40
Construction		
Construction	9.53	7.79
Manufacturing		
Food, beverage, and tobacco product manufacturing	4.45	4.96
Textile mills and textile product mills	0.62	0.58
Leather and allied product manufacturing	0.16	0.11
Wood product manufacturing	0.45	0.13
Paper manufacturing	0.12	0.02
Printing and related support activities	1.53	2.50
Petroleum and coal products manufacturing	0.08	0.10
Chemical manufacturing	4.97	1.13
Plastics and rubber products manufacturing	10.10	2.21
Nonmetallic mineral product manufacturing	0.10	0.03
Primary metal manufacturing	0.16	0.02
Fabricated metal product manufacturing	1.17	0.19
Machinery manufacturing	5.21	0.93
Computer and electronic product manufacturing	16.44	7.87
Electrical equipment and appliance mfg.	1.01	0.49
Transportation equipment manufacturing	0.13	0.04
Furniture and related product manufacturing	3.76	2.29
Miscellaneous manufacturing	1,054.15	3.83
Trade, transportation, and utilities		
Utilities	5.55	5.08
Wholesale trade	61.82	1,051.35
Motor vehicle and parts dealers	13.35	13.14
Furniture and home furnishings stores	3.49	3.09
Electronics and appliance stores	3.84	3.71
Building material and garden supply stores	8.26	8.36
Food and beverage stores	19.10	19.16
Health and personal care stores	6.82	6.80
Gasoline stations	4.87	4.97
Clothing and clothing accessories stores	10.51	10.72
Sporting goods, hobby, book and music stores	5.01	4.95
General merchandise stores	21.23	21.26
Miscellaneous store retailers	6.70	6.66
Nonstore retailers	8.49	8.55

[132] Source: IMPLAN; CBRE

Impact by Industry: Number of Total Jobs Created (Based on 1,000 direct jobs) (continued)		
Air transportation	2.02	1.98
Rail transportation	1.41	0.52
Water transportation	0.01	0.01
Truck transportation	26.66	10.93
Transit and ground passenger transportation	3.09	2.77
Pipeline transportation	0.09	0.10
Scenic and sightseeing transportation	4.38	7.82
Couriers and messengers	5.37	30.37
Warehousing and storage	9.15	21.48
Information		
Publishing industries, except internet	3.83	3.76
Motion picture and sound recording industries	2.08	2.27
Broadcasting, except internet	2.72	2.79
Internet publishing and broadcasting	0.46	0.49
Telecommunications	6.65	7.11
Data processing, hosting and related services	0.97	0.95
Other information services	0.22	0.25
Financial activities		
Monetary authorities - central bank	15.49	14.67
Credit intermediation and related activities	9.16	12.12
Securities, commodity contracts, investments	22.19	13.70
Insurance carriers and related activities	10.70	18.63
Funds, trusts, and other financial vehicles	1.46	1.63
Real estate	48.53	58.44
Rental and leasing services	5.88	6.19
Lessors of nonfinancial intangible assets	0.69	0.36
Professional and business services		
Professional and technical services	127.56	127.62
Management of companies and enterprises	24.44	25.35
Administrative and support services	59.53	105.84
Waste management and remediation services	1.70	1.60
Education and health services		
Educational services	18.06	21.40
Healthcare and social assistance	99.73	110.39
Leisure and hospitality		
Arts, entertainment, and recreation	22.72	25.48
Accommodation	11.05	8.89
Food services and drinking places	72.12	75.97
Other services		
Repair and maintenance	17.30	21.75
Personal and laundry services	13.52	17.65
Membership associations and organizations	15.41	16.46
Private households	14.19	15.70
Public administration and others		
Government and non NAICs	47.26	76.83
Total - All Industries	**2,154.18**	**2,219.11**

Appendix L: Population and Employment Focus[133]

Example and Case Studies

As evidenced by the long list of economic conditions that are included in the risk register, a number of things need to be considered when making transportation infrastructure investments. These items can vary from the quantitative, such as tax policy and economic growth, to the qualitative, such as public policy debate and economic development programs. Despite this array of influencing variables, the discussion must begin with the basics: population and employment base and growth potential.

Mapping current population centers and their proximity to the I-11 planning area gives a high level perspective on the extent improved road conditions will affect people's lives and also impact the local economies. In the case of Arizona, the planned route(s) go through two of the largest population and employment centers: Greater Phoenix and Tucson. Other states may face a different scenario; one where a larger number of medium-sized communities are initially impacted.

It is important to keep in mind that even the large population and employment centers in any state or region can have varying degrees of economic opportunity related to transportation infrastructure investment, depending on the full array of economic factors that influence growth. ***Primary opportunities will arise along the transportation routes and in the larger metropolitan areas, but opportunities to expand the local economies will be available in all parts of a state or region.*** This means that the primary interstate routes will be critical to economic development, as will the supporting networks that connect a community to the main trade routes. These factors may be illustrated by case studies of three Arizona counties with respect to the proposed I-11 project.

Pima County Example

Pima County in Southern Arizona has the City of Tucson economy as its hub. The local employment base has been considered high tech in certain areas, especially as it relates to federal government expenditures on defense manufacturing and research. It has a strong university presence and is very well positioned geographically to benefit from enhanced trade with Mexico. Tourism also is very important in the region.

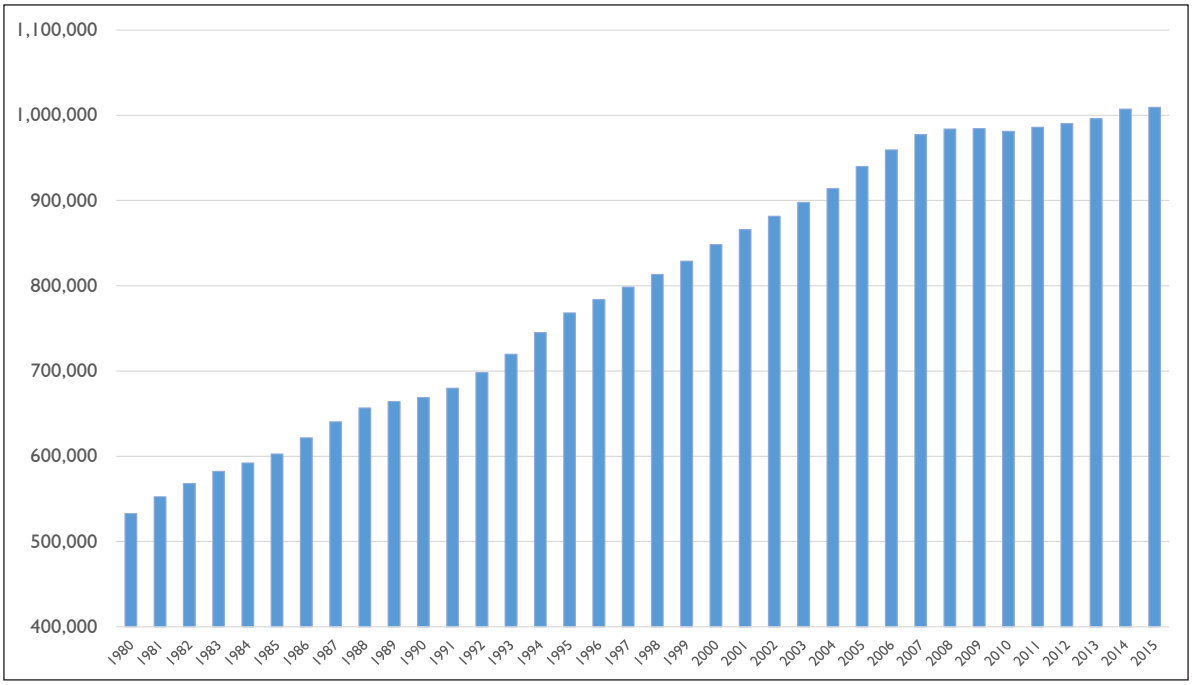
As of 2015, the population of Pima County was 1,009,371,[134] making it the second most populated county in Arizona. Pima County accounts for about 14.9 percent of the population in Arizona. Before the Great Recession in 2008, the annual population growth rate averaged about 2.3 percent. During the first half of this decade, the annual population growth rate averaged about 0.4 percent. Population grew by 0.2 percent in 2015. Population movement across the country has been an issue, though, and slower growth is not just happening in Arizona. One may conclude that economic conditions need to be identified as local, state or national, and temporary or persistent. Population flows in Pima County should improve by 2016, but will likely lag the historical rates for the remainder of this business cycle. One potential threat to the Pima County economy is the extent new job creation will consistently improve and enhance future population growth.

