GIS for Multi-Modal Needs Alignment

Lassen County Transportation Commission | CA

Geographic Information System Services

GEOGRAPHIC TECHNOLOGIES GROUP®

Beyond Location Intelligence

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GIS in Transportation

Introduction

Transportation planning agencies increasingly rely on location-based technologies and Geographic Information System (GIS) tools to help manage and analyze data to improve decision-making. Transportation is inherently a geospatial activity, therefore much of the data needed to support transportation policy, planning, and operations include location as a key attribute. GIS can play a valuable role in transportation in a variety of ways.

- **Data Management:** GIS enables the centralization of spatial datasets relevant to transportation. GIS tools are used to organize, update, and integrate data to provide a comprehensive view of the transportation system.
- **Spatial Analysis:** GIS enables spatial analysis of transportation data to identify patterns, trends, and relationships. Planners can use GIS to analyze factors such as congestion, travel demand, accessibility, and connectivity to assess the performance of the transportation system and identify areas for improvement.
- **Route Planning and Optimization:** GIS is used to plan and optimize transportation routes for different modes of transportation, including cars, buses, trains, bicycles, and pedestrians. By considering factors such as traffic conditions, road capacity, and travel time, GIS can help identify the most efficient routes.
- **Transportation Modeling:** GIS-based transportation modeling allows planners to simulate various scenarios and assess the potential impacts of proposed transportation projects or policy changes. It helps evaluate alternatives, forecast future transportation demand, and prioritize investments to meet the long-term needs of the transportation system.
- **Infrastructure and Asset Management:** GIS facilitates the management of transportation infrastructure assets such as roads, bridges, tunnels, and public transit facilities. It provides spatial data on the condition, maintenance history, and performance of these assets, allowing agencies to prioritize maintenance activities, allocate resources effectively, and ensure the safety and reliability of the transportation network.

- **Public Transit Planning:** GIS supports the planning and management of public transit systems by analyzing ridership patterns, service coverage, and accessibility. Planners use GIS to determine optimal routes, stop locations, and schedules to maximize ridership and improve the overall efficiency of public transit operations.
- **Environmental Impact Assessment:** GIS helps assess the environmental impact of transportation projects by analyzing factors such as air and noise pollution, habitat disruption, and land use changes. It allows planners to identify potential environmental risks, evaluate mitigation measures, and design transportation projects that minimize negative impacts on the environment.
- **Emergency Management:** GIS is critical for emergency response and management during transportation-related incidents such as accidents, natural disasters, or infrastructure failures. It helps coordinate rescue efforts, reroute traffic, and communicate critical information to the public to ensure the safety and resilience of the transportation system.

National GIS in Transportation Use and Resources

U.S. Department of Transportation

Federal Highway Administration

The U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA) has a GIS in Transportation team that facilitates knowledge transfer of GIS skills, best practices, and technical resources among State, regional, and local transportation organizations. They regularly publish case studies and host peer exchanges to promote the use of GIS while highlighting lessons learned and best practices amongst the GIS in Transportation communities. Some of the recent topics explored include:

- Advancing Transportation Equity
- Crash Location Analysis
- E911/NG911

- Asset and Performance Management
- Right-of-Way GIS Applications

A full list of reports published by FHWA's GIS Team can be found on their website at the following link: https://www.gis.fhwa.dot.gov/Reports.aspx.

Federal Railroad Administration

The USDOT Federal Railroad Administration (FRA) is the authoritative source of information on passenger and freight rail networks for the US. Numerous public resources are provided including the FRA Safety Map, Trespassers Casualty Map, and the Grade Crossing Inventory application.

A full list of GIS applications and data provided by the FRA can be found here: https://railroads.dot.gov/rail-network-development/maps-and-data/maps-geographic-information-system/maps-geographic.

Federal Aviation Administration

Beginning in 2007 the USDOT Federal Aviation Administration (FAA) began modernizing the National Airspace System which included implementing GIS software and processes. The FAA's Airports GIS Program is responsible for the collection and submission of aeronautical data and for identifying an appropriate GIS data model for airport-related data.

The FAA's GIS Program developed the Airport Data and Information Portal (ADIP) to assist in the collection of data in support of NextGen. The ADIP can be found here:

https://www.faa.gov/airports/planning_capacity/airports_gis_electronic_alp.

Figure 1: Airport Data and Information Portal (ADIP)

Bureau of Transportation Statistics

The USDOT's Bureau of Transportation Statistics (BTS) develops GIS data and tools, conducts spatial and network analyses, as well as creates high-quality cartography and web applications. They are also responsible for publishing and maintaining the National Transportation Atlas Database.

For a full list of maps, data, and applications created by the BTS please visit https://www.bts.gov/maps.

American Association of State Highway and Transportation Officials

The American Association of State Highway and Transportation Officials (AASHTO) is a non-profit association that represents highway and transportation departments throughout the United States, Washington DC, and Puerto Rico. As indicated on its website, AASHTO "represents all transportation modes: air, highways, public transportation, active transportation, rail, and water," and its goal is to "foster the development, operation, and maintenance of an integrated national transportation system."

AASHTO has a GIS-focused Innovation Initiative that includes hosting a Geospatial Online Transportation User Group (GOTUG: https://transportation.org/gotug/) as well as an annual GIS in Transportation Symposium (GIS-T: https://transportation.org/gis-t/).

Lassen County Regional Transportation Plan Review

Background

The Lassen County Transportation Commission (LCTC) was formed in 1971 in response to the Mills-Alquist-Deddeh Act, more commonly known as the Transportation Development Act, passed by the California Legislature. According to the California Department of Transportation (Caltrans), this legislation was passed "to improve existing public transportation services and encourage regional transportation coordination." It also provides funding for transit and non-transit purposes that follow regional transportation plans.

The LCTC is comprised of three members of the Susanville City Council and three members of the Lassen County Board of Supervisors. It supports Lassen County, the City of Susanville, and Susanville Indian Rancheria by providing strategic planning, grant planning, and transit funding for these local entities.

The Lassen County regional road network consists of 1,706.45 miles of roads, streets, and highways. Most of the roads are maintained by Lassen County while the rest are split between Federal, State, and Local ownership. The County is also home to five airports, several freight rail corridors, ten bicycle facilities (from trails to bike routes along highways), and the Lassen Transit Service Agency which provides public transportation services throughout the County.

Overview

The most recent Lassen County Regional Transportation Plan (RTP) was completed in 2023 and provides a 20-year plan for guiding transportation investments in the County involving local, state, and federal funding. The purpose of the RTP is to "provide a vision for the region, supported by short- and long-range transportation goals.". These goals are as follows:

REGIONAL TRANSPORTATION GOALS

The LCTC proposes the following general regional transportation goals:

- **Goal 1:** Develop and maintain a comprehensive, efficient, and safe transportation system to serve the needs of County residents and to stimulate the economic progress of the County.
- **Goal 2:** To provide adequate cost-effective public transit services, especially to accommodate the needs of the elderly and handicapped.
- **Goal 3:** Promote the continuous flow of goods in, out of, and through the County in a safe and economically efficient manner.
- **Goal 4a:** Provide an adequate number of safe, efficient airports and airfields.
- **Goal 4b:** Support the expansion of economical, efficient air services.
- **Goal 5:** Provide a safe and efficient bicycle and pedestrian circulation system that takes advantage of the natural scenery and physical characteristics of Lassen County.
- **Goal 6a:** Minimize traffic delays by increasing the efficiency of the existing transportation system through Transportation System Management (TSM) techniques.
- **Goal 6b:** Where feasible, reduce the demand for travel by Single Occupant Vehicles (SOVs) through Transportation Demand Management (TDM) techniques.
- **Goal 7:** Reduce GHG emissions from transportation-related activities within the Lassen County boundaries to support the state's efforts under AB-32 and to mitigate the impact of climate change.

Transportation Plan Goals and GIS Use

Highways and Local Roadways

Goal 1: Develop and maintain a comprehensive, efficient, and safe transportation system to serve the needs of County residents and to stimulate the economic progress of the County.

GIS has multiple uses for transportation system planning and management including determining roadway classification, infrastructure and asset management, safety management, and others. It is also a powerful public communication tool that can allow citizens to interact with local transportation data as well as receive important safety information. The examples below highlight how existing transportation agencies are using GIS to manage their transportation system.

Using GIS for Public Communication

The Greater Madison Metropolitan Planning Organization (MPO) in Madison, WI, builds regional agreements on transportation investments for roadways, public transit, bicycle, pedestrian, and other transportation needs. The Greater Madison MPO developed several GIS data layers and web applications in support of regional transportation planning needs. Public applications include maps of major transportation projects, functional classifications, bicycle routes, transit routes, and others.

