NEVADA Statewide ITS & ATM Master Plan

Technical Memorandum #1:

Existing Conditions and Inventory

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NEVADA DOT SAFE AND CONNECTED

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List of Abbreviations

AI	Artificial Intelligence
ARM	Adaptive Ramp Metering
ASCT	Adaptive Signal Control Technology
ASWS	Advance Signal Warning Systems
ATM	Active Traffic Management
ATMS	Advanced Traffic Management System
AV	Autonomous Vehicle
CAD	Computer-Aided Dispatch
CAMPO	Carson Area Metropolitan Planning Organization
CAV	Connected/Autonomous Vehicle
CCTV	Closed-Circuit Television
CMM	Capability Maturity Model
CV	Connected Vehicle
DJC	Dynamic Junction Control
DLUC	Dynamic Lane Use Control
DLR	Dynamic Lane Reversal
DMC	Dynamic Merge Control
DMS	Dynamic Message Sign
DShL	Dynamic Shoulder Lane
DSpL	Dynamic Speed Limit
DSRC	Dedicated Short Range Communications
EV	Electric Vehicle
FARS	Fatality Analysis Reporting System
FAST	Freeway and Arterial System of Transportation
FHWA	Federal Highway Administration
GIS	Geographic Information System
HAR	Highway Advisory Radio
HOV	High Occupancy Vehicle
ICM	Integrated Corridor Management
IPT	Investment Prioritization Tool
ITS	Intelligent Transportation System
MDSS	Maintenance Decision Support System
MPO	Metropolitan Planning Organization
NCATS	Nevada Citation and Accident Tracking System
NDOT	Nevada Department of Transportation
NHP	Nevada State Police Highway Patrol Division
NSRS	Nevada Shared Radio System
OSS	One-Stop Shop
PHB	Pedestrian Hybrid Beacon
QW	Queue Warning
RITIS	Regional Integrated Transportation Information System
ROC	Roadway Operations Center
RTC SNV	Regional Transportation Commission of Southern Nevada
RTC Washoe	Regional Transportation Commission of Washoe County
RWIS	Road Weather Information System
SHSP	Strategic Highway Safety Plan
SET	Sustainable and Emerging Transportation
SLI	Signals, Lighting, and ITS Section
STIP	Statewide Transportation Improvement Program
STMS	Strategic Traffic Management Site
TAMP	Transportation Asset Management Plan
TIM	Traffic Incident Management
TMC	Traffic Management Center
TOTS	Traffic Operations Technology Section
TPAS	Truck Parking Availability System
TSMO	Transportation Systems Management and Operations
USDOT	United States Department of Transportation
VSL	Variable Speed Limit
WIM	Weigh In Motion
WWD	Wrong Way Driving
WZ	Work Zone Management

EXISTING CONDITIONS AND INVENTORY

1. EXISTING CONDITIONS AND INVENTORY INTRODUCTION

1.1. Plan Overview

The Nevada Department of Transportation (NDOT) is developing the Statewide Intelligent Transportation System (ITS) and Active Traffic Management (ATM) Master Plan to leverage resources and capabilities through the application of a wide range of ITS and ATM strategies to improve safety, reliability, mobility, and overall performance of Nevada's surface transportation system. NDOT has been deploying and operating ITS infrastructure for over 30 years. Nevada's changing travel patterns, growing demand, and shifting traveler expectations and mobility options will challenge NDOT's current technology and operational capabilities.

The ITS & ATM Master Plan provides a thorough evaluation to assess the current systems in rural and urban areas, determine future needs, and outline future ITS and ATM strategies to advance NDOT's capabilities. Generally, ATM is the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions. Focusing on trip reliability, ATM maximizes the effectiveness and efficiency of the transportation facility. ATM approaches seek to increase throughput and safety by using systems that have been integrated with new technology, including the automation of dynamic deployment for optimization. In this master plan, "ITS" encompasses traditional ITS devices and equipment, and "ATM" strategies encompass variable speed limit (VSL), hard shoulder running (HSR), queue warning detection systems, and other ATM strategies. The master plan also accounts for other related efforts such as connected vehicle/automated vehicle (CAV), smart work zones, asset management, performance metrics, and various other technologies available to NDOT. The master plan was developed in alignment with the NDOT Transportation Systems Management and Operations (TSMO) Program, One Nevada Plan, Transportation Asset Management Plan (TAMP), and ITS Strategic Deployment Plan elements. The plan also provides NDOT with a clear understanding of how to plan for, implement, operate, and maintain ITS & ATM strategies and devices at a statewide level. The development of this plan engaged all key stakeholders, as well as the TSMO Steering Committee. **Figure 1** depicts the stages of the master plan tasks toward completion as well as ongoing activities that were completed concurrently throughout the process in engaging stakeholders and updating tools and resources utilized for state initiatives.

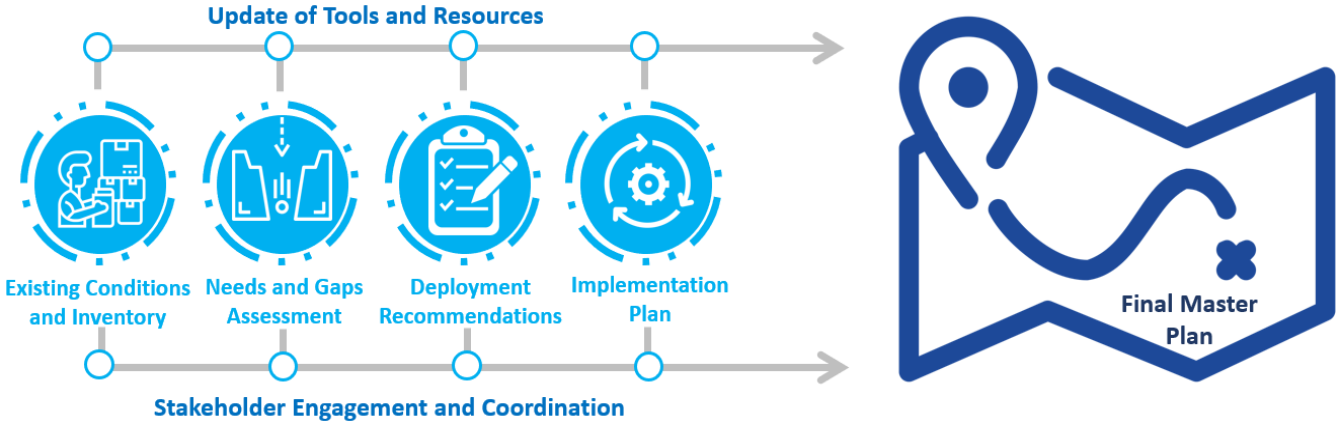


Figure 1 – ITS & ATM Master Plan Development

2. VISION, GOALS, AND OBJECTIVES

2.1. Vision, Goals, and Objectives

The vision, goals, and objectives for this plan were developed in coordination with the project management team to focus on tactical and actionable strategies that encompass the breadth of ITS & ATM investments in the state. The existing visions that the state is driving toward in the NDOT Strategic Goals, One Nevada Plan, TSMO Program Plan, and the United States Department of Transportation (USDOT) Fixing America's Surface Transportation Act drove the need to determine future direction in five key strategy areas: communications, regional operations, technologies, data, and partnerships. The goal of the ITS & ATM Master Plan is to evaluate current systems in rural and urban areas, determine future needs, and outline future ITS and ATM strategies to advance NDOT's capabilities in improving safety, reliability, mobility, and overall performance of the transportation system. The vision and five supporting strategy areas for this plan are presented in **Figure 2** and **Table 1**.