In 2015, Pima County employment grew by 0.8 percent. Between 2007 and 2010, Pima County lost 52,100 jobs or about 13.3 percent of its employment base. However, conditions can change rapidly for some regions. In the first half of 2016, the rate of job growth was 3.6 percent. While the Tucson area has yet to regain the number of lost jobs from the last economic downturn and lags the state as a whole, the rate of job growth has indeed improved. Some of this has to do with basic math: building on a lower base results in higher rates of initial growth but then tends to slow. On the other hand, the region is much more sophisticated in its economic development efforts and has demonstrated solid leadership in this area. This will have a positive impact on the economy but may take some time to build up momentum.

[133] Source: "SHRP2 – Economic Development Concepts," Rounds Consulting Group, Inc., prepared for Maricopa Association of Governments, 2016.

[134] Source: Arizona Department of Administration

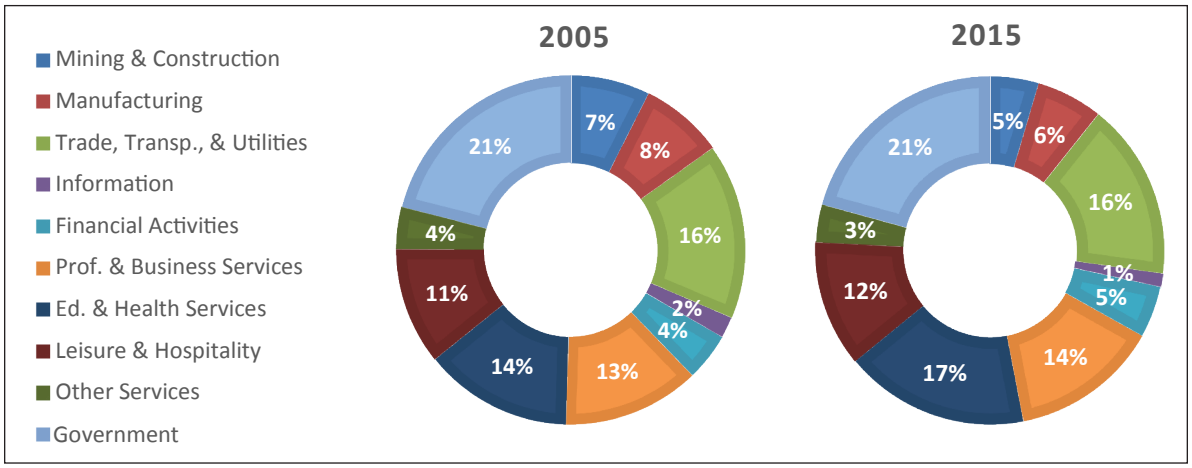
Pima County Population 1980-2015



Pima County Population and Employment[135] (in thousands)											
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Population	940.0	959.5	977.3	984.0	984.3	981.2	986.1	990.4	996.0	1,007.2	1,009.4
Employment	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Nonfarm	367.0	380.0	385.6	381.4	361.3	353.3	354.4	359.8	363.2	365.2	368.1
Total Private	289.9	303.7	307.7	301.5	282.2	275.1	277.7	282.2	286.0	288.2	291.8
Mining & Construction	55.4	57.6	55.7	51.9	43.3	40.7	39.7	39.7	40.6	39.6	39.4
Manufacturing	27.2	29.6	28.3	24.8	18.4	16.9	16.5	16.5	17.7	17.1	16.8
Trade, Transportation, & Utilities	28.2	28.0	27.4	27.1	24.9	23.8	23.3	23.2	23.0	22.5	22.6
Information	311.6	322.4	329.9	329.5	318.0	312.6	314.7	320.1	322.5	325.6	328.7
Financial Activities	234.5	246.1	252.0	249.7	238.9	234.4	237.9	242.4	245.3	248.6	252.4
Professional & Business Services	59.8	63.0	64.8	63.1	58.6	57.2	58.0	58.0	59.2	60.6	60.6
Educational & Health Services	7.3	7.0	6.1	5.5	4.9	4.5	4.4	4.5	4.5	4.4	4.5
Leisure & Hospitality	16.3	17.4	18.0	16.9	17.1	17.2	16.9	16.9	17.3	17.5	17.6
Other Services	46.4	50.3	53.2	52.0	47.6	46.2	47.1	48.9	49.9	50.0	50.8
Government	50.6	52.7	54.8	57.2	58.6	58.4	59.9	61.0	61.6	61.5	63.0
Federal Government	39.8	40.6	40.2	40.4	38.7	38.2	39.1	40.3	40.1	41.6	43.0
State and Local Government	14.4	15.2	15.0	14.6	13.4	12.7	12.6	12.8	12.7	13.0	12.9
Unemployment Rate	4.5%	4.1%	3.7%	5.8%	9.1%	9.3%	8.5%	7.4%	6.8%	6.2%	5.5%

[135] *Ibid.*

Changes in Employment Composition for Pima County



These basic facts would entice a reviewer to allocate net new job creation estimates from additional transportation infrastructure investment based on past performance, but also be skeptical about the extent the recent momentum will continue. Federal spending cuts have caused regional fiscal struggles and the city lags in local infrastructure investment. Recent efforts to increase taxes to pay for new infrastructure also failed. Based on these select forward-acting influences, the city and county may ultimately be challenged, to some unknown degree, to capture a higher ratio of any net new employment opportunities from the broader I-11 planning efforts.

On the positive side, the county has developed high quality economic development plans and regional leaders are coordinating more than in past decades. Larger scale infrastructure projects are being considered and the recently enhanced economic growth, if it continues, will help with the fiscal issues that would eventually negatively impact economic development efforts. In this case, a prominent past gave way to a very weak economic recovery, and may now be giving way to more robust economic growth. These "inflection" (turning) points add to a forecast's risk, at least until a trend is more completely established. The outlook: positive but with a slightly tempered forecast until the data shows a definite trend.