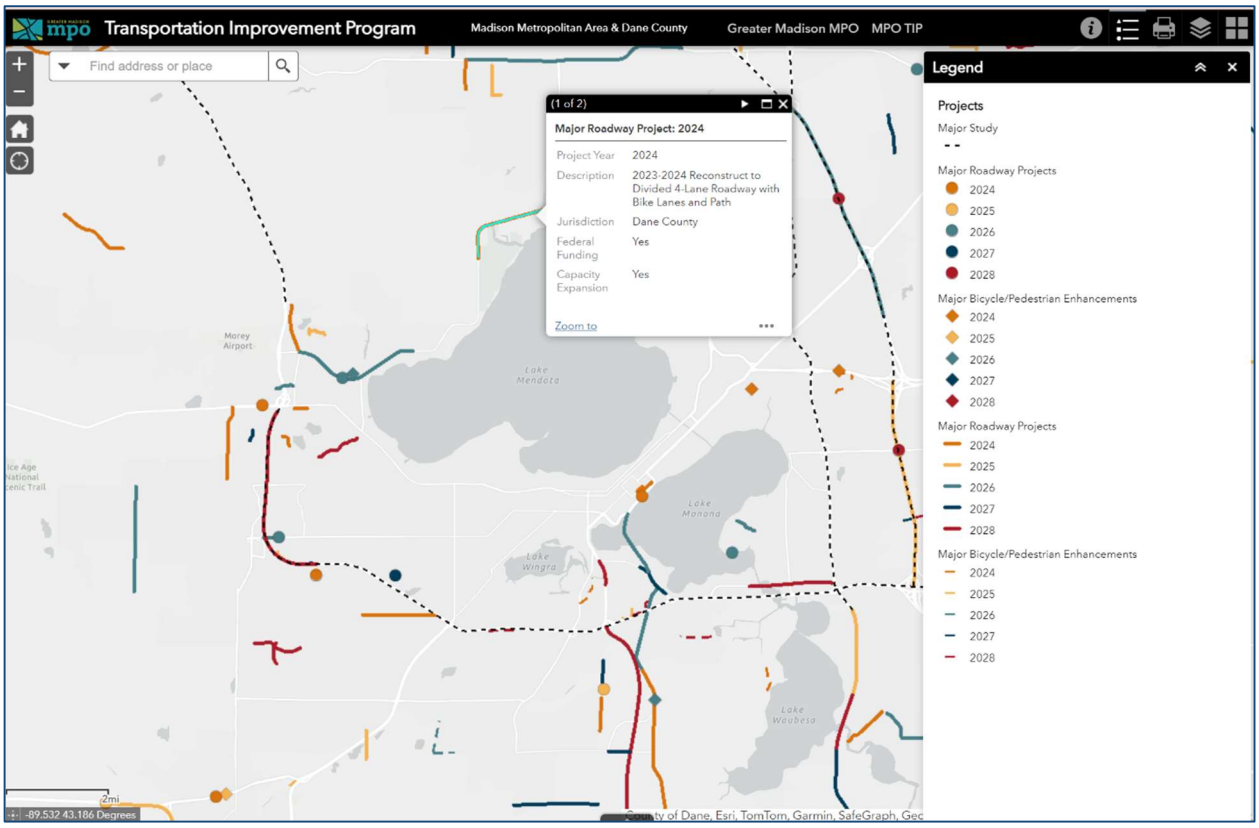

Figure 2 - Greater Madison MPO uses GIS to display their Transportation Improvement Program projects

One way the Greater Madison MPO uses GIS is to allow for public comments on the existing transportation network as well as future projects. A map of proposed projects and associated public comments are represented. Figure 3 shows an application that provides the region with a mechanism to collect public comments on transportation projects.

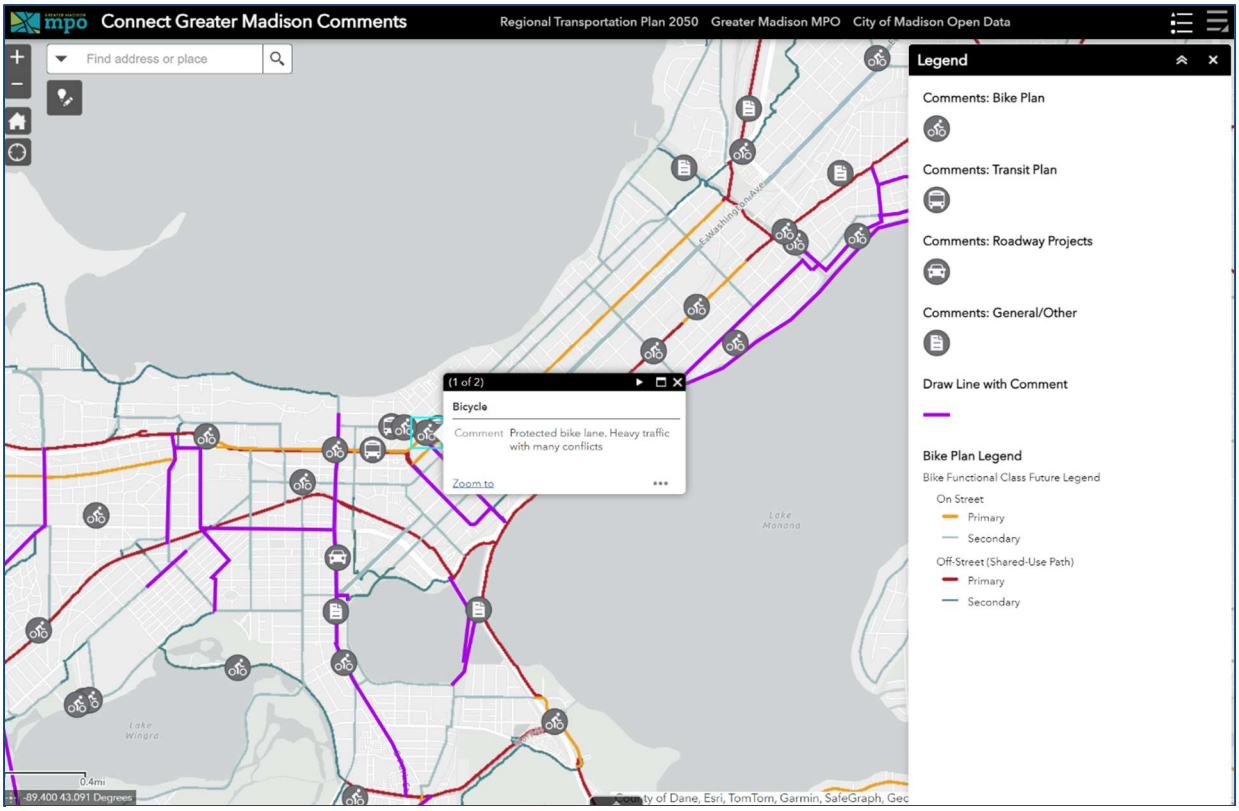

Figure 3 - GIS is used by Greater Madison MPO to receive public comments on transportation projects

The Tehama County Transportation Commission (TCTC) is a close neighbor just to the Southwest of Lassen County in Red Bluff, California. Like LCTC, the Tehama County TC establishes rules and regulations in support of transportation planning and assists with allocating local transportation fund dollars. The Commission is using ArcGIS Online to provide its citizens with access to transportation information including road closures, pavement conditions, and collision data.

Dashboards provide a unique one-stop-shop view of all the data needed to be informed or make decisions. They are designed to be intuitive and easy to understand so that both County Leadership and everyday citizens can access and understand the data.

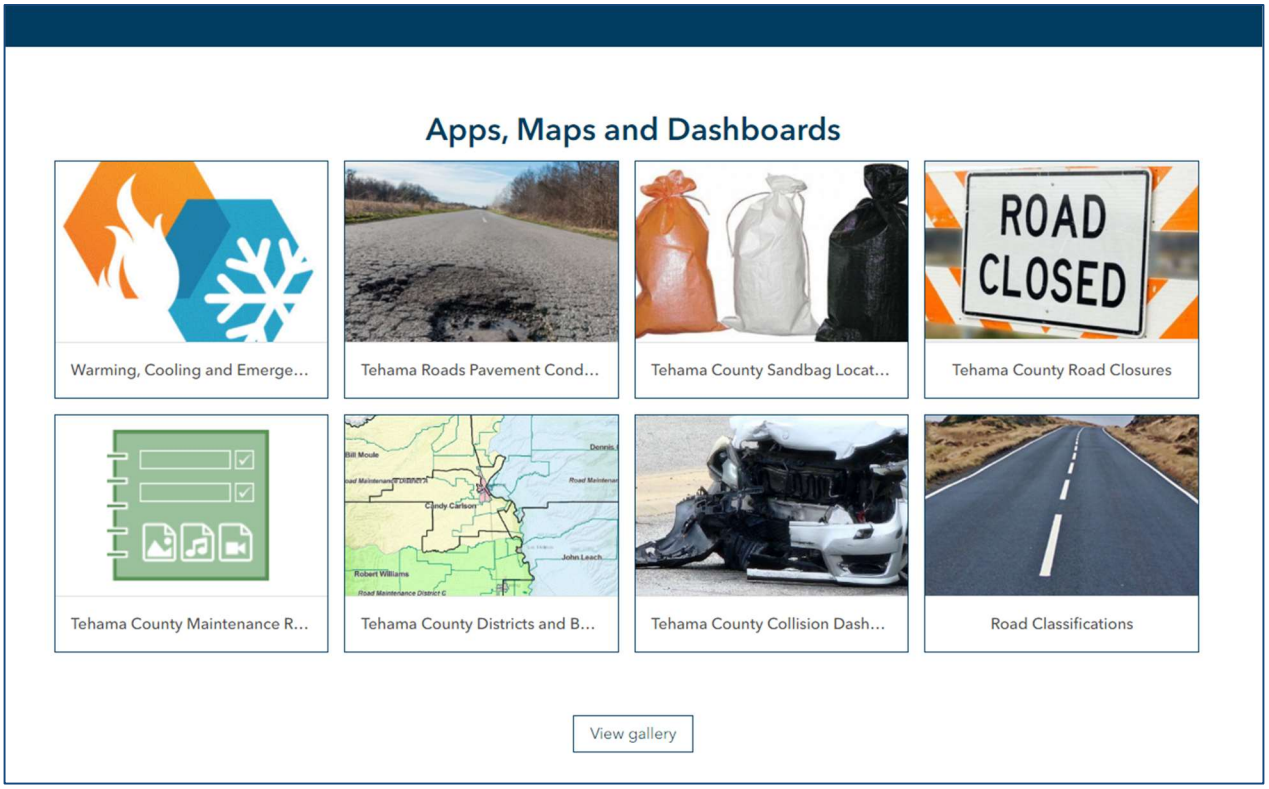

Figure 4 - Tehama County Transportation Commission's ArcGIS Online App Gallery

The Tehama County Transportation Commission's public-facing pavement conditions map shows users where infrastructure with various condition ratings can be found within the County. Figure 5 below shows how the data are displayed.