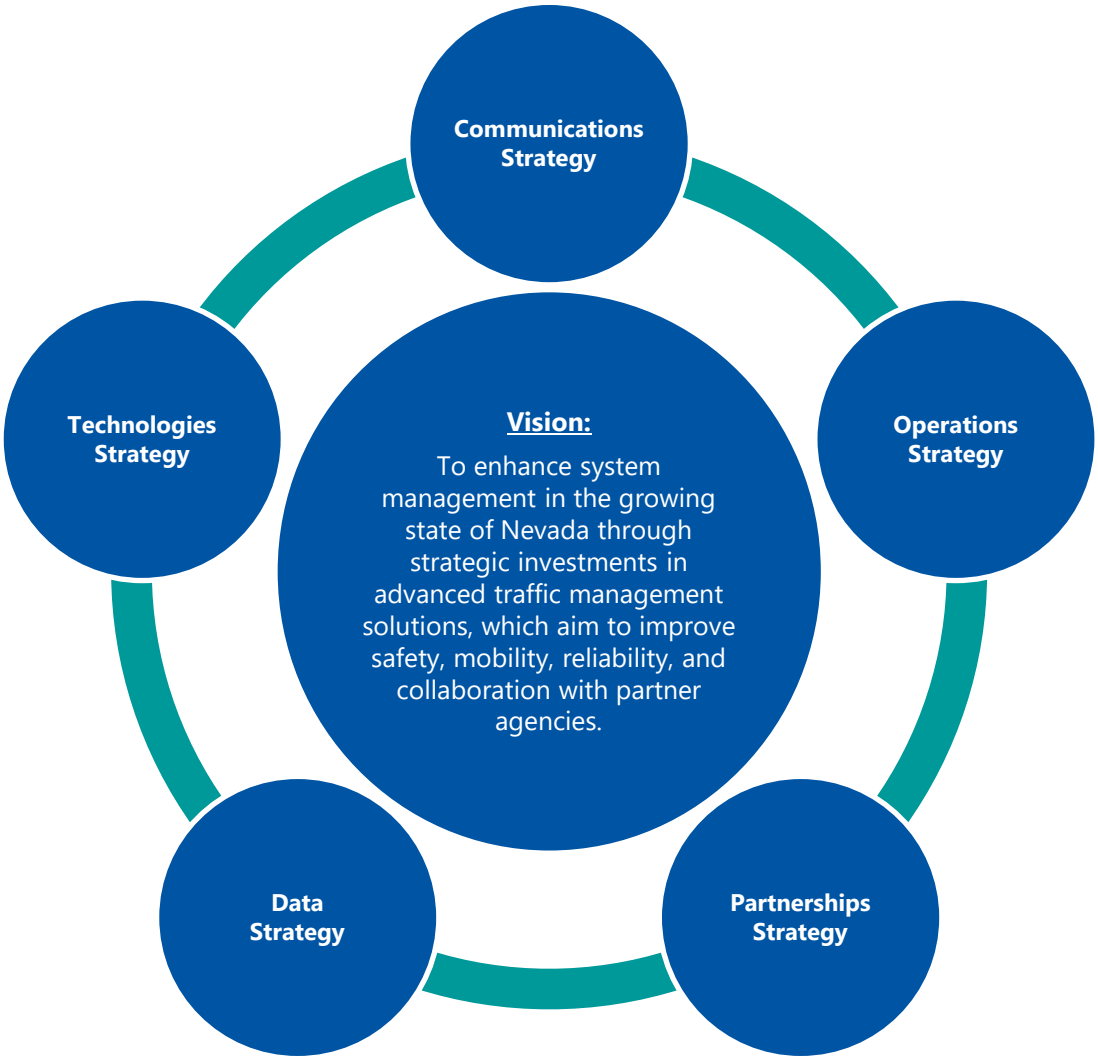


Figure 2 – Vision and Strategies

Table 1 – Strategy Area Summary

Strategy	Goal	Objective	Implementation Description
Communications	Install reliable communications on critical routes statewide to connect ITS devices.	Increase percentage of routes covered by communications infrastructure, increase connectivity to NDOT devices.	The key to successful implementation of ITS devices and ATM strategies is a robust communications network. The One Nevada Plan mentions the importance of communications for the implementation of future technologies and specially to prepare for the incoming connected and autonomous vehicles. A communications strategy would recommend critical corridors and necessary steps for the implementation and maintenance of a statewide communications network.
Operations (Ops)	Standardize operational hubs across all NDOT Districts dedicated to active traffic management and operations support.	Provide redundant cross-district operational capabilities based on standardization of operational procedures to support continuous operations.	Various devices, communications, and data is only valuable if there is centralized staff and a centralized program to monitor and process the available resources in real time. Centralized District operations provides a location dedicated for staff to manage operations in real time. A statewide operations strategy applied at a District-level would identify staffing and infrastructure needs to actively manage NDOT's investment into ITS as well as plan to accommodate future needs and emerging technologies. That will likely look different District-to-District but should be consistent across the state to leverage statewide resources such as third-party data, contracting mechanisms, and economies of scale with investments and staffing support. A statewide District operations strategy would establish an agreed-upon concept of operations from which to build from for investments in infrastructure, software, and staffing.
Partnerships (Partner)	Improve communication and collaboration between NDOT and other partners to support a variety of purposes.	Create seamless operations across jurisdictions throughout the state and leverage partners for additional data, real-time situational awareness to support regional active traffic management.	The state-owned roadway network does not function as a standalone transportation network and relies on strong partnerships and coordination with local roadway networks and the agencies that support operations on those networks. As technology advancements grow and the ability for data to provide information for decision-making improves, it will be important for agencies to evolve their partnerships to make the most use of new capabilities and new ways of sharing resources to serve the public. This includes state highway patrol, local cities, local counties, local metropolitan planning organizations, local law enforcement, transit, emergency services, and other types of partners that all should stay on the same page as to how investments can support the state, regardless of the owning jurisdiction.

Strategy	Goal	Objective	Implementation Description
Data	Centralize and optimize data for decision-making and improving safety, mobility, reliability, and collaboration.	Increase data sharing quantity, availability, quality, reliability, and use of data.	A primary function of ITS infrastructure is collecting system data that can be processed to help inform successes, priorities, and needs throughout the state. Each individual strategy will provide the data capabilities implemented with the recommended infrastructure but there is also the additional question of: what to do with all the available data? The One Nevada Plan admits that the emergence of "massive 'big data' storage and analytical capabilities will require NDOT to reinvent its role as an agency". A data strategy would provide guidance and recommendations on how that reinvention might look with policy, training, and staffing needs. Additionally, a data strategy would outline the required data to help make informed, data-driven decisions on the future of ITS and ATM infrastructure policy and funding.
Technologies	Identify programs and candidate locations for ITS foundational and emerging technologies to improve safety, mobility, reliability, and collaboration.	Reduce travel times, reduce travel delay, and increase travel time reliability through new technologies installed and new pilot programs.	Active Traffic Management is not a one size fits all solution. Different regions, demographics, and travel patterns all require the deployment of unique ATM strategies to best improve operations. To determine the best opportunities to deploy various ATM strategies across a diverse Nevada, implemented devices and programs must be monitored and evaluated for successes and lessons learned and these metrics should be shared and discussed for wider implementation. The One Nevada Plan discusses the importance of advancing the current infrastructure to meet the future needs of a transportation system utilized by connected and autonomous vehicles. The emergence of connected and autonomous vehicles will revolutionize safety, mobility, and freight operations throughout the state and the agency must be prepared to accommodate these changes with infrastructure, data processing, and policy. Consideration must also be given to the differences in how autonomous and connected vehicles interact with a rural or urban environment. Advancements in a connected system have different benefits to a rural community than to an urban community and the needs of each community to capitalize on those benefits varies as well.

Each strategy area serves a specific purpose in the visioning for statewide ITS and ATM master planning. As shown in **Figure 3**, the success of this plan lies in the partnerships between NDOT's internal and external stakeholders. Strong partnerships will drive the plan and its components toward ultimate success throughout the state.