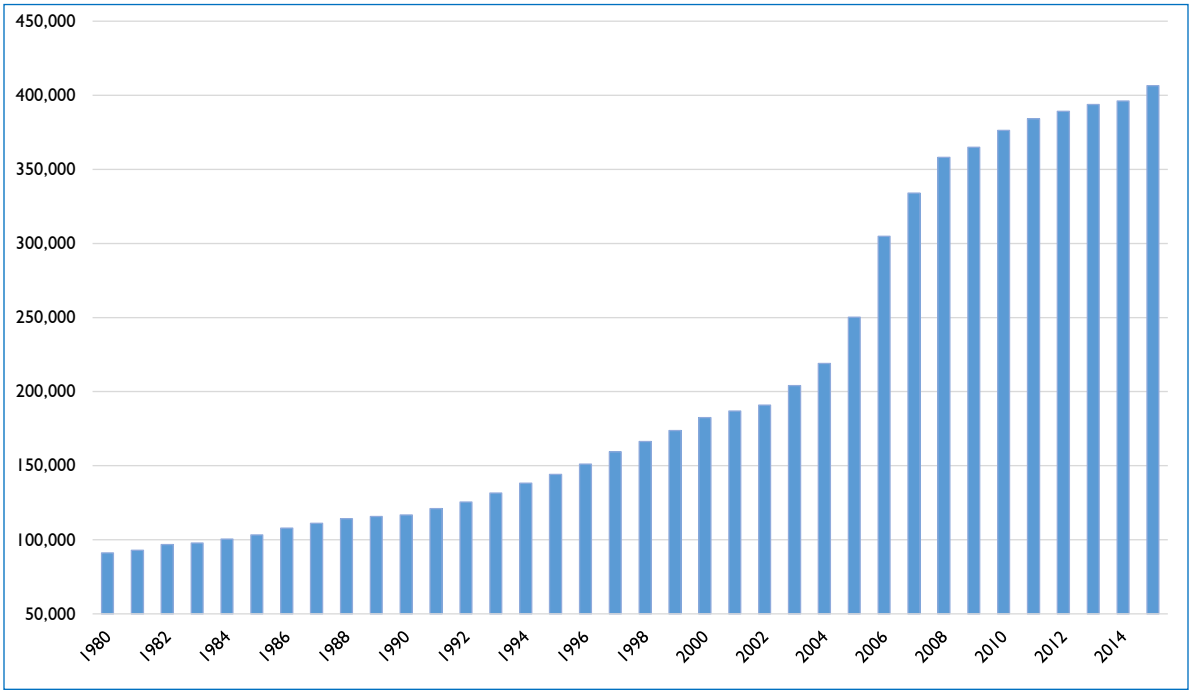
Pinal County Example

Pinal County, to the north of Pima County, is differently positioned on these economic matters. While the proposed I-11 routes traverse the county, the area has a more dispersed grouping of major communities. It is also anchored to a large degree by the City of Casa Grande. Some of the communities are developing based on growth in the broader Greater Phoenix region, and some are expanding on their past trade and transportation-related economic bases to also include higher valued-added projects as well as new leisure opportunities.

The population of Pinal County was 406,468 in 2015, making it the third most populous county in Arizona. The average annual growth rate between 1980 and 2001 was 3.4 percent. During the expansion between 2001 and 2007, the average growth rate tripled to 10.3 percent. Over the past five years, Pinal county has experienced an average growth rate about half of its previous trend (1.8 percent from 2010 to 2015). In 2015, the population of Pinal County increased 2.6 percent.[136]

While Pinal County lost 5,900 jobs or 10.7 percent of its employment base between 2007 and 2010, the county recovered the lost jobs (in terms of quantity) by 2012, and is working aggressively on its economic development policies that are adding additional base sector jobs. As of mid-2016, the county has added approximately 1,500 more jobs than its pre-recession peak.

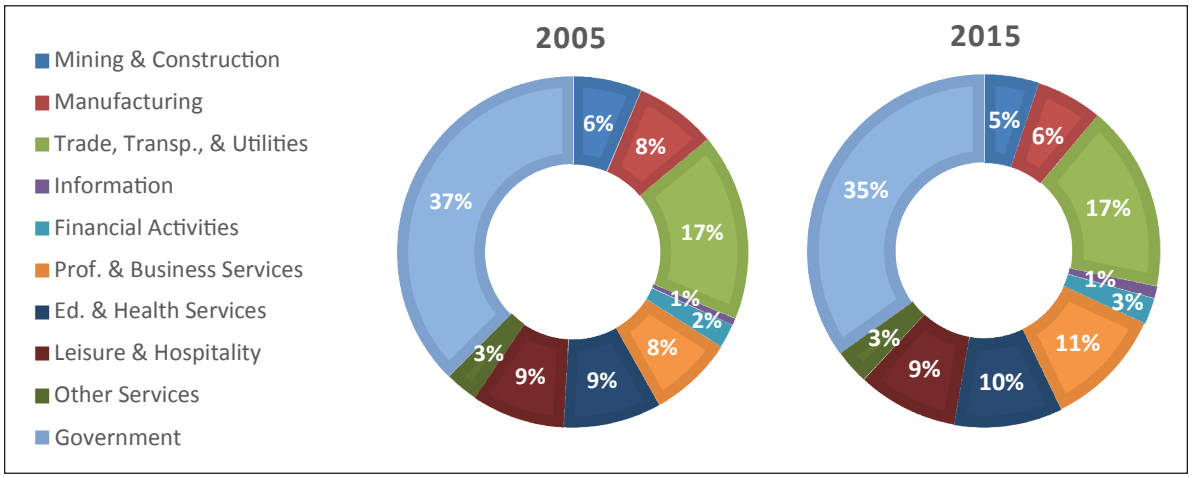
Pinal County Population 1980-2015



[136] *Ibid.*

Pinal County Population and Employment[137] (in thousands)											
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Population	250.2	304.9	334.0	358.2	365.0	376.4	384.2	389.2	393.8	396.2	406.5
Employment	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Nonfarm	44.7	48.1	52.2	54.1	51.5	51.5	52.7	56.0	56.4	56.5	55.9
Total Private	28.0	30.5	33.2	33.6	31.0	31.4	32.7	35.5	36.2	36.6	36.4
Mining & Construction	2.9	3.7	4.2	4.4	2.9	2.6	2.7	2.9	3.3	3.0	2.9
Manufacturing	3.4	3.7	4.0	3.9	3.3	3.0	3.0	3.2	3.3	3.6	3.4
Trade, Transportation, & Utilities	7.7	8.4	8.8	9.1	8.7	8.4	8.5	8.6	8.8	9.2	9.6
Information	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.7	0.6	0.6
Financial Activities	1.0	1.2	1.5	1.5	1.4	1.4	1.3	1.3	1.4	1.4	1.4
Professional & Business Services	3.5	3.3	3.9	4.5	4.7	4.8	5.2	6.1	5.5	6.1	6.2
Educational & Health Services	4.0	4.1	4.2	4.0	4.0	4.9	5.2	5.8	5.8	5.5	5.6
Leisure & Hospitality	3.9	4.2	4.6	4.4	4.3	4.4	4.6	4.8	4.9	5.0	5.1
Other Services	1.4	1.6	1.6	1.7	1.5	1.5	1.8	2.4	2.5	2.3	1.8
Government	16.8	17.6	19.1	20.5	20.5	20.1	20.0	20.6	20.2	19.9	19.5
Federal Government	1.1	1.3	1.3	1.5	1.7	1.7	1.8	1.8	1.7	1.7	1.7
State and Local Government	15.7	16.3	17.7	19.0	18.8	18.4	18.3	18.7	18.5	18.2	17.8
Unemployment Rate	**4.5%**	**5.0%**	**4.6%**	**7.4%**	**12.3%**	**10.7%**	**9.8%**	**8.8%**	**8.3%**	**7.2%**	**6.3%**

Changes in Employment Composition for Pinal County



The fiscal issues derived from past policy decisions (pre-2008) caused the region to fall behind in local transportation infrastructure investment. Pinal County focused on housing development during the unsustainable development that occurred prior to the recession of 2008 and less focus was placed on base sector job creation. However, current economic development efforts have been completely refocused on employment and infrastructure investment and long-term growth. In this case, the past performance of the county will likely understate the economic development opportunities in higher value-added industries that would accompany strategic transportation investment.