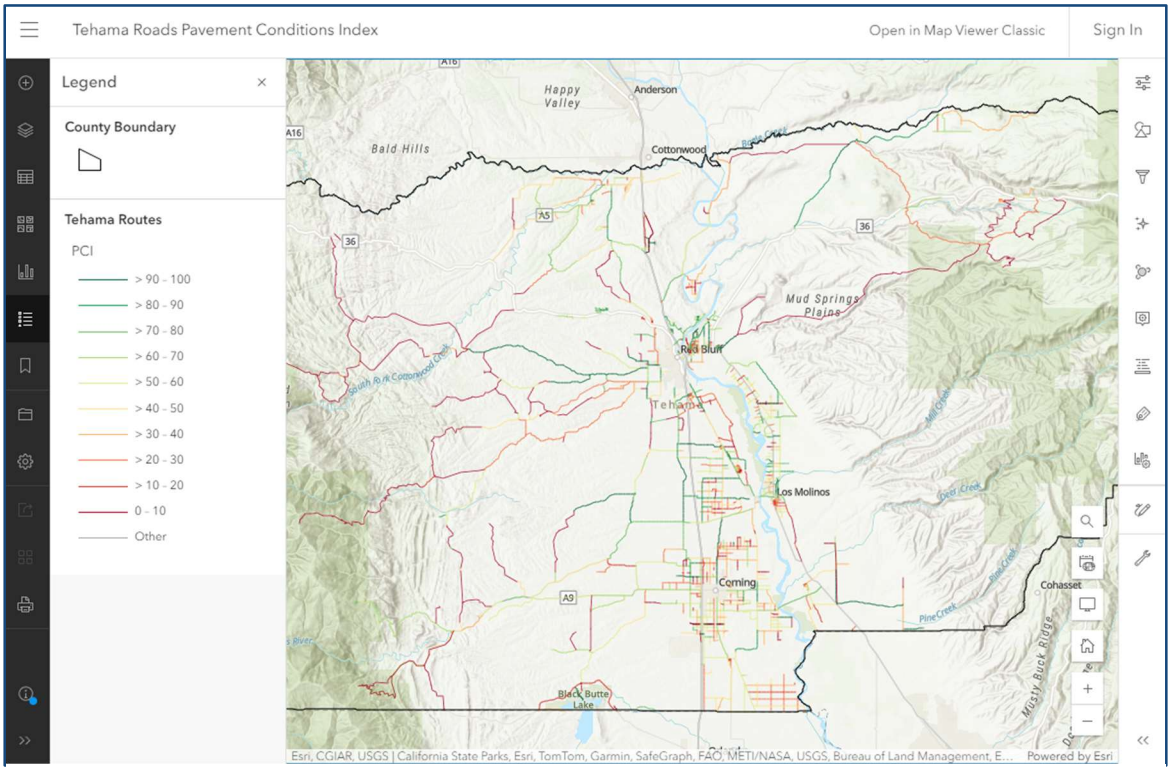

Figure 5 - Pavement Condition Index map for Tehama County, CA

By adopting GIS as a platform to share public information, the Lassen County Transportation Commission will be able to spatially visualize their current and planned transportation projects and provide an alternate communication mechanism for their stakeholders.

Using GIS-Centric Dashboards to Visualize and Analyze Key Performance Measures

The Greater Madison MPO uses ArcGIS Experience Builder to share its adopted performance measures using a GIS-centric dashboard that displays federal measures for safety, bridge and pavement conditions, system reliability, transit asset management, and public transit safety.

Figure 6 highlights several of the Greater Madison MPO safety measures including serious injuries, crash fatalities, and non-motorized injuries and fatalities. While not portrayed, these charts and graphs are interactive and allow users to click and view values of the different data points displayed.

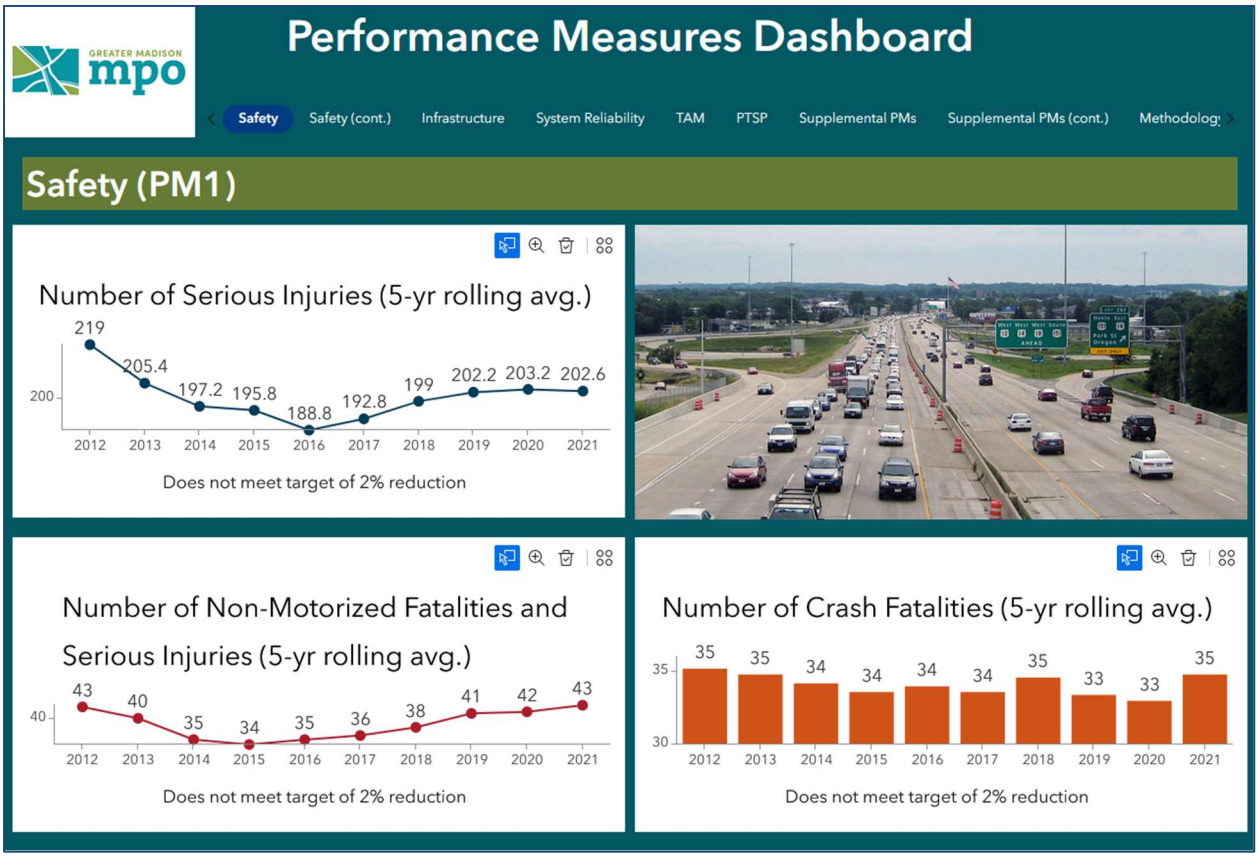

Figure 6 - Performance Measures Dashboard representing safety and crash data

When displaying infrastructure conditions, The Greater Madison MPO uses stacked bar charts to represent "Good," "Fair," and "Poor" ratings. They also include a map of the area to show the physical locations of different infrastructure condition ratings. See Figure 7 for more details.