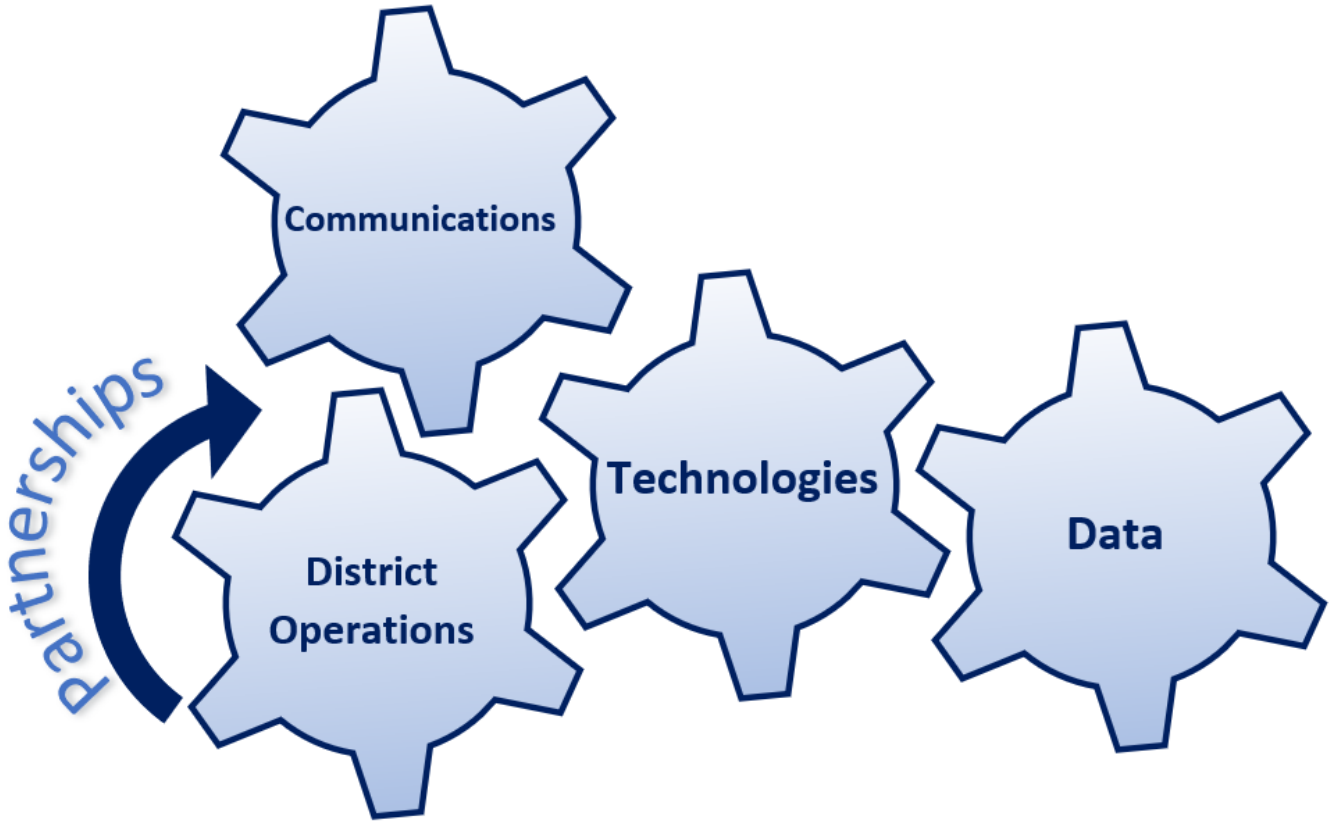


Figure 3 – ITS & ATM Master Plan Strategy Relationship

The goals for this ITS & ATM Master Plan are shown in **Figure 4.** The plan goals can be directly linked to the goals of the TSMO Program Plan, One Nevada Plan, NDOT Strategic Goals, and the USDOT Fixing America's Surface Transportation Act. Each of these plans consider the safety, system reliability, mobility, infrastructure preservation, and transformation of economies.

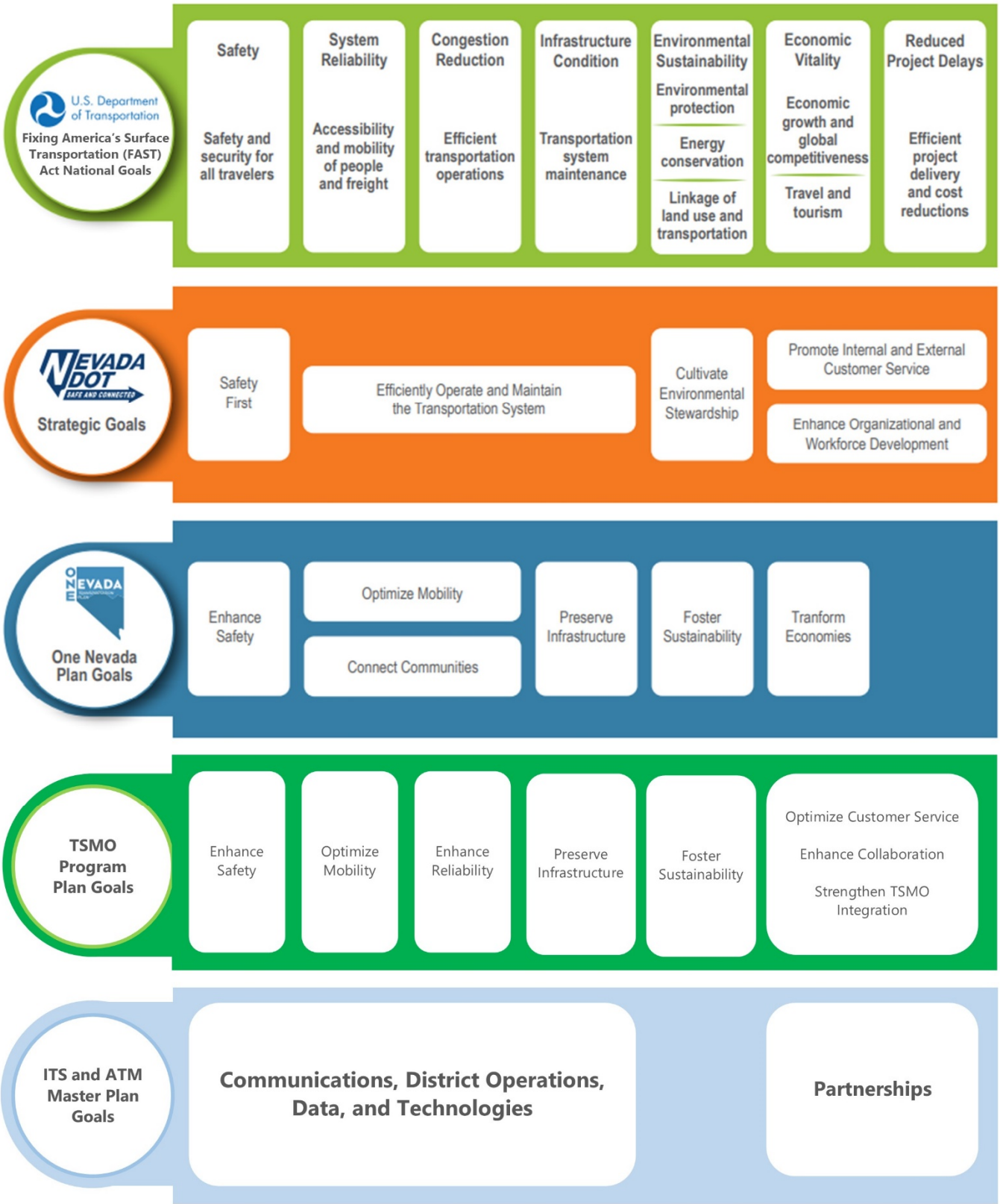


Figure 4 – ITS & ATM Master Plan Alignment of Goals

3. STAKEHOLDER ENGAGEMENT

One-on-one meetings with the following NDOT stakeholders were conducted to gather existing ITS focused efforts as well as to obtain input on their vision for planned ITS & ATM strategies as it relates to their region.