[137] *Ibid.*

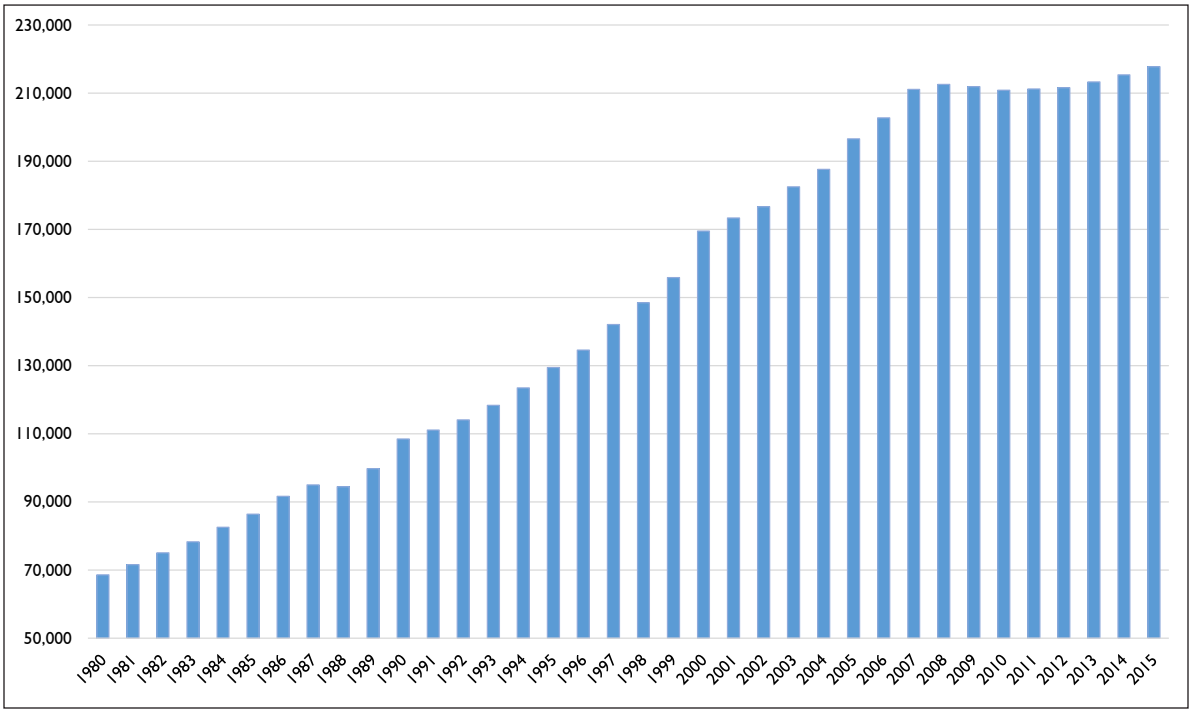
Yavapai County Example

The northern portion of our abbreviated case study is Yavapai County. This county is reviewed because of the fact that its major communities are NOT directly in alignment with the proposed I-11 routes.

As of 2015, the population of Yavapai County was 217,778.[138] Between1980 and 2006, the annual population growth rate was averaging about 4.0 percent. Population growth has improved in recent years, increasing 1.0 percent in 2014 and 1.1 percent in 2015. However, the average over the past five years was a relatively weak 0.5 percent. Again, this must be reviewed in context. The recession of 2008 greatly impacted people's net worth, and many postponed retirement, or moved from the Rust Belt to the Sun Belt. While net worth of retirement-aged individuals has improved, debt and difficult lending standards continue to limit population flows from one state to another. This will ease around 2020. Thus, population inflows to Yavapai County, an important component of the economy, will be improving, but is not at the "inflection" point that was noted in Pima County.

Job creation is not just limited to tourism and retirement. Yavapai County also has a technical base and is aggressively pursuing economic development coordination among its communities and enhanced diversification. In 2015, total employment increased 2.9 percent over 2014. Between 2007 and 2010, Yavapai County lost 12,400 jobs, or about 18.9 percent of its total employment base. As of June 2016, the county has regained about 10,400 jobs, or 83.9 percent of the total jobs lost since 2010.

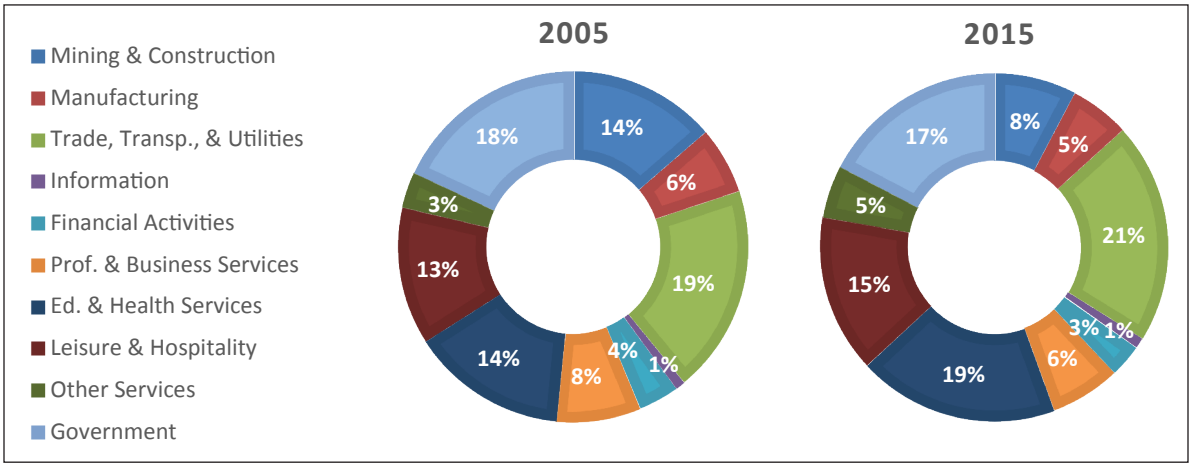
Yavapai County Population 1980-2015



[138] *Ibid.*

Yavapai County Population and Employment[139] (in thousands)											
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Population	196.6	202.8	211.1	212.6	211.9	210.9	211.2	211.6	213.3	215.4	217.8
Employment	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Nonfarm	59.7	64.1	64.6	62.0	57.0	55.0	54.6	55.8	57.1	59.4	61.1
Total Private	48.9	53.0	53.1	50.2	45.6	43.9	44.0	45.4	46.6	48.7	50.5
Mining & Construction	11.9	12.8	12.0	10.3	7.9	7.0	6.8	7.2	7.5	7.9	8.1
Manufacturing	8.2	9.1	8.6	7.2	5.3	4.4	4.0	4.2	4.3	4.6	4.7
Trade, Transportation, & Utilities	3.7	3.7	3.4	3.2	2.7	2.6	2.8	3.0	3.2	3.3	3.4
Information	47.9	51.3	52.6	51.7	49.1	48.0	47.9	48.7	49.6	51.5	53.0
Financial Activities	37.1	40.1	41.0	39.9	37.7	36.9	37.2	38.2	39.1	40.8	42.4
Professional & Business Services	11.5	12.4	12.8	12.5	11.5	11.4	11.4	11.4	11.6	12.2	12.6
Educational & Health Services	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Leisure & Hospitality	2.2	2.5	2.5	2.3	1.9	1.8	1.8	1.7	1.7	1.8	1.9
Other Services	4.7	5.1	4.8	4.0	3.6	3.2	3.1	3.2	3.2	3.5	4.0
Government	8.6	9.3	10.0	10.3	10.5	10.3	10.1	10.4	10.9	11.3	11.4
Federal Government	7.6	8.1	8.3	7.9	7.2	6.9	7.3	7.8	8.0	8.4	9.0
State and Local Government	2.0	2.1	2.1	2.3	2.5	2.7	2.9	3.1	3.1	3.0	3.0
Unemployment Rate	4.4%	4.0%	3.7%	6.2%	10.5%	10.7%	9.9%	8.7%	7.7%	6.3%	5.5%

Changes in Employment Composition for Yavapai County



[139] *Ibid.*

Yavapai County may prove to be one of the better examples of how economic development opportunities related to I-11 investments can be captured even if the local communities are not directly aligned with the proposed highway alignment. These opportunities will vary in scale. If the local areas have a more diverse economic base, more opportunities will be presented. If the economic base has the ability to supply business inputs, fewer will need to be imported and the "multiplier" impacts will be expanded. If the whole of the local infrastructure is well maintained (i.e. transportation, utilities, etc.) the current economic development opportunities will be enhanced. Additional note: Yuma County in the southwestern part of the state will yield a similar conclusion if evaluated in this manner.