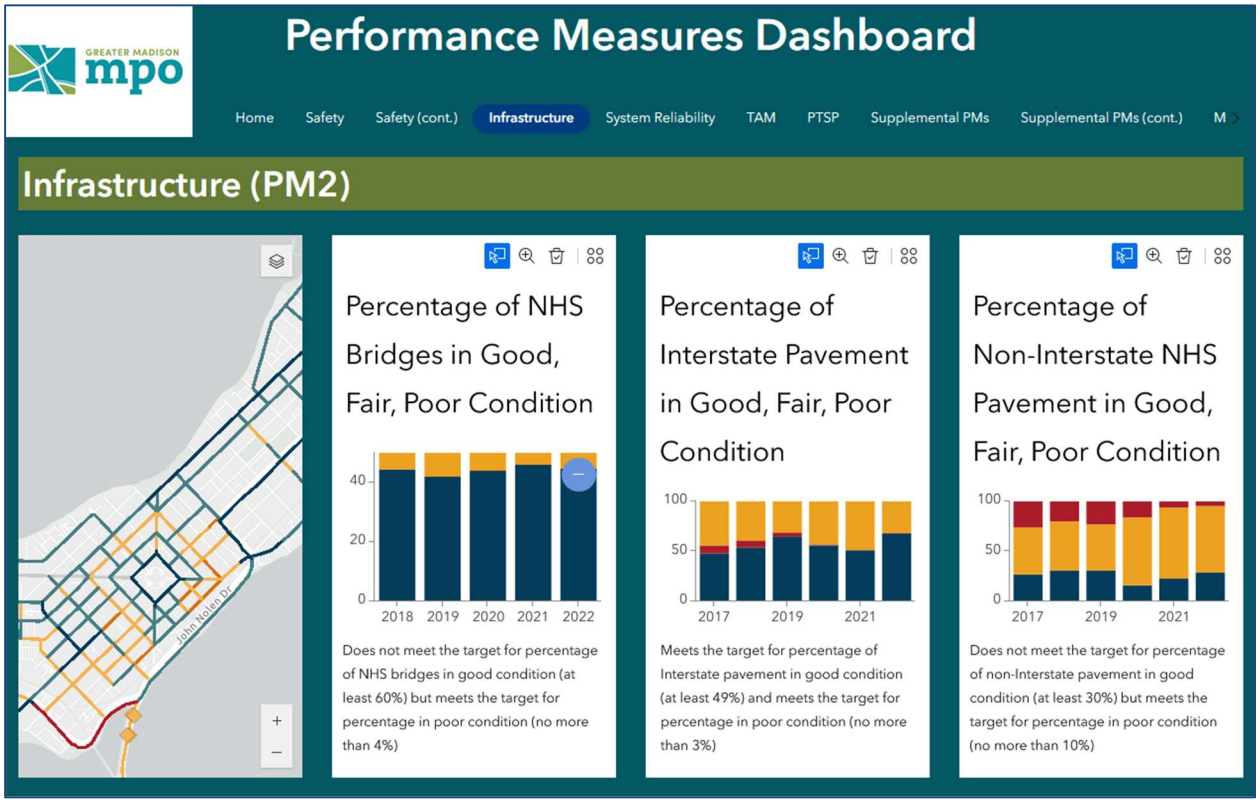

Figure 7 - Dashboard visualizing infrastructure conditions and locations

The Tehama County Transportation Commission (TCTC) also uses dashboards to display collision data. Their dashboard is more map-focused, but still provides pie charts that the users can interact with to glean more information about the data. As shown in Figure 8, users can filter and search the data by a variety of parameters.

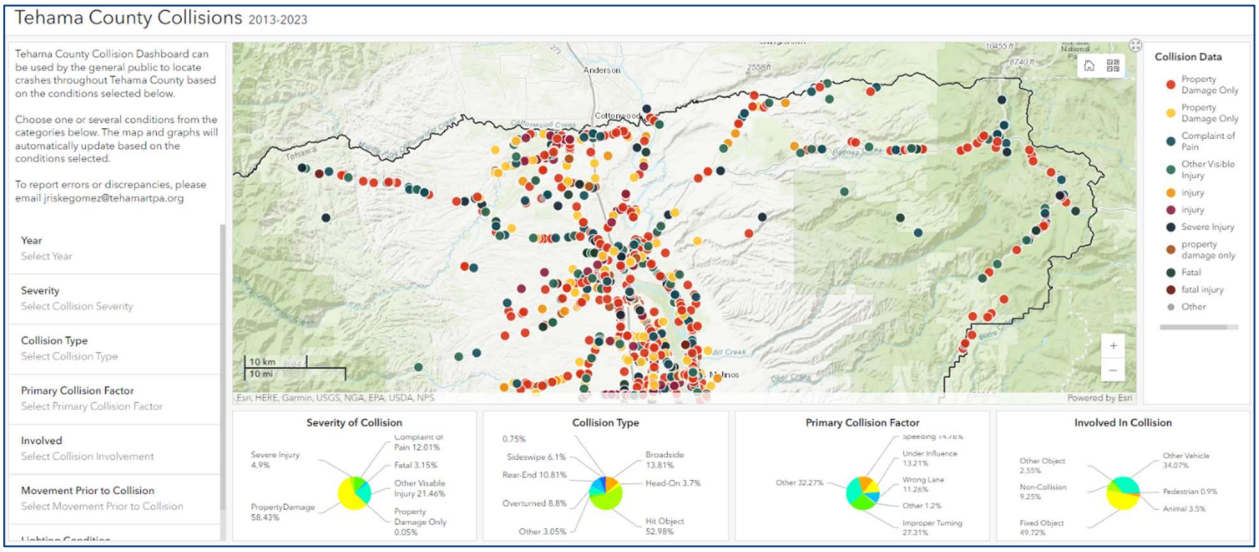

Figure 8 - Interactive Collision Dashboard by Tehama County Transportation Commission

Public Transportation

Goal 2: To provide adequate cost-effective public transit services, especially to accommodate the needs of the elderly and handicapped.

By leveraging GIS technologies and spatial analysis techniques, transit agencies can optimize public transportation route planning, scheduling, fare policies, and accessibility to provide cost-effective public transit services that meet the diverse needs of communities while maximizing operational efficiency and financial sustainability. Specifically to the LCTC's goal, GIS can be used to identify areas with underserved or unmet transportation needs.

The San Francisco Municipal Transportation Agency (SFMTA) in San Francisco, CA, developed a GIS tool allowing transportation professionals to address social and economic issues to create a more equitable transportation system. The SFMTA Equity Toolkit evaluates access to jobs via transit to make better-informed decisions for future transit services.

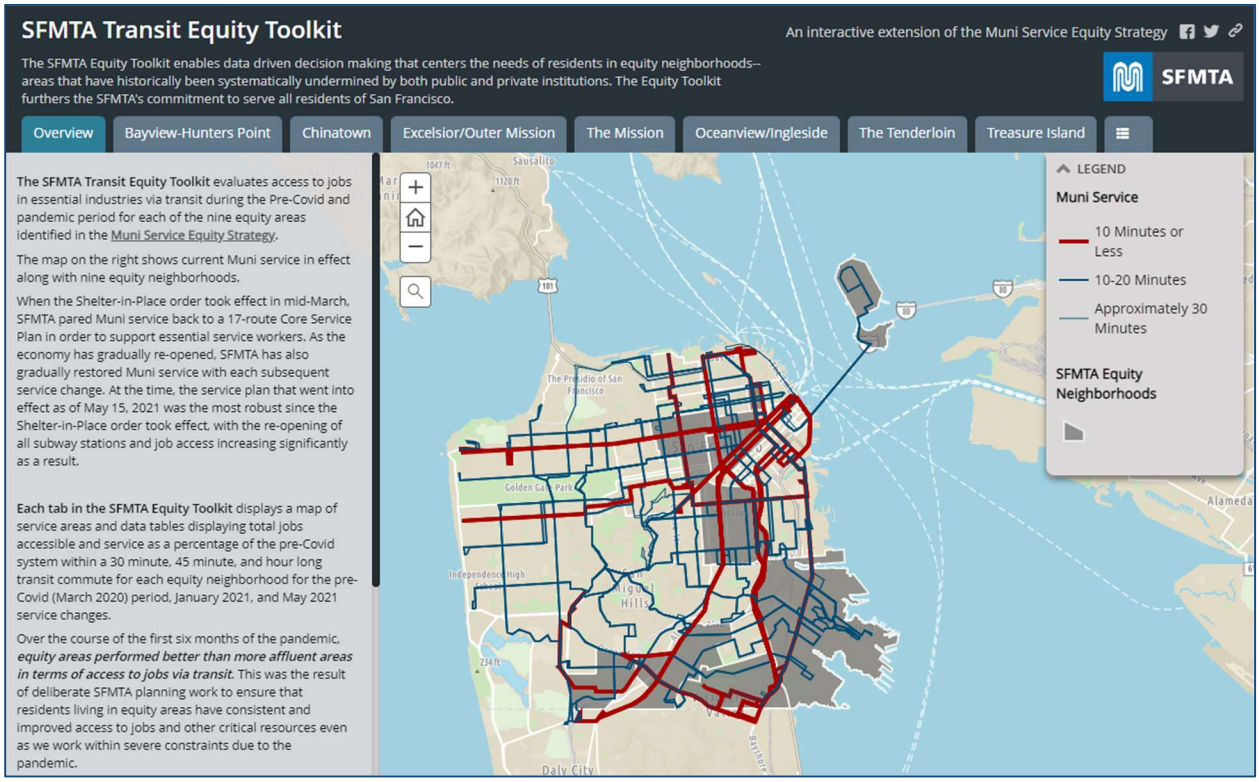

Figure 9 - SFMTA Transit Equity Tool

The full case study about the SFMTA Equity Toolkit can be found here: https://www.esri.com/en-us/lg/industry/transportation/stories/connecting-people-to-opportunity

Goods Movement - Freight and Rail

Goal 3: Promote the continuous flow of goods in, out of, and through the County in a safe and economically efficient manner.