- NDOT District 1
- NDOT District 2
- NDOT District 3
- NDOT Traffic Operations – ITS Programs and Operations
- NDOT Traffic Operations – Technology Services
- NDOT Traffic Operations – Signals, Lighting, & ITS
- NDOT Traffic Operations – Signs, Striping, and Traffic Control
- NDOT Traffic Operations – Operations & Network Analysis
- NDOT Planning
- NDOT Freight
- NDOT Sustainable and Emerging Transportation (SET)
- NDOT Structures
- NDOT Construction
- Regional Transportation Commission (RTC) of Southern Nevada (RTC SNV)
- RTC of Washoe County (RTC Washoe)
- Carson Area Metropolitan Planning Organization (CAMPO)
- Nevada National Oceanic and Atmospheric Administration Weather Forecast Offices in Elko, Reno, and Las Vegas
- Nevada State Police Highway Patrol (NHP) Northern Command, Central Command and Southern Commands
- A variety of local public agencies (city and county agencies) in proximity to state-owned facilities

From the one-on-one meetings, many topics were covered including physical technology, deployment and management processes, funding and programming processes, and staffing for asset management and maintenance. NDOT has been deploying ITS technologies for over 30 years and there are a variety of notable accomplishments that arose from these discussions, including:

- **ITS deployment** – Deployed an extensive freeway management system including detection, traffic monitoring cameras, dynamic message signs, and robust communications networking covering the major urbanized areas of Las Vegas and Reno/Sparks/Carson City.
- **Distributed operations covering the entire state** – Distributed operations through localized Regional Operations Centers (ROC) in each of the three NDOT Districts to serve the unique needs of the localized areas within the state.
- **Data ownership and management** – Standardizing on several statewide data services that provide traveler information, central management, and data accessibility to partner agencies and private sector to further safety and mobility goals for the state. This includes a centralized

data repository, the statewide 511 NVRoads traveler information system, and statewide central software system to manage all freeway assets utilized by each of the District ROCs. This also includes the statewide Spillman Computer-Aided Dispatch (CAD) which provides a direct link to the NHP CAD system to allow for CAD-CAD coordination between NDOT and NHP during incidents and dispatching.

- **Strong partnerships** – Cooperative and innovative partnership with RTC Freeway and Arterial System of Transportation (FAST) to manage the Southern Nevada Traffic Management Center (TMC) which operates both the arterials and the freeway networks from one centralized facility in coordination with Nevada State Police Highway Patrol Dispatch.
- **Encouraging and creating innovation** – Nevada is at the forefront of allowing technology innovation and testing in the state through the adjustment of legislative statute, adoption of laws and bills, independent network capabilities, and funding support of emerging technologies such as on-board connected vehicle devices, autonomous driving on public roadways, broadband public-private partnerships, and several other innovations that other states are looking to Nevada to emulate.
- **Organizational support** – Extensive support in terms of staffing appropriately and collaboratively with private partners as required to support initiatives statewide. This includes establishment and ongoing staffing for independent divisions and groups to facilitate change statewide in the area of ITS and technology such as the NDOT Traffic Operations Technology Section (TOTS) and the Office of Science, Innovation & Technology, and its Broadband Task Force.
- **Forward thinking planning efforts** – Forward thinking has led to a number of statewide and regional planning and implementation activities over the past decades. This has served in a variety of plans and studies looking at various technology implementations, regional programming, and project planning. Most recently this forward thinking has culminated in the form of the state's TSMO and Smart Mobility planning efforts that looks to unite all TSMO components under the NDOT umbrella to increasingly benefit the public. NDOT has been successful in not just planning, but also incorporating those planning results into annual updates or regular occurring processes that keeps the plans up to date and relevant for use.
- **Consolidated planning across state initiatives** – There are several factors to consider when implementing projects in the state, including safety, mobility, efficiency, innovation, different vehicle classifications, different modes of travel, different types of desired roadway characteristics, etc. The state has taken a major effort in the form of creating the One Nevada Plan that looks to consolidate and align planning efforts across all these factors to approach projects and state initiatives more holistically. The recognition that there are competing priorities and there needed to be a more synchronized process is a testament to the state making the best use of taxpayer dollars.

Key takeaways that serve as opportunities to improve efficiency of assets, processes, or investments from these meetings are as follows. Detailed findings are provided in **Attachment A**:

- Access to data coming from ITS devices can serve more NDOT functions and services than it does today.
- ITS investments warrant data-driven decision-making prior to investments being made.

- There is a need for better training and more staffing in appropriate areas as amount of infrastructure grows.
- Coordinated and regional operations is needed in the urbanized Reno/Sparks area that is growing rapidly.
- Spot ITS technologies continue to be needed throughout the state to address specific areas of needs and issues experienced by travelers and state personnel such as weather, work zones, communications gaps, and information to support freight movement and detours.
- ITS asset management and processes for updating and maintaining vary by District and warrants a comprehensive program.
- Regular coordination is desired between NDOT and partner agencies including NHP, local metropolitan planning organizations (MPO), local counties and municipalities, and neighboring states to blur the jurisdictional boundaries.
- Stronger ties between NDOT Divisions during project planning would be beneficial to help the One Nevada movement toward collaborative and multi-faceted projects.
- Data gathered by ITS is desired around the state, however, the accessibility of that data in real-time for decision making purposes has yet to be fully realized.

4. ITS & ATM Definition

As noted in Section 1.1, "ITS" encompasses traditional ITS devices and equipment as well as innovative and leading-edge technology applications developed to improve safety, mobility, and provide faster access to better information. Within the umbrella of TSMO, there are a variety of ITS strategies to consider for application throughout the state for several different purposes. "ATM" strategies encompass abilities to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions. **Figure 5** provides an overview of the types of ITS strategies under the TSMO umbrella that were considered for this plan.

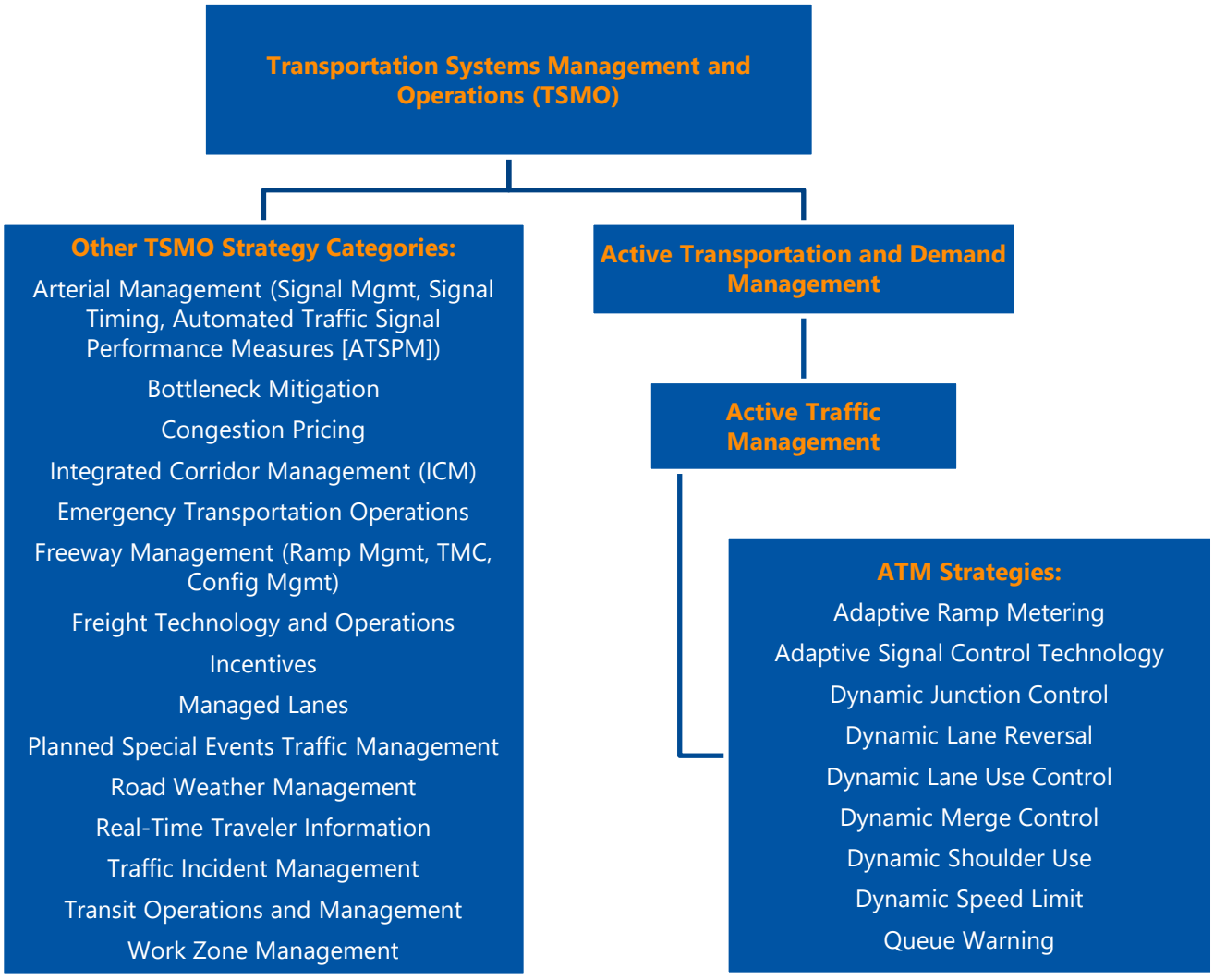


Figure 5 – ITS Strategies Considered

ITS has been utilized around the world for nearly four decades and continues to evolve on a yearly basis to improve the speed, agility, and capabilities it can provide to public agencies, the private sector, and the public. The amount of potential technology for transportation deployment across the world, and specifically in this country, for the consideration of planning efforts is vast. This section provides the key

elements of each technology application as it pertains to NDOT for future implementation. A primary source of information used in this section is the Federal Highway Administration's TSMO Resource Webpage: https://ops.fhwa.dot.gov/tsmo/. The information found was supplemented by the team's national expertise and understanding of ITS & ATM planning and implementation that has been done by other states and metropolitan planning. Planning efforts included state-of-the-practice knowledge that have published documentation to support their implementation.