The overarching point is that each community has its own economic story. In some cases, the same economic issues arise when comparing communities, but the interpretation and conclusions can vary. In other cases, the economic discussion can be completely different from one community to the next. However, there are consistent themes as shown in the risk register. Transportation infrastructure is one of the few themes consistent to the well-being of all communities.

Appendix M: SHRP2 (C19) Project Timeline

Listed below are details of when major efforts occurred. This does not include day-to-day efforts such as internal meetings to further scope project, individual calls, updating SHRP2 C19 material (PowerPoints, fact sheets, communications listing, webpage, etc.).

Date	Event
	2013
October 24, 2013	• Announcement of FHWA SHRP2 award
	2014
February, 2014	• Funds obligated; contract with DOT has been finalized.
March 10, 2014	• Participate in FHWA C19 kick-off call.
March 31, 2014	• FHWA C19 kick-off call with MAG.
April 1, 2014	• FHWA Kick-off call to confirm performance measures, expected deliverables, resources, funding and next steps.
April 2, 2014	• Email to Intermountain West MPO/TMA directors to introduce project and seek input on project and staff POC.
April 14, 2014	• Call with Intermountain West MPO/TMA directors to introduce project and seek input on project and staff POC. • Participate in Western Regional Alliance phone call and provide SHRP2 C19 project update.
May 5, 2014	• Participate in Western Regional Alliance phone call and provide SHRP2 C19 project update.
May 15, 2014	• Follow up email to Intermountain West MPO/TMA directors to identify staff POC and send project fact sheet and draft work plan.
July 2014	• Submit C19 progress report to FHWA.
August 7, 2014	• Draft GIS survey sent out to SHRP2 technical team for review.
August 12, 2014	• Call with SHRP2 technical team to review GIS survey; seek input for refinement. • During the call, background on SHRP2 grant, uniqueness of Intermountain West region, project goals and request for assistance: common operating vision/ platform was presented.
August 25, 2014	• Participate in Western Regional Alliance phone call and provide SHRP2 C19 project update.
August – October, 2014	• Compile GIS survey responses; follow-up on responses; individual calls with agencies.
October 16, 2014	• Participate in Western Regional Alliance phone call and provide SHRP2 C19 project update.
October 17, 2014	• Webinar presentation to SHRP2 technical team on SHRP2 grant, project goals and update on efforts since last call. o Review of survey responses and data o Discussion on next steps
October 28, 2014	• Webpage for project is unveiled: https://www.azmag.gov/information_services/shrp2-expediting-project-delivery-grant.asp
October 31, 2014	***Start of webinars to highlight GIS survey results and discussion*** • Webinar presentation to SHRP2 technical team to highlight: o Arizona Department of Transportation GIS tools by Patrick White ford, GISP, Senior GIS Analyst o Utah Department of Transportation GIS tools by Becky Hjel, GIS Manager, UDOT

Date	Event
November 21, 2014	• Webinar presentation to SHRP2 technical team to highlight: o SHRP2 project update o Spokane Regional Transportation Council (SRTC) GIS tools by Kevin Shipman, GIS Analyst o Western Governors' Association (WGA) Critical Habitat Assessment Tools (CHAT) presentation by Carlee Brown, Policy Advisor, Western Governors' Association and Laura Canaca, Project Evaluation Program Supervisor Arizona Game and Fish Department
December 12, 2014	• Webinar presentation to SHRP2 technical team to highlight: o SHRP2 project update o Denver Regional Council of Governments demo of data collection and distribution tools by Ashley Summers, Information Systems Manager o Maricopa Association of Governments interactive mapping and reporting tools presentation by Anubhav Bagley, Information Services Manager
December 16, 2014	• Technical call with MAG and WGA CHAT GIS folks on lessons learned/data collaboration.
December 23, 2014	• Call between MAG and Federal Highway Administration (FHWA) to highlight efforts in the geospatial data collaboration initiative.
2015	
January 2015	• Submit C19 progress report to FHWA.
January through March 2015	• Conduct individual agency interviews on GIS and summarize findings.
January 9, 2015	• Webinar presentation to SHRP2 technical team to highlight: o SHRP2 project update. o Pikes Peak Area Council of Government's (PPACG) web data by Craig T Casper, Regional Transportation Director, PPACG. o Overview of Western Regional Partnership and its GIS capabilities by Gabe Lovasz, GIS Manager, ManTech International Corporation and Amy Duffy, Duffy Consulting.
January 15, 2015	• Participate in Western Regional Alliance phone call and provide SHRP2 C19 project update.
January 29, 2015	• Webinar presentation to SHRP2 technical team to highlight: o SHRP2 project update o Mid-Region Council of Government (MRCOG) ▪ Transportation Analysis Querying Application (TAQA) by Aaron Sussman. ▪ Story Maps by Caerllion (Caeri) Thomas, AICP, GIS Coordinator/Transportation Planner and Andrew Gingerich.
March – April 2015	• Collect data from SHRP2 C19 technical team.
March 3, 2015	• Webinar presentation to SHRP2 technical team to highlight: o SHRP2 project update. o Review of survey questions centered on best methods to share data and input on data collaboration.
March 4, 2015	• Request input from SHRP2 C19 technical team on recommendations for Intermountain West transportation vision.
March 5-6, 2015	• Intermountain West MPO/TMA/Transit meeting—presented on project; requested agency involvement.

Date	Event
May 11, 2015	• Webinar presentation to SHRP2 technical team to highlight: o SHRP2 project update. o Regional Transportation Commission of Southern Nevada presentation on: ▪ Interactive mapping for planners, examples for TIP projects by Beth Xie. ▪ HERE Data On Dashboard for Performance Measures by Gang Xie.
May 28, 2015	• Webinar presentation to SHRP2 technical team to highlight: o Brief update on project status with focus on data collection and review. o Overview of August 27 & 28: SHRP2 technical meeting including agenda and meeting goals.
June - August 2015	• Develop with SHRP2 C19 technical team draft land use look-up tables for the Intermountain West.
July 2015	• Submit C19 progress report to FHWA.
July 2015	• Begin drafting GIS presentation summaries.
July 11 – 12, 2015	• SHRP2 C19 project discussion at COG/MPO Socioeconomic Modeling Miniconference at SANDAG.
August 2015	• Survey SHRP2 C19 technical team on their agencies' use of risk registers.
August 27-28, 2015	Twenty-six technical staff from 14 different agencies (DOTs, MPOs, TMAs) meet in Denver to provide input on the SHRP2 (C19) project and to share information: • Overview of SHRP2 project efforts to date and meeting goals. • Roundtable discussion on GIS -related efforts in the intermountain region. • Interconnected economies presentation. • SHRP2 implementation plan. • Transportation data and analytics. • Data. • Long range growth patterns in the Intermountain West • Common data reporting and mapping tools.
September 2015	• Draft report outline circulated for further review and input.
September 4, 2015	• Participate in call with Colorado Department of Transportation to learn more on their use of risk registers.
September 7, 2015	• Participate in call with California Department of Transportation to learn more on their use of risk registers.
September 25, 2015	• Webinar presentation to SHRP2 technical team to highlight: o Brief recap of August project meeting. o Feedback from meeting o Discussion/input on next steps.
October 2015	• Continue seeking input from SHRP2 C19 technical team on recommendations for Intermountain West transportation vision.
October 7, 2015	• Project update provided to Intermountain West directors on SHRP2 C19 effort via email.
October 27, 2015	• Call between MAG and ADOT on risk register and SHRP2 C19 project.
October 29, 2015	• SHRP2 C19 project call among FHWA, MAG, Volpe Center and ADOT.
November 13, 2015	• SHRP2 C19 project update to Arizona COG/MPO directors.
November 18, 2015	• Webinar presentation to SHRP2 technical team to highlight: o FHWA geospatial data collaboration: tools for data sharing by Mark Sarmiento, Community Planner, FHWA, USDOT Headquarters. o Western Electricity Coordinating Council (WECC) transmission analysis and use of GIS, by Byron Woertz, Manager of System Adequacy Planning and Jon Jensen, Staff Engineer, WECC.