Freight transportation is crucial to a region's economic and population growth. GIS plays a key role in optimizing the movement of goods throughout freight and rail networks. From infrastructure management to intermodal planning, GIS provides spatial analysis capabilities to enhance decision-making.

The Sarasota Manatee Metropolitan Planning Organization in Florida uses GIS to assist with freight corridor management. They visualize their freight network in an interactive map and use it to analyze a variety of economic measures such as travel time and truck volume along the network.

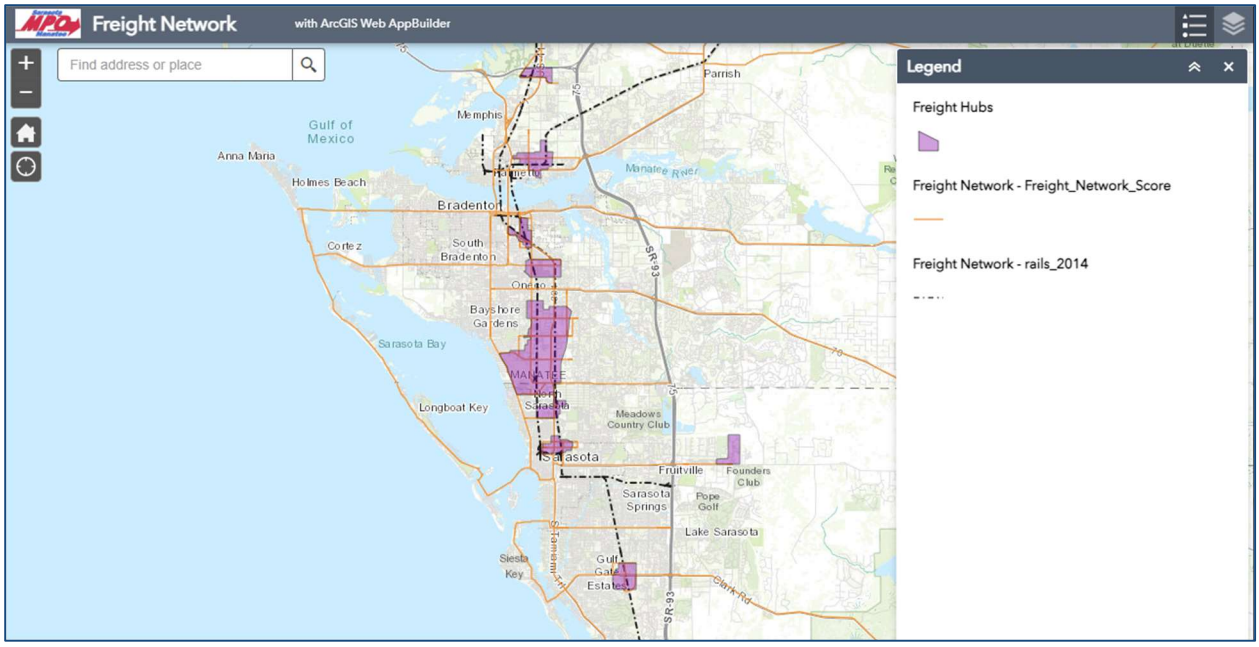

Figure 10 - Visualization of the Freight Network for Sarasota/Manatee MPO

In Figure 11, the Sarasota/Manatee MPO uses their Truck Travel Time Reliability application to visualize the Truck Travel Time Index, which is a comparison between the travel conditions at peak times (highly congested) versus "free flow" conditions. It shows which segments of the freight network are the busiest and most traveled. Since both travel time and speed are indicators of transportation system performance, stakeholders can visualize how well their freight corridors are performing.

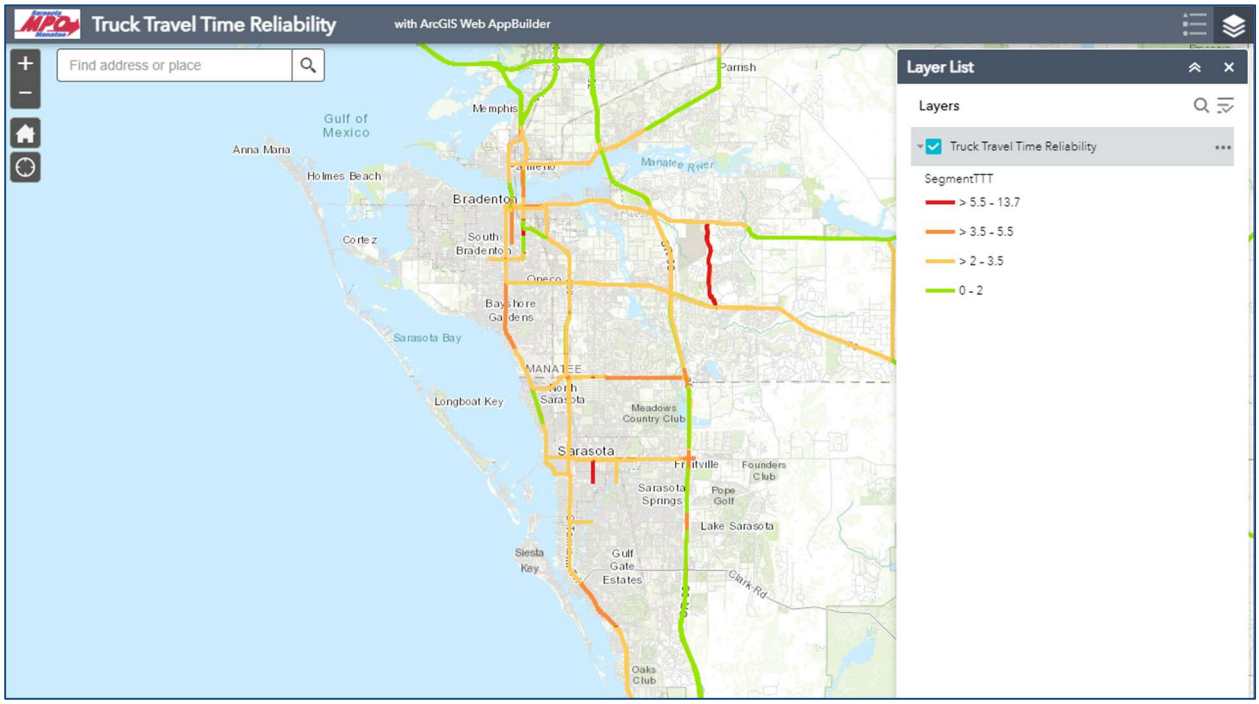

Figure 11 - Truck Travel Time Reliability for Sarasota & Manatee Counties, Florida

Route planning and optimization is a growing priority for the freight industry. By displaying factors such as travel times, traffic conditions, and distance, analysis can be done using modeling to maximize the efficient use of goods through the freight network and eliminate "transportation waste," or unnecessary movement of goods within the county. Improved freight transportation systems reduce consumer costs for delivery of goods and services.

Airports

Goal 4a: Provide an adequate number of safe, efficient airports and airfields.

Goal 4b: Support the expansion of economical, efficient air services.

GIS enables small, non-commercial, municipal, and regional airports to improve service to the communities where they are located. GIS is used in applications such as lease management, asset management, and regulatory compliance.

Lease Management

The Susanville Municipal Airport has a program that offers ground space and hangar space for lease. Integrating this program with GIS would allow planners to identify trends, track

lease documents, and engage in customer management. GIS tools such as dashboards and applications would provide the Commission insight into key metrics such as the number of leases available, average lease revenue, and average annual revenue. By creating a single view of lease information, stakeholders and county leaders will be able to make faster and more informed decisions.

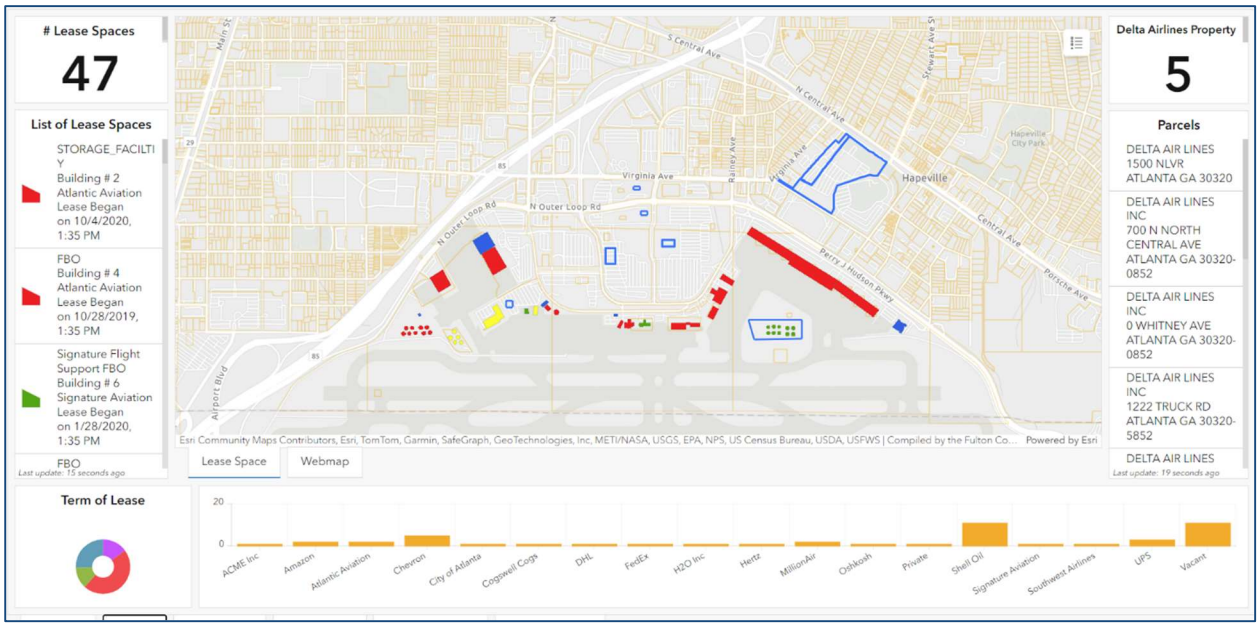

Figure 12 - Example of an Airport Lease Management Dashboard

Bicycle and Pedestrian Facilities

Goal 5: Provide a safe and efficient bicycle and pedestrian circulation system that takes advantage of the natural scenery and physical characteristics of Lassen County