As recommended by the various state-of-the-practice examples of ITS applications, the following types of data should be collected by an ITS Program throughout the state as foundational applications for traffic management prior to advancing to more complicated systems (such as ATM or Integrated Corridor Management [ICM]):

- Traffic volumes
- Travel speeds
- Occupancy (mainline or shoulder presence or lack of presence)
- Existence of road concern by location (such as weather condition, incident, queuing, rockslide, etc.)
- Situational awareness such as closed-circuit television (CCTV) or vehicle detection)

The following types of data could be collected by an ITS Program to be used for advanced situational awareness or artificial intelligence (AI) applications:

- Environmental sensing
- Vehicle diagnostics and location
- Third-party data
- Travel time

Table 2 provides an inventory of all available and applicable ITS and ATM strategies and emerging technologies that NDOT should consider. **Attachment B** provides a summary of each of the ITS strategies including the technologies involved, operational use case, recommended application geography, and expected benefits.

Table 2 – ITS and ATM Strategy Summary

ITS Technology Strategies (* currently in Nevada)	Definition
Freeway and Arterial Traffic Management*	Real-time traffic management capability on any facility to be able to support traffic monitoring, situational awareness, and incident response for traveling public.
Adaptive Ramp Metering (ARM)	The deployment of traffic signals on ramps to dynamically control the rate at which vehicles enter a freeway facility. Utilizes traffic-responsive or adaptive algorithms (as opposed to pretimed or fixed-time rates) that can optimize either local or system-wide conditions.
Adaptive Signal Control Technology (ASCT)	The continuous monitoring of arterial traffic conditions and queuing at intersections and the dynamic adjustment of signal timing to smooth traffic flow along coordinated routes and to optimize one or more operational objectives (such as minimize overall stops and delays or maximize green bands). Also known as responsive and/or multimodal preferential signal control.
Dynamic Junction Control (DJC)*	The dynamic allocation of lane access on mainline and ramp lanes in interchange areas with high traffic volumes, and where the relative demand on the mainline and ramps changes throughout the day. Through the use of signs, mainline lanes can be closed or become an exit, shoulders can be opened, and so forth to accommodate entering or exiting traffic.
Dynamic Lane Reversal (DLR)	The use of lane control signals to manage the reversal of one or all lanes to dynamically allocate capacity of congested roads, allowing capacity to better match traffic demand throughout the day. Lane reversal could include changing the number of available lanes per direction by physically moving barriers or by signage.
Dynamic Lane Use Control (DLUC)*	The use of lane control signals for dynamic closing or opening of individual traffic lanes as warranted and providing advance warning of the closure(s), typically through dynamic lane control signs, to safely merge traffic into adjoining lanes. Often installed in conjunction with DSPL, and supports the ATM strategies of DShL and DJC.
Dynamic Shoulder Lane (DShL)	The dynamic enabling of the use of the shoulder as a travel lane(s) utilized by specific types of vehicles or occupants. The use of shoulder lanes can be based on congestion levels during peak periods and in response to incidents or other conditions as warranted during peak or nonpeak periods. This strategy is frequently implemented in conjunction with DSpL and Dynamic Lane Assignment (DLA). Static, time-of-day approaches are not generally included in the definition.
Queue Warning (QW)*	The real-time display of warning messages (typically on dynamic message signs and possibly coupled with flashing lights) along a roadway to alert motorists that queues or significant slowdowns are ahead, thus reducing rear-end crashes and improving safety. QW may be included as part of DSpL strategies. Static QW signs are not included in this definition.
Dynamic Speed Limit (DSpL)*	The adjustment of speed limit displays based on real-time traffic, roadway, and/or weather conditions. Can either be enforceable (regulatory) speed limits or recommended speed advisories and can be applied to an entire roadway segment or individual lanes. This “smoothing” process helps minimize the differences between the lowest and highest vehicle speeds.
Dynamic Merge Control (DMC)*	The dynamic management of the entry of vehicles into merge areas with a series of advisory messages approaching the merge point that prepare motorists for an upcoming merge and encouraging or directing a consistent merging behavior. It can help create or maintain safe merging gaps and reduce shockwaves upstream of merge points.
Integrated Corridor Management (ICM)	When congested traffic conditions occur on one roadway, traffic on adjoining roadways or freeway interchanges in the corridor, are also impacted. ICM is the approach of managing traffic as a network as an origin to destination network of roadways operated by various jurisdictional entities, rather than freeways or arterials.

ITS Technology Strategies (* currently in Nevada)	Definition
Emergency Transportation Operations	Improved management of traffic incidents, natural disasters, security events, and other emergencies on the highway system.
Freight Technology and Operations*	Technologies that improve efficiency and productivity, increase global connectivity, and enhance freight system performance. Applications are both in-vehicle, freight owner-manager systems as well as the Department of Transportation infrastructure that can support freight mobility and routing.
Managed Lanes*	Specific lanes where operational strategies are proactively implemented and managed in response to changing real-time conditions. Pricing for lane use, vehicle eligibility, and access control are the three typical categories of managed lanes.
Planned Special Events Traffic Management*	Special events cause different types of nonrecurring traffic management challenges from incidents or work zones.
Road Weather Management	Technologies used to support the identification of current weather conditions impacting road users as well as the predictive weather forecasts that can support maintenance and resource planning.
Real-Time Traveler Information*	Collecting real-time data and turning that data into information to support the traveling public through methods such as 511, social media, traveler alerts, and websites.
Ramp Management*	The application of control devices, such as ramp meter traffic signals, signing, and gates to regulate the number of vehicles entering or leaving the freeway, to achieve operational objectives.
Traffic Incident Management (TIM)*	Technologies, software, and processes to support unplanned roadway events that affect or impede the normal flow of traffic. The National Incident Management System (NIMS) protocol utilized during incident command can utilize technologies and integration of data to support incident management.
Work Zone Management (WZ)	Managing traffic during construction and assessing work zone impacts on the traveling public. Work zone management techniques includes providing better information to the traveler through the work zone and creating a safer environment for the workers in the construction area.
Connected and Autonomous Vehicle Application (CAV)	Vehicles are becoming more capable of communicating with the in-field infrastructure and with other vehicles around itself. Technologies in this realm are advancing faster than public agencies can deploy which means it will be important to focus on foundational investments that will be used by the CAV future.

5. ITS AND ATM IN NEVADA

A review of currently deployed ITS and ATM technologies in Nevada was conducted to gain an understanding of the state's current capabilities through an evaluation of NDOT's freeway and arterial advanced traffic management system, a comprehensive review of existing plans and studies, and new and innovative technology being explored by NDOT.

5.1. Summary of Deployed Technologies

ITS technologies and functional capabilities have evolved over time and have broadened in scope from when they were first deployed decades ago within the state. Some devices collect and communicate data to NDOT for monitoring or decision-making purposes. Others transmit messages based on road conditions to help harmonize speeds or alert road users of adverse conditions ahead. The ITS technologies outlined in this section have been implemented by NDOT in some capacity throughout the state to enhance the safety and efficiency of Nevada's roadway system. The intent of this section is not to be an exhaustive list of deployments or functions, but rather a high-level reflection of the types of technologies that NDOT has invested in or continues to pilot.