Date	Event
December 7, 2015	• Meeting with ADOT and MAG on risk register and SHRP2 C19 project.
2016	
January 2016	• Submit C19 progress report to FHWA.
January through September 2016	• Development of draft report with risk register. Seeking input from key stakeholders to further refine.
January 8, 2016	• Attend Joint Planning Advisory Council meeting for potential inclusion of information into SHRP2 C19 project efforts in Arizona.
February 2016	• MAG hires economist to augment SHRP2 C19 report to include economic perspective in report and risk register.
February 9, 2016	• SHRP2 C19 project update to Arizona COG/MPO directors.
March – June 2016	• SHRP2 C19 economic section drafted and further refined based on input.
March – September 2016	• Prepare multiple drafts of SHRP2 C19 report; further refine based on stakeholder input.
April 22, 2016	• Webinar presentation to SHRP2 technical team to highlight: o SHRP2 project update. o Telephone updates (SRTC, DRCOG, ADOT, CDOT, MAG).
April 26, 2016	• SHRP2 presentation to Intermountain West directors meeting by Amy Duffy, Duffy Consulting; Jami Dennis, MAG; and Joe Bryan, WSP/PB Freight Logistics.
May 2, 2016	• SHRP2 C19 project update to Arizona COG/MPO directors.
May 24, 2016	• Meeting between MAG and ADOT regarding SHRP2 C19 project with focus on risk register.
June 29, 2016	• Jami Dennis presented at the Esri International User Conference.
July 19, 2016	• SHRP2 C19 presentation at C19 Expediting Project Delivery session at the TRB conference in Salt Lake City.
July 23 – 24, 2016	• SHRP2 C19 project update at COG/MPO Socioeconomic Modeling Miniconference at SANDAG.
July 2016	• Submit C19 progress report to FHWA.
August – September 2016	• SHRP2 C19 Report sent multiple times to stakeholders for input. • Communication with ADOT on SHRP2 C19 project with focus on risk register.
August 25, 2016	• SHRP2 C19 project update at Arizona COG/MPO meeting.
September 6, 2016	• Meeting between MAG and ADOT regarding SHRP2 C19 project with focus on risk register.
September 27, 2016	• SHRP2 C19 project close out meeting/webinar.

Appendix N: February/March 2015 Survey Questions and Compiled Responses

Question #1: "Do you have any concerns with sharing information?"

- 2 – Most data would need a data sharing agreement.
- 12 – In general, no concerns with sharing data.

Recommendations/Comments:

- 4 - Be efficient about this so that it can be done with minimal amount of staff time; limited staff resources.
- The data should have a date and be referenced (linked back to the data source) in case there are questions.
- Refresh the data that someone does not end up with stale or even incorrect data.
- Perhaps good first step would be to create a metadata catalogue with "pointers" to the data's real location.

Question #2: *"Do you have any concerns with posting your data to a FTP website? Would this need to be password protected?"*

- 8 – Password protected not necessary.
- 3 – Prefer MAG to download data from their website.
- 2 – Password protected is necessary/preferred (data sharing agreement).
- 1 - Recommend a metadata catalogue first.

Question #3: *"For the data you can share with MAG, may it also be shared with others (as either view only or download)? May this data continue to be shared with MAG after this federal grant is completed?"*

- 10 – Data can be shared with others during and after the grant ends.
- 3 - MAG could share the data after the grant is over. If the data was for sharing (no download) the data could be displayed for others. Anyone wanting to download data would need to complete a data sharing agreement.
- 1 – Much data can be shared; recommend data catalogue to begin

Recommendations/Comments:

- It would be helpful to know operating rules; how often data is to be refreshed; the process to refresh data; data gatekeeper.

Question #4: *"If you required a data sharing agreement, what are next steps to secure such an agreement? Does MAG need to sign documentation? And if so, do others also need to sign a document for them to see the data too? What are the restrictions for MAG to show or share data?"*

- 7 - N/A; data is publicly available.
- 3 - MAG and others would need to sign the agreement (if desire to download data).
- 3 - Data sharing agreement needed for certain data only.
- 1 - Most data are publicly available; would prefer to have data sharing agreement to highlight value of effort to upper management.

Question #5: *"Are there tools/functions that you would like to see in a common data operating platform for this project?"*

- 3 - Regional GIS viewer.
- 3 - Search/query features (category, geography, keywords, etc.).
- 3 - ArcGIS Online.
- 1- Use Open matrix.
- 1 - Online web mapping application.
- 1 - Data download capacity.
- 1 - Contact information for data.

- 1 - Common release form.
- 1 - Network of all roads.
- 1 - Forum for Q and A.
- 1 - Track demographic data over time (estimates, forecasts).
- 1 - Visualize and compare data in a geographic region.
- 1 - Highlight methods for better data sharing/collaboration.
- 1 - Ability to develop data charts.
- Data Commonality:
    - 1 - Common schema.
    - 1 - Coordinate data updates so that similar data is being updated at the same time; use same lat/long/decimal degree.
    - 1 - Data uniform/consistent.
    - 1 - Standardized data documentation, including data dictionary, scope and source.

Question #6: *"Are there tools/websites/data analysis that you would like to have highlighted on a webinar?"*

- 7 - Demo other agencies' efforts:
    - 2 - Successful examples of GIS products
    - 1 – Highlight lessons learned/best practices/efforts that can be transferrable.
    - 1 – Linear referencing.
    - 1 – How other entities are incorporating spatial and non-spatial data and make that work.
    - 1 – RTC will be ready after mid-March.
    - 1 – Open model data.
- 2 - Data sharing next steps.
- 5 - N/A.
- 6 - It has been helpful to learn from others; impressive functionality.
- Lots of parties involved and good sharing; big effort to get everyone involved and sharing information.
- Helpful to learn of commonalities and opportunities to work together.
- Provide summary information about posted webinars.
- Develop a best practices website (interactive best practices, troubleshooting); common region dataset.

Question #7: *"Who are we missing on this effort?*

- 4 - N/A; would be helpful to look at current list.
- DOTs:
    - 3 - CDOT
    - 2 - WSDOT
    - 1 - UDOT
- 2 - AGRC
- Other contacts to follow up with/leveraging opportunities:
    - 1 - Colorado Information Marketplace
    - 1 - Open Colorado
    - 1 - NCR Homeland Security Group
    - 1 - CLTRP-Western Regional Lands
    - 1 – RGIS program
- Depending on data needs
    - 1 - UT Dept. of Workforce Services
    - 2 - Key local authorities
    - 2 - State CIOs

Question #8: "Are there any related data that you would like to consume that you currently do not have (looking for missing authoritative data layers)?"