The Greater Madison MPO in Dane County, WI publishes three GIS bicycle-related maps and applications. The Dane County Bicycle Map displays the area's bicycle trails and related facilities such as repair stations or trailheads. It also provides an ArcGIS StoryMap highlighting featured bicycle and pedestrian trails within the County, and a Low-Stress Bike Route Finder application that assists bicyclists in identifying bicycle routes based on their comfort level of riding on urban streets (see Figure 13).

By displaying the locations of bike trails or other bicycle-friendly roads and routes, the citizens of Lassen County could use the map or application to plan their bicycle trips ahead of time, creating safe opportunities for travel, transportation, and recreation.

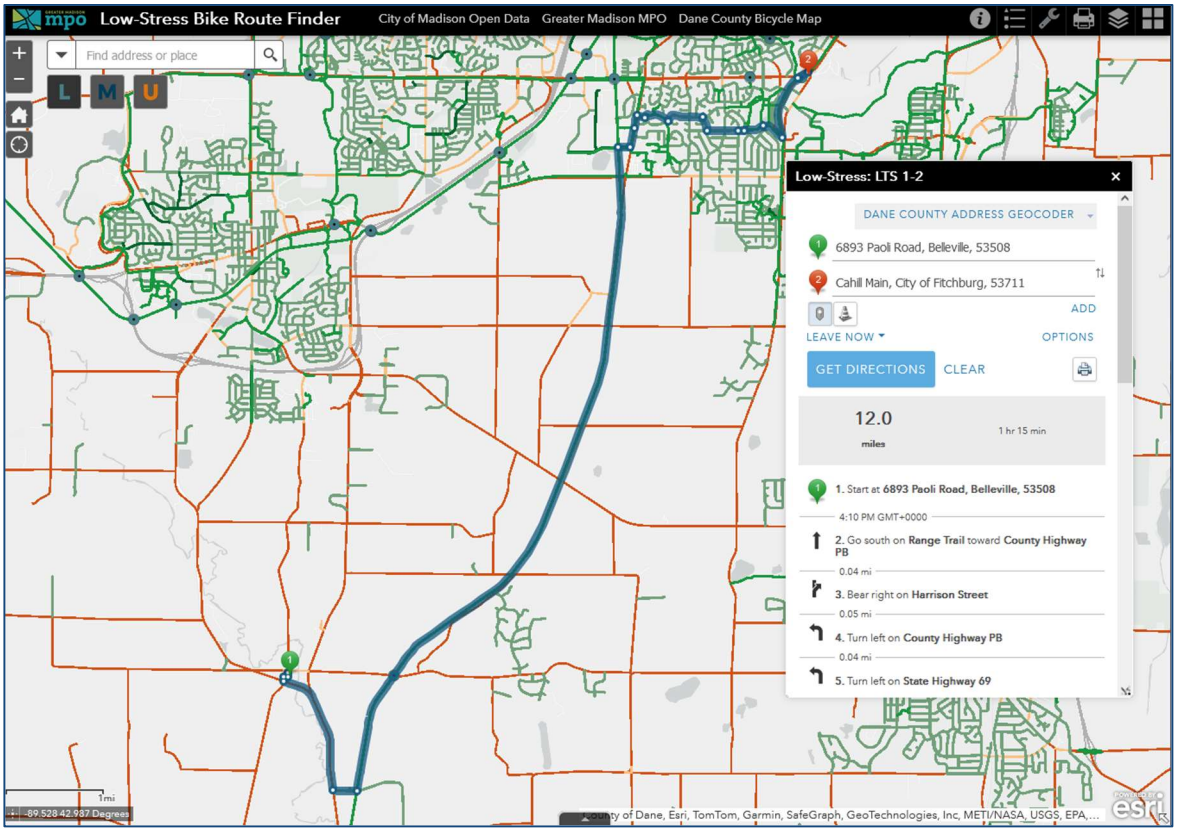

Figure 13 - Low-Stress Bike Route Finder provided by the Greater Madison MPO

The Greater Madison MPO also has a pedestrian-focused application that displays information relevant to pedestrians such as sidewalks, crosswalks, hiking trails, and whether transition points between sidewalks and roads are accessible for those with disabilities.

One need identified by the LCTC was to be able to visualize and connect transit routes and bus stops with bike and pedestrian paths and trails. By having bicycle routes/trails and pedestrian facilities in a GIS, the Lassen Transit Service Agency could use this information to visualize gaps in their transit network that could allow for future route improvements and help identify underserved areas for those transportation disadvantaged.

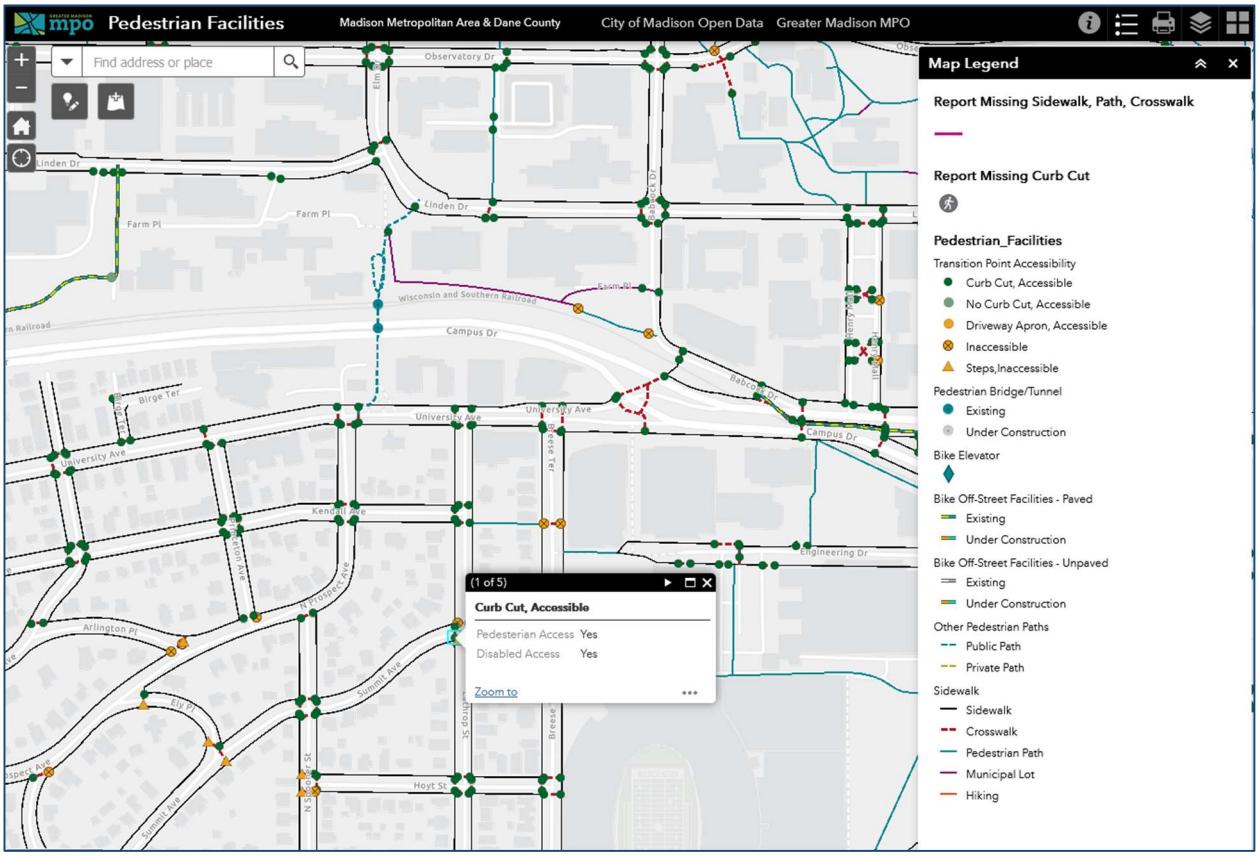

Figure 14 -Pedestrian Facilities Viewer provided by the Greater Madison MPO

Management of the Transportation System

Goal 6a: Minimize traffic congestion by increasing the efficiency of the existing transportation system through Transportation System Management (TSM) techniques.

Goal 6b: Where feasible, reduce the demand for travel by Single Occupant Vehicles (SOVs) through Transportation Demand Management (TDM) techniques.