5.1.1. Freeway Management

Freeway management technologies currently deployed throughout Nevada are found below, these include managed lanes, ATM, the use of third-party data, mainline detection, and CCTV cameras.

Managed Lanes – High Occupancy Vehicle Lanes (HOV Lanes)

Managed lanes in the form of HOV lanes currently exist in Las Vegas along U.S. 95 from Ann Road to the Spaghetti Bowl and on I-15 from the Spaghetti Bowl to Silverado Ranch Boulevard. HOV lanes are dedicated lanes to be used exclusively by vehicles with two or more people and can reduce travel time compared to general-purpose lanes especially during peak periods of travel.

Managed Lanes (Ramp Meters)

Ramp meters are signals and vehicle detection located at the end of freeway on-ramps to control the frequency in which vehicles enter the mainline. Ramp meters are found within the Reno/Sparks and the Las Vegas Valley urban areas.

ATM (Lane Control and VSL)

ATM assets include mainline vehicle detection, CCTV cameras every mile, and overhead lane control gantries every half mile with every other location having a dynamic message sign space to provide information to travelers. The devices implemented along portions of I-15 and US-95 in the Las Vegas Resort Corridor record and transmit data to the Southern Nevada TMC and help harmonize traffic speeds and alert road users of hazards or other information. Signs can be manually set to display specific information or can automatically display information based on the time of day and current road conditions.

Mainline Detection

Mainline detector stations are located throughout Nevada, primarily along interstate routes. Some stations are also located along other major roadways within the Las Vegas Valley; however, none are located on other major roadways in other parts of the state. These devices are permanent in ground or mounted devices that detect vehicles in real-time and communicate data to operations centers or other ITS devices. This data is typically seen as travel times posted to Dynamic Message Sign (DMS) devices.

Closed-Circuit Television (CCTV) Cameras

CCTV cameras are located throughout the state along both state-owned and locally owned roadways. CCTV cameras are primarily used to visually monitor road conditions during weather events, traffic incidents, or congested conditions with the goal of improving traffic management and decision making. CCTV cameras typically have pan, tilt, and zoom capabilities which allow cameras to view different areas according to current points of interest. CCTV is not recorded by NDOT but can be shared with authorized users and the public, the live video stream of cameras is accessible from NDOT's website.

Continuous Count Stations

NDOT operates 3,439 count stations, with 3,337 short term count stations and 102 long term count stations (data published March 4, 2021, from NDOT TRINA website) Count stations provide the necessary data to compute Monthly Average Daily Traffic, Average Annual Daily Traffic and the percent Design Hour Volume. Vehicle classification data is provided by Permanent Continuous Weigh in Motion (WIM), Permanent Continuous Automatic Vehicle Classification, Short Term Automatic Vehicle Classification, or Manual Classification.

5.1.2. Arterial-Freeway Coordination

Integrated Corridor Management

Although there are no formal ICM activities occurring throughout the state, there is a concerted effort in sharing information ITS device information between NDOT and local agencies to supporting ICM activities in the future. The Southern Nevada TMC has the ability to view and share status of ITS devices on the local network and the freeway network in the Las Vegas metropolitan area. There is an established center-to-center system in place in northern Nevada in the RTC Washoe Reno and Sparks metropolitan area where agencies can share ITS device information across jurisdictions and across transportation networks.

An example of ITS device sharing occurring nationwide that NDOT has participated in the past with is the Western States Rural Transportation Consortium One-Stop-Shop (OSS) website serves as a resource to disseminate real-time information gathered from ITS devices to allow travelers to plan their trips accordingly. ITS devices informing the OSS website include CCTV and Road Weather Information Systems (RWIS). Other information such as construction work and incident alerts are also provided.

5.1.3. Crash Prevention and Safety

Monitoring/Detection

CCTV cameras are used by the ROCs and RTC FAST to monitor roadway conditions. CCTV camera footage can be used to identify crashes or other incidents on major roadways where CCTV is currently deployed. CCTV footage is live streamed but not recorded by NDOT, however at least one private company has begun using footage captured by NDOT traffic cameras to help investigators solve crimes or cases of other misconduct.

Bicycle/Pedestrian Crossings

NDOT has a decision matrix to identify the appropriate pedestrian improvement at roadways based on various characteristics such as average daily traffic, posted speed limit, and general roadway cross section. Current technologies recommended in the matrix include rectangular rapid flashing beacons (RRFBs), overhead RRFBs, and enhanced lighting at pedestrian crossings.

Advance Signal Warning Systems

Advance signal warning systems (ASWS) are being updated across Nevada to ensure there is uniformity in the systems being used to enhance safety. These systems warn drivers of upcoming signals using additional warning signs that precede a signal. ASWS are interconnected with existing signals to alert drivers of a potential need to stop at signalized intersections.

Rural Intersection Variable Speed Limit

VSL signs have been implemented at various locations in Washoe County and Clark County (along I-15). The VSL signs in Washoe County were originally implemented serve to support a wind warning system and were ultimately removed. The VSL signs in Clark County are implemented as part of the ATM system.

5.1.4. Road Weather Management

Road Weather Information System (RWIS)

RWIS are typically installed on towers at locations throughout the state to collect weather data. Nevada has 143 RWIS devices that collect and report atmospheric conditions, pavement conditions, water level conditions, and visibility to ROC and TMC operators. Data is transmitted via polling software in two-minute intervals. The Advanced Traffic Management System (ATMS) software also processes and transfers the RWIS data to other systems both internal to NDOT and public facing websites. Each of the three NDOT districts have RWIS devices, however some of the RWIS devices located in District 1 can only communicate with the system in District 2.

Vehicle Integrating Mobile Observations (IMOs)

NDOT has approximately 60 vehicles equipped to receive mobile weather data, these include snowplows and light duty trucks that have been outfitted with Maintenance Decision Support Systems (MDSS). The MDSS is able to transmit data real-time via dedicated short-range communication (DSRC) or cellular networks to operations centers for decision making purposes especially during winter conditions.

Ice Detection

The Galena Creek bridge along I-580 connecting Reno to Carson City is equipped with a de-icing system that sprays de-icing solution on the road surface when icy conditions are detected through air and pavement temperature readings.

5.1.5. Alternative Fuels

Electric Highway

The Nevada Electric Highway is a network of Electric Vehicle (EV) charging stations placed at strategic locations throughout the state. Charging stations are located at gas stations, rest areas, or other locations of interest along both interstates and state routes. Key corridors where EV charging stations have been installed include I-80, I-15, US 95, US 93, and US 50.

5.1.6. Traffic Incident Management

Incident Management Platform System

NDOT, RTC FAST, and the NHP all currently utilize the same incident management platform system. The data provided by the incident management platform system leverages machine learning technology, which gives cloud-based access to all users from a desktop or tablet so they can coordinate their response to incidents and share information. The data platform's open architecture supports a wide array of modifications, which are supplemented by different applications, feature sets, and tools. The user interface is configured by the type of device and the role of each user. The platform is designed to be multi-tenant, granting simultaneous use to all agencies. A layered live-map displays traffic conditions, crashes, incidents, cameras and DMS, events, road construction/closures, and predictive analytics for high-risk roadways.

Strategic Traffic Management Sites (STMS)

STMS are physical pad structures built adjacent to travel lanes to elevate police vehicles with their flashing lights, prompting motorists to reduce their speed. Statistical data from the incident management platform system was used to evaluate and prioritize locations, days, and hours with the overall highest density of traffic incidents along three key corridors: I-15 Northbound near Russell Rd., US-95 Southbound near Jones Blvd., and I-15 Southbound near Lake Mead Blvd. Using this information, NDOT built STMS in an upstream location closest to the area with the highest impact.

NHP in coordination with NDOT and RTC FAST uses these sites to position troopers during key periods when preventive action will be the most beneficial. RTC FAST coordinates with NHP to update DMS, alerting drivers when they are approaching a STMS zone. STMS have a measurable traffic calming effect, which creates safer roadways. Connected Vehicle data can be used to measure driver behavior, providing additional safety insights.

Computer-Aided Dispatch (CAD) Integration

The Spillman CAD system is owned by NHP and provides a direct link to NDOT to allow for CAD-CAD coordination during incident dispatching events.