- 4 - Environmental (air/water quality, wildlife corridors, fire risk, flood plains) data
- 2 - Traffic data (travel time and travel speed; historical)
- 2 - Utility data
- 2 - Parcel data from political jurisdictions
- More user friendly data:
    - 3 - Census data

2 - Improved state household/employment data

- National Data Sets:
    - 1 - BLM PLSS and land ownership data
    - 1 - NSDI
    - 1 - Natural constraints data (BLM and NPS)
    - 1 - Authoritative data layer of federal roads
- 1 - Freight data
- 1 - LiDAR data

Appendix O: IMW GIS Resources/URLs

Agency	Details	Web Address
Arizona		
ADOT	APLAN	http://adot.maps.arcgis.com/home/index.html
	AZGEO	https://azgeo.az.gov/AZGEO/
	Map and Data Clearinghouse	http://adot.maps.arcgis.com/home/index.html
PAG	GIS Data and Maps	http://www.pagregion.com/Default.aspx?tabid=84
	Interactive Maps	http://www.pagnet.org/RegionalData/GISDataandMaps/InteractiveMaps/tabid/109/Default.aspx
	Travel Data and Forecasting	http://www.pagnet.org/RegionalData/TravelDataandForecasting/tabid/87/Default.aspx
Tucson	ZoomTucson	http://maps.tucsonaz.gov/zoomTucson/
	Map Resources	http://it.tucsonaz.gov/gis/map-resources
Marana	Marana Map	http://maranaegov.com/webmap3/webmap3.aspx?xml=marana2c.xml
Oro Valley	Oro Valley Maps - GIS	http://www.orovalleyaz.gov/town/departments/maps-gis
Pima County	Pima Maps	http://webcms.pima.gov/cms/one.aspx?portalId=169&pageId=22235
MAG	Connect Bien	http://www.connectbien.com/
	GreaterPhoenixRising	http://greaterphoenixrising.com
	Employment Map Viewer	http://geo.azmag.gov/maps/employment/
	Read On Arizona's MapLIT	http://readonarizona.org/data-center/
	Land Use Map Viewer	http://geo.azmag.gov/maps/landuse/
	MAG Neighborhood Explorer	https://geo.azmag.gov/maps/landmarks/
	Projections Map Viewer	http://geo.azmag.gov/maps/projections2013/
	Bikeways Map Viewer	https://geo.azmag.gov/maps/bikemap/
	Victim Services Map Viewer	http://geo.azmag.gov/maps/VictimAdvocates/
	Regional Data Center	http://datacenter.azmag.gov/
	Demographic Map Viewer	http://geo.azmag.gov/maps/demographic/
	Interactive Map Viewer	http://ims.azmag.gov/
Colorado		
DRCOG	Denver Regional Equity Atlas	http://www.denverregionalequityatlas.org/
	Denver Regional Visual Resources	https://drcog.org/services-and-resources/denver-regional-visual-resources or https://drcog.org/drvr
	Regional Data Catalog	http://gis.drcog.org/datacatalog/
CDOT	Online Transportation Information System (OTIS)	http://dtdapps.coloradodot.info/otis
RTD Denver	RTD Data Downloads	http://maps.rtd-denver.com/gisdatadownload/datadownload.aspx
Piton Foundation	Colorado Data Engine	http://codataengine.org/
State of Colorado	Open Colorado	http://opencolorado.org/
	Office of Information Technology Data Portal	http://www.oit.state.co.us/home
	Colorado Information Marketplace	https://data.colorado.gov/
NFRMPO	NFRMPO GIS	http://www.nfrmpo.org/GeographicInfo.aspx
	Crosswalk Cooperative Planning (AECOM)	http://www.cooperativeplan.com/

Agency	Details	Web Address
Colorado (continued)		
El Paso County	Geographic Information Systems	http://adm.elpasoco.com/InformationTechnologies/GeographicInformationSystems/Pages/default.aspx
Colorado Springs	Interactive Maps	https://gis.springsgov.com/
Idaho		
COMPASS	Performance Dashboard	http://www.compassidaho.org/dashboard/
	Products, Services and Data	http://www.compassidaho.org/prodserv/intro.htm
	Communities in Motion 2040	http://www.compassidaho.org/prodserv/cim2040.htm#Plan
	Air Quality Conformity Demonstrations	http://www.compassidaho.org/prodserv/aq-demo.htm
	Mapping and GIS	http://www.compassidaho.org/prodserv/mapgis-maps.htm
Boise	Property Viewer	http://gis.cityofboise.org/
Ada County	Mapping Services	https://adacounty.id.gov/Mapping-Services
Ada County Highway District	RITA	http://achdidaho.org/gis/
Canyon County	Interactive Map	http://gis.canyonco.org/flexviewers/Test/
State of Idaho	Highway Info	http://hb.511.idaho.gov/main.jsf
Montana		
MDT	MDT Travel Info	http://roadreport.mdt.mt.gov/travinfomobile/
Nevada		
Clark County	Open Web	http://gisgate.co.clark.nv.us/openweb/
NVDOT	NV Roads	http://www.nvroads.com/
RTCS	RTC TIP	http://rtcws.rtcsnv.com/TipViewer
	Fast Dashboard	http://bugatti.nvfast.org/
RTC Washoe	Map Warehouse	http://www.rtcwashoe.com/planning-94
New Mexico		
University of New Mexico	Earth Data Analysis Center	http://edac.unm.edu/
Albuquerque New Mexico	ABQ Maps	http://www.cabq.gov/gis
MRCOG	Transportation Analysis and Querying Application (TAQA)	http://www.mrcog-nm.gov/transportation/technical-services/transportation-analysis-querying-application-taqa
	Interactive Maps	http://www.mrcog-nm.gov/transportation/technical-services
	Long Range Transportation System Guide Gallery	http://www.mrcog-nm.gov/transportation/technical-services/46-transportation/1281-long-range-transportation-system-guide-map-gallery
	Regional Traffic Safety Report	http://www.mrcog-nm.gov/transportation/technical-services/safety-analysis
	Socio-Economic Data	http://www.mrcog-nm.gov/transportation/technical-services/socio-economic-data?task=view&id=192
	Futures 2040 Map Gallery	http://www.mrcog-nm.gov/transportation/technical-services/31-transportation/technical-services/1280-futures-2040-map-gallery
NMDOT	NM Roads	http://nmroads.com/mapIndex_04211601.html
NMDOT	Maps	http://dot.state.nm.us/en/Maps.html