GIS supports traffic management and operations by providing real-time data on traffic conditions, incidents, and congestion. It enables transportation agencies to monitor traffic flow, optimize signal timing, manage detours, and coordinate emergency response efforts to minimize disruptions and improve safety on roadways.

Congestion

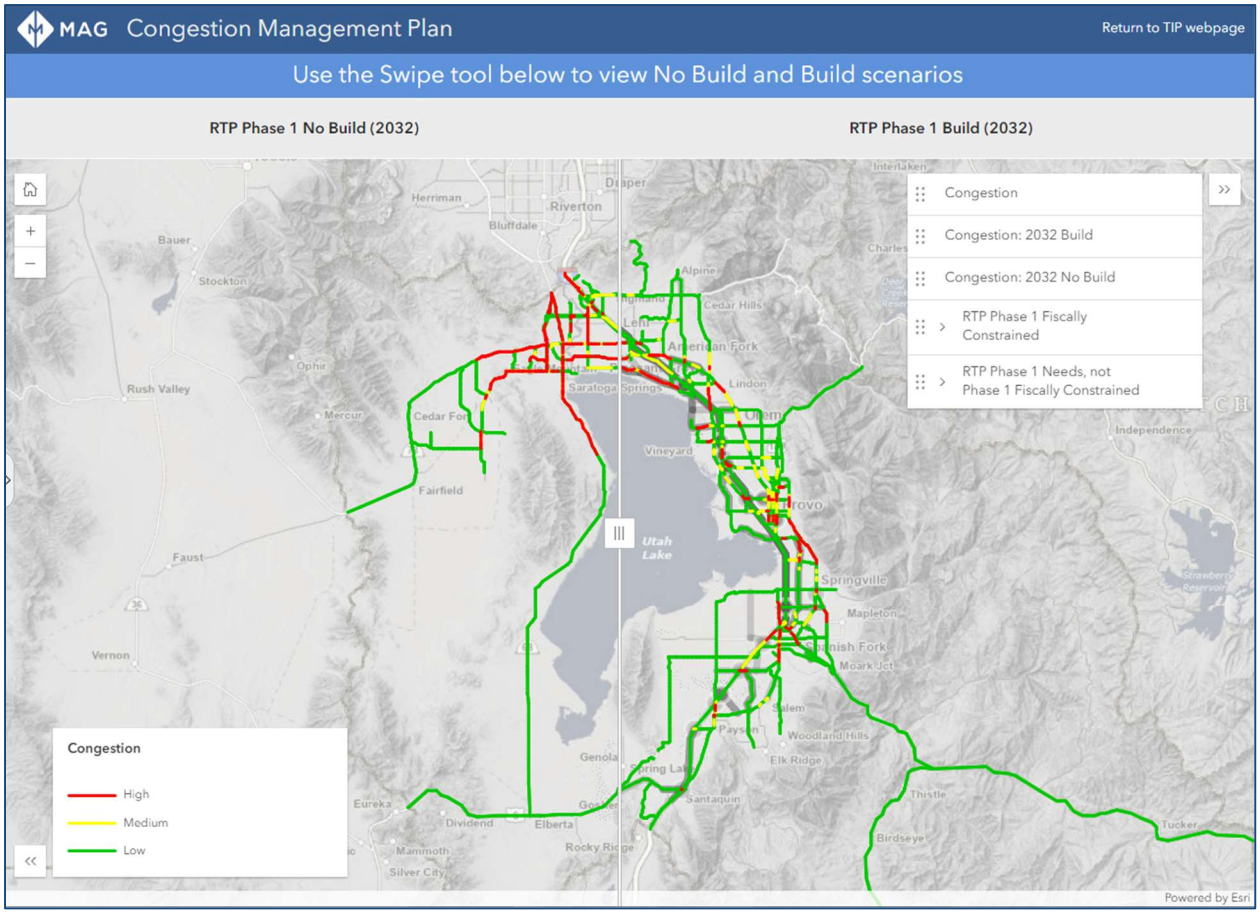

Figure 15 - Mountainland Association of Governments Congestion Management Plan Map

The Mountainland Association of Governments (MAG) serves Summit, Utah, and Wasatch Counties in Utah. MAG created a GIS-centric congestion management tool in support of their Regional Transportation Plan. The goals were to assist with identifying future congestion points within the region and provide decision-makers with potential solutions to address those areas. The map in Figure 15 above also displays project-level "before" and "after" data of future congestion based on existing traffic data and anticipated improvements.

The Ventura County Transportation Commission in Southern California uses GIS to display and analyze their local transportation model data. Figure 16 below identifies and visualizes work-based and home-based Vehicle Miles Traveled (VMT) data for the region.

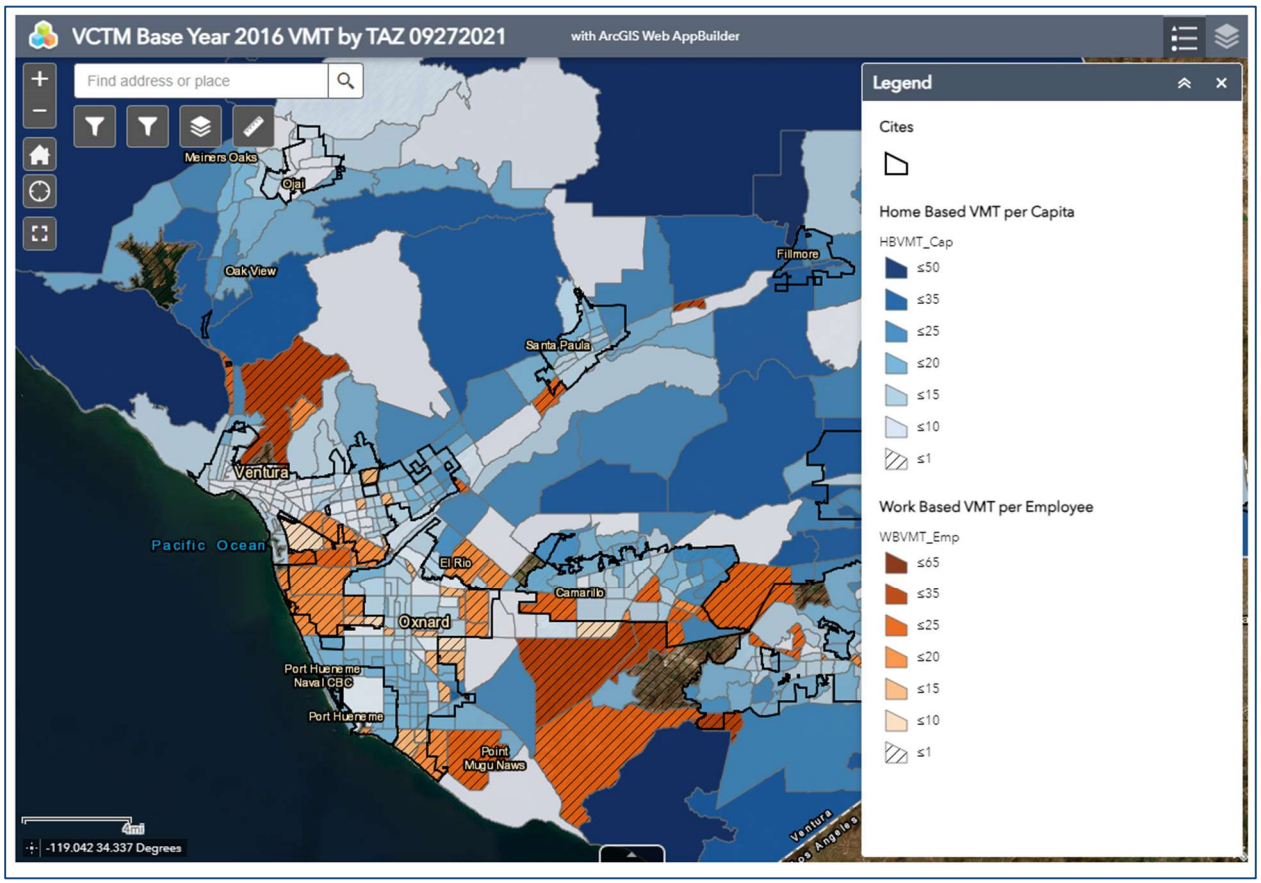

Figure 16 - Ventura County visualization of VMT by residents and employers

By adapting GIS to its transportation model, Ventura County can better understand and project traffic and transportation features in relation to land use. The model can also be used for transportation impact assessments and VMT analysis in support of environmental review and air quality applications.

Promoting Ridesharing

Ridesharing encourages commuters to reduce single-occupant vehicles on the road by facilitating the use of alternate transportation. The Central Shenandoah Planning District Commission in western Virginia maintains a GIS StoryMap to highlight the 13 Park and Ride lots in the region. This application not only provides critical information such as the number of spots and accessibility but also shows photos of the lot to ensure commuters park and meet in the proper location (see Figure 17).