5.1.7. Emergency Management

Emergency Vehicle Preemption and Tattle-Tale Lights

Emergency Vehicle Preemption and tattle-tale lights have been implemented in Clark County. Preemption allows emergency vehicles to cause a signal to change phases giving them the right-of-way when traveling to or from an emergency scene. Tattle-tale lights can alert law enforcement when a vehicle runs a red light by displaying a small light above the signal post. Preemption and tattle-tale technology both can increase road safety. EVP is included in the NDOT SLI Design Guide and has been incorporated as part of the NDOT process for the installation of all new traffic signals.

5.1.8. Traveler Information

Dynamic Message Signs (DMS)

There are currently 358 DMS signs across the state. The DMS communicate information about travel time between locations or other important warnings to road users with the goal of improving the flow of traffic and safety. Several types of DMS exist, these include typical DMS signs along major roadways displaying travel times or messages relevant to current road conditions, blue travel time signs which display digital travel time information, and large ATM systems which have been discussed previously. There is potential for the blue travel time signs to be phased out due to ITS upgrades or a shift in technology used by road users.

Highway Advisory Radio (HAR)

Automatic Vehicle Classification (HAR) are traveler information stations that alert travelers within the device's range of current traffic and travel conditions. A total of 34 HAR devices exist within Nevada. A HAR Master Plan Update was completed in March 2021 which acknowledges the intended decommissioning of HAR over time if it is determined that there is no longer use for particular HAR locations.

Nevada Advanced Traveler Information System (ATIS)

The Nevada 511 system is a phone and web-based service that provides real-time information from various ITS devices to inform the traveling public of current roadway condition.

Chain Up Signage

Chain-Up signage technology provides notification to remind travelers to use tire chains in specified areas that need more traction such as up/downhill and where there are common occurrences of snow and ice. NDOT's chain up signs typically include beacons and in certain areas throughout the state can be remotely activated to begin flashing.

5.1.9. Commercial Vehicle Operations

Truck Escape Ramps

Truck escape ramps provide an emergency roadway exit area along hills with steep downgrades for trucks with compromised brake systems to use to safely come to a stop. Nevada has four truck escape ramps located at the following locations:

- SR 431 Mount Rose Highway (Mile Post Washoe County 0.27)
- US 50 (Mile Post Carson City 2.98)
- US 50 (Mile Post Carson City 7.03)
- SR 163 Laughlin Highway (Mile Post Clark County 17.3)

5.1.10. Work Zone Management

Smart Work Zones

Smart Work Zone technology transmits various traffic data to third-party crowdsource companies in real-time allowing for improved safety of construction workers and the traveling public. Smart work zone devices have been deployed on some construction projects in Southern Nevada.

5.1.11. Connected Vehicles/Autonomous Vehicles (CAV)

Nevada was the first state to implement regulations to encourage CAV technology and has become the nation's leader in testing, licensing, and regulating CAVs.

In addition to this cutting-edge leadership, all government entities within the state are completely united to work together to continue and lead the nation in the testing of CAV technology. Nevada understands policy, partnerships, collaboration, and innovation.

As CAV initiatives are prioritized by a growing number of agencies, smart and connected projects in Nevada are quickly emerging. Some project examples include the Northern Nevada Intelligent Mobility Living Lab, Mobile Observations and Connected Snowplow Projects' Integration, Smart Mobility Initiative, and Nevada Electric Vehicle Infrastructure Deployment Plan.

Nevada agencies have partnered and are actively involved in the promotion of CAV initiatives. Each of these agencies bring a unique perspective based on their respective roles and responsibilities in planning, implementation, operation and maintenance of CAV technologies. Representatives from each of these agencies have been involved in discussions related to statewide CAV activities and each will play a pivotal role in leading and supporting the key functional activities needed to further CAV initiatives.

NDOT has been at the forefront of establishing policies and coordinating with state and federal legislators to develop and deploy CAV test policies. NDOT has also been coordinating with other state transportation departments and national transportation agencies to bring best practices to Nevada.

In 2017, NDOT established Sustainable and Emerging Transportation (SET) to formally support planning and deployment of CAV initiatives. SET's goal is to play an integral part, helping to revolutionize transportation in Nevada. SET will focus on assisting with the development of an overarching strategy for the implementation and integration of emerging transportation technologies. SET is dedicated to exploring the unlimited potential of these technologies and prepare NDOT with a plan for the future. Emerging technologies including CAVs will be an important part of our future at NDOT.

5.1.12. Communication

Fiber Optic Cable

Fiber optic cable enables high bandwidth point-to-point communications with ITS devices and facilities all over the state. Fiber is deployed in underground conduit typically within the right-of-way of state-owned roadways throughout the state.

Fiber Hub

Fiber hubs are small buildings located along the fiber system where fiber cables and infrastructure are terminated to limit the distance that data needs to travel to reach its software/server destination. Fiber hubs offer an opportunity for the termination of one fiber cable and the redistribution of that data along a new fiber cable to continue along the fiber network to reach its destination.

Conduit

Conduit is insolated tubing installed underground by capital or development projects that enable a path by which fiber- optic cable can travel for its point-to-point communications.

Wireless (Radio and Cellular)

The state has a wide network of communications capabilities to connect ITS devices that are not able to be connected to fiber optic cable. The communications options NDOT uses include microwave radio as well as cellular devices to connect to any device that are not physically located along a fiber path.

Additional radios in the state are part of the Nevada Shared Radio System (NSRS) consists of over 100 sites. NSRS provides radio communications services to public safety agencies in Nevada, and the system enhances the safety, mobility, reliability, and operability of Nevada's road network. The NDOT Land Mobile Radio (LMR) service provides radio services upon request. LMR is often used during parades or other large events to support emergency or communications services dependent upon radio communication for functionality.

Dedicated Short-Range Communications (DSRC)

DSRC is enabled by both field and on-board technology. Signal Phase and Timing (SPaT) technology uses DSRC for communication purposes, enabling DSRC field devices to communicate with CAV roadside equipment, and DSRC is used in NDOT's winter IMO/MDSS project for snowplows that travel along the I-580 corridor. The IMO devices are after-market and are installed on snowplows and some police vehicles to assist in gathering weather data and decision making.

5.2. ITS Technologies Being Explored in Nevada

A few ITS technologies currently being explored by NDOT were discovered through the review of the existing plans and studies as well as through the one-on-one discussions with the different NDOT Divisions.

Truck Parking Availability System (TPAS)

Truck parking facilities provide a much-needed amenity for truck drivers. Having safe and adequate truck parking facilities allow truck drivers to make stops along their travel route to wait for

congestion to clear within urban areas, wait for a business' delivery window, or stay overnight in the middle of a long-haul trip. In 2019, NDOT developed the *Nevada Truck Parking Implementation Plan* to identify where existing facilities could be improved with truck parking technology. The technology recommended was the TPAS to make finding parking easier for truck drivers. TPAS is able to provide the number of available parking spaces to truck drivers at connected facilities.

The *Nevada Truck Parking Implementation Plan* identified various truck parking projects along I-80, I-15, SR 306/US 6, and US 95, the TPAS installation was proposed in two phases. Six priority locations for TPAS were identified for Phase 1, these include three locations along I-15 and three along I-80. NDOT's Traffic Operation's Division is currently scoping Phase 1 of the TPAS project. TPAS Phase 2 will consist of the installation of TPAS technology at the 15 remaining public rest areas along I-15 and I-80.