Agency	Details	Web Address
Utah		
Mountainland AOG	Maps and Data	https://www.mountainland.org/mapsdata
	Mapping Center	http://mag-gis.maps.arcgis.com/home/index.html
	Population and Demographics	https://www.mountainland.org/data
	Future Population Projections	https://www.mountainland.org/population-projections
	Historic Population Data	https://www.mountainland.org/historic-population-data
	Latest Census Population Estimates	https://www.mountainland.org/2014-census-estimates
	2010 Census Data	https://www.mountainland.org/city-data
	2000 Census Data	https://www.mountainland.org/2000-census-data
	Hazard Mitigation Data	https://www.mountainland.org/hazards
Utah County	County Maps and GIS Data	http://www.co.utah.ut.us/OnlineServices/maps/index.asp
Utah AGRC	Automated Geographic Reference Center	http://gis.utah.gov/
UDOT	Data Portal	https://www.udot.utah.gov/ugate/f?p=111:2:0::NO:::
	Ugate	https://maps.udot.utah.gov/ugate
	Uplan UDOT Map Center	http://uplan.maps.arcgis.com/home/
WFRC	WFRC Data	http://www.wfrc.org/new_wfrc/index.php/resources/data
	WFRC Map Gallery	http://www.wfrc.org/public-maps-gallery/index.html
Washington		
SRTC	Featured Data Groups	http://srtc.maps.arcgis.com/home/group.html?owner=SRTCadmin&title=SRTC%20Featured%20Data
	Maps	https://srtc.maps.arcgis.com/home/
	SCOUT	http://maps.spokanecounty.org/
Spokane County	Maps Spokane	http://maps.spokanecity.org/
Spokane	WSDOT GeoPortal	http://www.wsdot.wa.gov/data/tools/geoportal/
WSDOT	WSDOT GeoData Distribution Catalog	http://www.wsdot.wa.gov/mapsdata/geodatacatalog/default.htm
WSDOT	Washington State Geospatial Open Data Portal	http://wa-geoservices.maps.arcgis.com/home/
State of Washington	Washington State Geospatial Open Data Portal	http://wa-geoservices.maps.arcgis.com/home/
Wyoming		
WYDOT	Interactive Transportation System Map	https://apps.wyoroad.info/itsm/map.html

Agency	Details	Web Address
Regional/National		
ESRI	Geospatial Data Collaboration	http://www.fhwa.dot.gov/everydaycounts/edctwo/2012/gis.cfm
FHWA	NEPA Guidance for Federal Aid Projects-Cultural Resources	http://www.azdot.gov/business/environmental-planning/environmental-guidance/nepa-process-guidance/cultural-resources
	Planning and Environmental Linkages	http://www.environment.fhwa.dot.gov/integ/index.asp
	Eco-Logical	http://www.environment.fhwa.dot.gov/ecological/eco_index.asp
	American Association of State Highway and Transportation Officials GIS for Transportation Symposium	http://www.gis-t.org/
	Data Sharing	https://github.com/osPlanning/omx
Open Matrix	Long-Term Planning Tool	https://www.wecc.biz/TransmissionExpansionPlanning/Pages/Environmental-and-Cultural-Considerations.aspx
WECC	Development of Sustainable Strategies Supporting Transportation Planning and Conservation Priorities across the West	http://www.westgov.org/images/images/WGA_FHWA_FinalReport.pdf
WGA	Western Association of Fish and Wildlife Agencies (WAFWA) CHAT	http://www.wafwachat.org/
WRP	Tools and Analysis	https://wrpinfo.org/GISGroup.aspx

Appendix P: Story Map Data Layers

SHRP 2 Story Map Data Layers				
Story Map Description:	*https://azmag.maps.arcgis.com/home/item.html?id=7bd67bee486140faaa8a8b8c90f36a5f*			
Direct link to Story Map:	*http://arcg.is/1MThxpp*			
list updated 7/25/2016				
Layer Name	**Description**	**Category**	**Data Source**	**Key Attributes**
Cities	major cities	Base Map	U.S. Census Bureau	
Counties	county boundaries	Base Map	U.S. Census Bureau	
Intermountain West	boundary for Intermountain West region (IMW)	Base Map	U.S. Census Bureau	
MPO Boundaries	boundaries for the metropolitan planning organizations in the IMW	Base Map	U.S. Census Bureau	
States	state boundaries	Base Map	U.S. Census Bureau	
Census Block Groups	Census 2010 Block Group boundaries for the IMW region	Demographics	U.S. Census Bureau, 2010 Decennial Census	population, housing units, minority population, poverty population
Population Concentration	2010 population concentration by square mile for the IMW region (raster)	Demographics	U.S. Census Bureau, 2010 Decennial Census	
IMW Blocks	2010 Census Blocks for the IMW region	Demographics	U.S. Census Bureau, 2010 Decennial Census	population, housing units, minority population
Population Data for IMW Counties	population by county for the 9-sate IMW region; attributes include population for the years 2000, 2010, 2050.	Demographics	U.S. Census Bureau for 2000 and 2010 attribute data. 2050 population projections collected in 2016 from various state agencies who produce them.	Census population for 2000 and 2010; population projections for 2050; population growth from 2010 to 2050.
2014 Jobs by county	2014 jobs by county for the Intermountain West	Economy	Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) Data http://lehd.ces.census.gov/ v7. 12 (2014 data)	number of jobs in the county for 2014
Workers per square mile	workers per square mile - where persons with jobs reside according to the 2014 LODES 7.2 data (raster)	Economy	Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) Data http://lehd.ces.census.gov/ v7. 12 (2014 data)	

Layer Name	Description	Category	Data Source	Key Attributes
Concentration of Working Age Population	distribution of the working age population, those aged 18 to 64, for the Intermountain West region. (raster)	Economy	U.S. Census Bureau, 2010 Decennial Census	
Job concentration	concentration of jobs in the Intermountain West from the 2014 LODES 7.2 data (raster)	Economy	Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) Data http://lehd.ces.census.gov/ v7. 12 (2014 data)	
Critical Habitat Areas	critical habitat areas in the IMW region	Environment	US Fish & Wildlife Service Threatened & Endangered Species Active Critical Habitat Report, Environmental Conservation Online System http://ecos.fws.gov/ecp/report/table/critical-habitat.html	
Areas of Critical Concern (ACEC)	ACECs are designated by decisions made during BLM Resource Management Planning. Existing ACECs have a resource value tied to them. An example of these resources would be: Threatened and Endangered Plants.	Environment	Bureau of Land Management (BLM)	
BLM Herd Mgmt.	BLM herd management areas	Environment	Bureau of Land Management (BLM)	
Parks and Forests	national, regional, state, county, and local parks or forests	Environment	Esri, Tele Atlas North America	
National Monuments and Wilderness Areas	national monuments and wilderness areas	Environment	Protected Areas Database of the US, PAD-US (Conservation Biology Institute Edition). http://consbio.org/products/projects/pad-us-cbi-edition	
Water Bodies	lakes, streams, reservoirs	Land	ESRI, National Atlas of the United States and the United States Geological Survey	
Hydrology	rivers, creeks, washes, streams	Land	ESRI, National Atlas of the United States and the United States Geological Survey	
Land Cover	National Land Cover Database 2011 (NLCD) clipped to the Intermountain West area	Land	created by the Multi-Resolution Land Characteristics (MRLC) Consortium http://www.mrlc.gov/nlcd2011.php	
Projected Truck Volumes 2040	projected truck volumes from the Freight Analysis Framework (FAF)	Transportation	U.S. Dept. of Transportation, Federal Highway Administration (FHWA), Freight Management and Operations http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf3/netwkdbflow/index.htm	AADT for 2007 and projected 2040, truck tonnage

Layer Name	Description	Category	Data Source	Key Attributes
Airports	airports in the Intermountain West	Transportation	Shapefile from the U.S. National Atlas, http://viewer.nationalmap.gov/basic/#startUp Enplanement data from the FAA http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/	total enplanements for 2013 and 2014, percent change from 2013 to 2014
Bridges	bridges points clipped from the National Bridge Inventory (NBI) for the Intermountain west region	Transportation	USDOT National Bridge Inventory http://www.fhwa.dot.gov/bridge/britab.cfm	average daily traffic (aadt), year built, other NBI data
Ports of Entry	ports of entry into the US for the Intermountain west	Transportation	Source: US Customs and Border Protection	
Average Annual Daily Traffic (AADT)	data by state (for Intermountain West region states) of the AADT; data come from the Highway Performance Monitoring System (HPMS) 2013 submittal.	Transportation	Collected and submitted by the State DOT to the US DOT, Federal Highway Administration http://www.fhwa.dot.gov/policyinformation/hpms/shapefiles.cfm	AADT

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