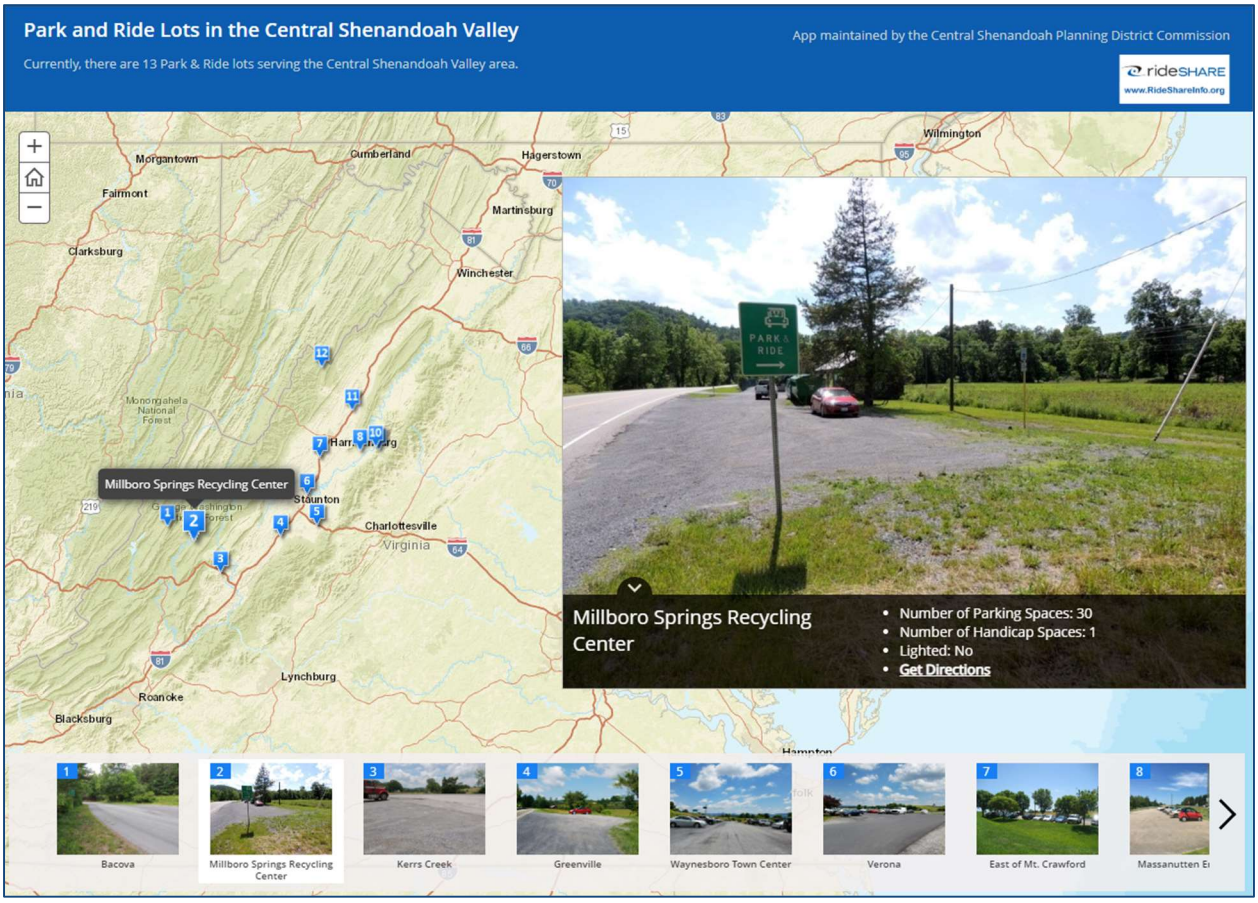

Figure 17 - Park and Ride Lots Story Map Example

Climate Change and Resiliency

Goal 7: Reduce GHG emissions from transportation-related activities within the Lassen County boundaries to support the state's efforts under AB-32 and to mitigate the impact of climate change.

Transportation environmental applications are focused on the impacts that transportation infrastructure and operations may have on both the natural and human environment. GIS can significantly enhance analysis capabilities of transportation environmental applications such as modeling stormwater runoff and air quality impacts, and infrastructure resiliency. Extreme weather events can cause significant damage to transportation infrastructure, leading to expensive repairs or replacements. Planning for climate change impacts on road and highway infrastructure requires an understanding of the impacts of future change, and GIS can help transportation leaders in Lassen County plan and design more resilient transportation networks.

The Sacramento Area Council of Governments (SACOG) is the metropolitan planning organization for the Sacramento region of California. SACOG has created a Climate

Figure 18 - Landing Page for the SACOG Climate Adaptation GIS Page

Adaptation Site with multiple GIS applications centered around transportation and climate change. According to SACOG, these applications "provide access to scientifically backed information that outlines the project impacts of climate change on the transportation networks and populace of the Sacramento region." These applications contain data from national climate models that use estimates of greenhouse gas concentrations to predict overall change. SACOG's specific climate applications include spatial analysis of wildfires, floods, extreme heat, precipitation, and temperature impacts on the region.

Protecting the transportation system from extreme weather and other natural hazards includes identifying where the network is most vulnerable and implementing strategies to mitigate future damage and lessen the severity and impact of service disruptions. By accessing datasets such as bridge condition ratings and flood zones, the LCTC can use GIS to perform spatial analysis to identify infrastructure at risk of failure under extreme weather conditions.

The Vermont Agency of Transportation (VTrans) worked with a consultant team to build the Transportation Resilience Planning Tool. This web-based GIS application identifies bridges, culverts, and road embankments vulnerable to flood damage. It also estimates risk levels based on that vulnerability and identifies potential mitigation measures.

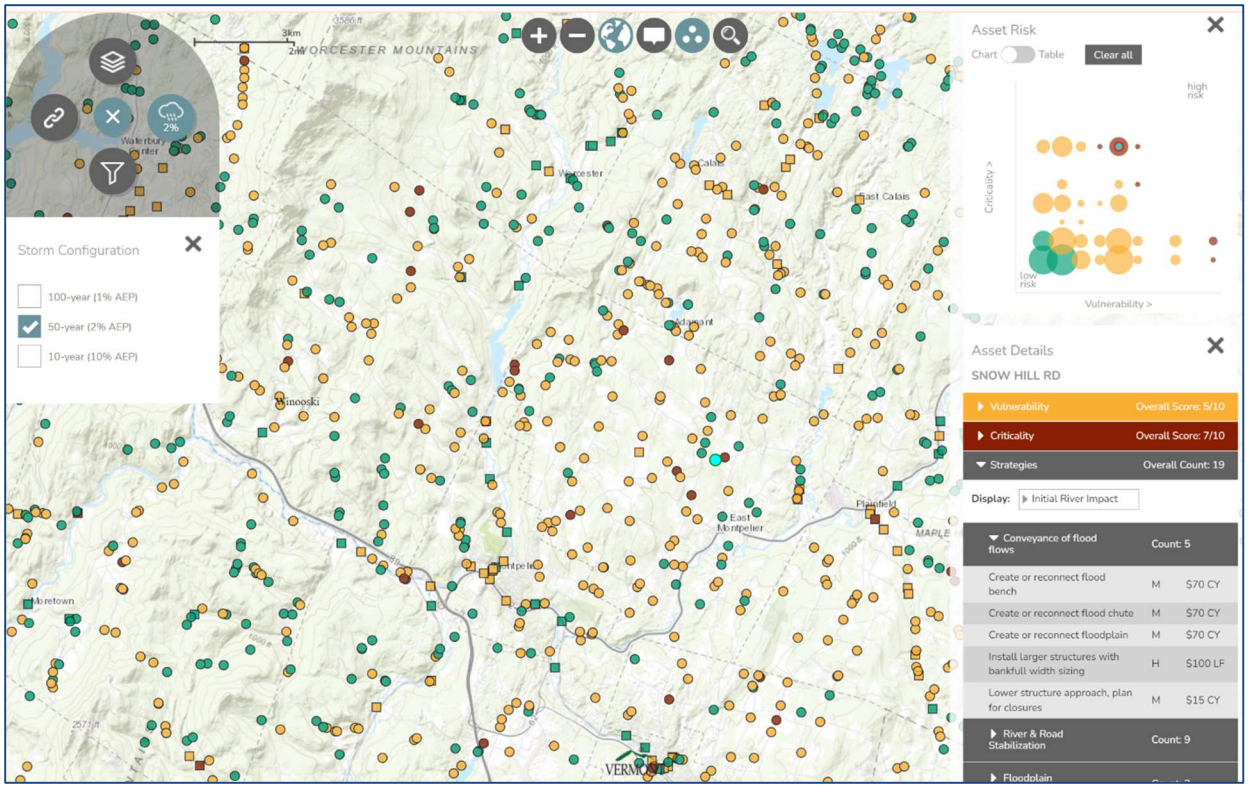

Figure 19 - VTrans Transportation Resilience Planning Tool

Conclusion

The integration of GIS in multi-modal transportation planning plays a transformative role in designing and implementing effective transportation systems. By utilizing GIS for data visualization, spatial analysis, and scenario modeling, transportation planners are empowered to make more informed, efficient, and equitable decisions that enhance mobility and accessibility within communities.

The tools and resources available through various U.S. Department of Transportation agencies further underscore the critical importance of GIS in optimizing decision-making processes and improving the overall efficiency of transportation systems. As technological advancements continue, GIS will remain an indispensable tool in addressing the evolving challenges within the transportation sector.

By embracing the practices and investing in the tools outlined in this report, the Lassen County Transportation Commission can go beyond maintaining aging infrastructure and proactively build transportation networks for the future. This approach will equip county leaders with vital location-based insights for making strategic decisions related to infrastructure planning, management, and network resilience, ultimately guiding more effective allocation of transportation funding.