Wrong-Way Driver Detection

In 2021 NDOT published a study called, "*A Data-Driven Approach to Implementing Wrong-way Driving Countermeasures*" (*WWD Study*) which researched best practices to reduce wrong-way driver (WWD) crashes. NDOT currently places "Wrong Way" signs on all freeway ramps to notify drivers errantly entering in the wrong direction. As part of the *WWD study*, NDOT received interim approval for a list of freeway-exit ramps for experimental installation of the RRFBs. The RRFBs have been installed to face wrong way traffic on exit ramps and are activated when a wrong way vehicle is detected. The system is designed to alert drivers to the fact that they are about to enter the freeway in the wrong direction by use of CCTV or radar. The detection technology communicates with NDOT ROCs and the Southern Nevada FAST TMC, alerting them of the presence of a wrong-way driver. Four WWD treatment levels were recommended as part of the *WWD Study*, these include:

- Level 1 Baseline Improvements (recommended for all interchanges)
- Level 2 Enhanced Improvements
- Level 3 ITS Improvements
- Level 3i ITS Improvements (where ITS infrastructure exists)

The Level 3 ITS improvements include the recommendations listed for Level 2, with the addition of ITS-specific improvements including dynamic message signing, light emitting diode lighting on signage, radar sensors, detection cameras, and active communication warnings to the NDOT ROC and/or the Southern Nevada FAST TMC. A subset of the Level 3 ITS (Level 3i) improvements was developed to include infrastructure ready projects. These are locations where ITS infrastructure currently exists (four interchanges in Clark County, and four interchanges in Carson City). As such, infrastructure is already in place at these locations to expedite the Level 3 ITS improvements. **Table 3** provides a summary of the WWD recommendations involving ITS technology.

Table 3 – WWD Implementation by Ramp

Mitigation Implementation Zones	Level 3 ITS	Level 3i ITS	Level 3ii (Previously Installed)
Reno/Sparks and Surrounding Area	11 (1 Project)	3 (1 Project)	36
Las Vegas and Surrounding Area	46 (3 Projects)	31 (2 Projects)	1
Rural Nevada	43 (Group Based on County Borders)	10 (2 Projects)	0
Total	**100**	**44**	**37**

Construction has been completed on the following Level 3 locations:

- I-15 at Starr Ave – NB and SB off ramps
- US 95 at Durango – NB and SB Off ramps
- US 95 at Sky Canyon – NB and SB Off ramps
- US 95 at Kyle Canyon – NB and SB Off ramps
- I-580 at Carson Street – SB Off ramp
- I-580 at Arrowhead Dr – NB Off ramp
- I-580 at College Pkwy – NB and SB Off Ramps
- I-580 at Lincoln Hwy (US 50) – NB and SB Off Ramps
- I-580 at Fairview Dr – SB and NB Off Ramps

High Occupancy Vehicle Detection

Currently High Occupancy Vehicle (HOV) lanes are operated full time and not on a time-of-day basis. Detection is being deployed on an HOV Pilot Study to collect and analyze occupancy data to determine if freeway operations could be improved by changing the operational hours. This study is anticipated to be completed in 2023. Detection also supports an understanding of how many HOV violations are happening and if measures should be taken to enforce and support HOV restrictions more. Due to lack of personnel, current state law, and higher priorities elsewhere, detection is not used for enforcement. Detection is being designed and deployed throughout the state as projects arise to increase detection and thus increase availability of data to support improved operations with HOV lanes.

Adaptive Lighting

Adaptive lighting systems are designed to adjust their light output as detected conditions are met, such as detection of vehicles or pedestrians. NDOT is currently working on an adaptive lighting pilot project. The adaptive lighting system activates when approaching vehicles and pedestrians are detected, brightens the area for first responders, and detects and activates when gun shots are heard.

Pedestrian Hybrid Beacons

The pedestrian hybrid beacon (PHB) is a traffic control device that consists of two red lenses above a single yellow lens where the lenses remain dark until a pedestrian desiring to cross the street pushes the call button to activate the beacon, which then initiates a yellow to red lighting sequence consisting of flashing and steady lights that directs motorists to slow and come to a stop, and provides the right-of-way to the pedestrian to safely cross the roadway before going dark again. NDOT is currently conducting a research project to identify the feasibility of implementing PHB within the state. Outcomes of this research project will determine future application needs of PHB around the state.

Hard Shoulder Running

Hard shoulder use in the state is currently limited for use by authorized emergency vehicles. Transit and emergency services have expressed interest in utilizing the hard shoulder for public service. Currently, NDOT and NHP have collaborated to suggest modifications to applicable statutes as required to allow for shoulder use by government-authorized transit vehicles and emergency vehicles with appropriate signing in place to allow for use. Hard shoulder running would maximize the use of freeway investments already made and can be supported by the anticipated expansion of the ATM system.

For the state to implement this change, there would need to be appropriate pavement for transit and emergency vehicles to drive on, signage installed to allow for shoulder use, and a method of monitoring lane use. NDOT already has monitoring capabilities in place. NDOT is preparing for those investments where there may be pavement that requires repair or new signage that would need to be installed.

The application of this revision to Nevada Revised Statues would be determined by NDOT on an as needs-based and data-driven planning process. The application is not intended to be widely implemented, but rather in specific circumstances in urbanized areas that could support transit routing using the freeways to maximize the use of the investments already made in the transportation system. Other states such as Virginia and Colorado, have already implemented similar hard shoulder running implementations that serve as appropriate references.

Adaptive Signal Control Technology

Adaptive Signal Control Technologies (ASCT) are technologies that capture current traffic demand data and adjust traffic signal timing to optimize traffic flow in coordinated traffic signal systems. While conventional signal systems use pre-programmed daily signal timing schedules, ASCT adjusts the timing of red, and green lights to accommodate changing traffic patterns and ease traffic congestion.

First, strategically placed sensors collect data then the adaptive signal control technology implements the signal timing updates based on actual demand. This process is continuously updated to adapt to the changing volumes and conditions on the roadway to optimize traffic signal timing.

According to the Federal Highway Administration (FHWA), the main benefits of ASCT over conventional signal systems include the following:

- Continuously distribute green light time equitably for all traffic movements
- Improve travel time reliability by progressively moving vehicles through green lights

- Reduce congestion by creating smoother flow
- Prolong the effectiveness of traffic signal timing which translates to more effective use of limited resources

NDOT and local partners were in process of planning for and implementing ASCT on I-15 and Tropicana Avenue interchange to mitigate congestion during the construction activities, although it has been removed from the project. However, during construction activities that affect the normal operation of traffic, ASCT can be advantageous in managing the traffic demand. With the ability to adjust to the demand of traffic, work zones typically have continually changing traffic flow, based on the normal flow. This is due to some drivers using alternative diversion routes and the increased demand following planned or unplanned event. Traditional fixed time plans do not allow for rapid changing traffic flows and are only based on historic data. When changes to the work zone is implemented, such as a change in lane use, opening and closing lanes, the ASCT can be updated remotely as the change is made on street and then the ASCT will adjust to the new demand. Benefits can be gained during all demands, including peak and off peak, having the additional comfort that any fluctuation in demand will be automatically adjusted for.

5.3. Review of Existing Plans and Studies

The existing plans and studies collected were reviewed to identify where there has already been future plans and directions documented in each of the five strategy areas or where there is relation and context that needs to be considered in the development of the statewide ITS & ATM Master Plan. **Table 4** provides a list of all the plans and studies reviewed along with the related ITS strategies they serve as input toward. There are some existing documents that resulted in no tangible future recommendation in any of the strategy areas, which was expected in the broad range of documents reviewed. There are also documents that were finalized and published following this review effort, including the Nevada State Plan for Electric Vehicle Infrastructure Deployment that were reviewed subsequently during the ITS and ATM strategy development process to make sure there was alignment with recommendations coming from more recent plans. **Attachment C** provides a detailed summary of each document noting the type of information that has been collected within each of the strategy areas noted in the columns as they align. The detail in Attachment C were used extensively during the strategy development task of the project. No activities currently underway that do not have completed documents were included in this review.

Table 4 – Existing Plans and Studies Summary

Main Category	Subcategory	Item Collected	Comm	Ops	Partner	Data	Tech
Freeway Management	General	ITS Architecture Update 2019	✓	✓		✓	
	Managed Lanes	Managed Lanes and Ramp Metering Manual	✓		✓		✓
		Feasibility of Using Video Cameras for Automated Enforcement on Red-Light Running and Managed Lanes		✓	✓	✓	✓
		Southern Nevada HOV Plan Update and Addendum		✓	✓	✓	✓
	ATM	ATM Concept of Operations Update	✓	✓	✓	✓	✓
		ATM Standard Operating Procedure Draft Checklists		✓			
		Active Transportation Demand Management Cohort Meeting Notes					
	Third Party Data	Waycare: https://waycaretech.com/	✓	✓		✓	✓
Arterial- Freeway Coordination	General	CAMPO Regional Arterials Study	✓	✓	✓	✓	✓
		Traffic Prediction and Responses through Data Mining and Data Stream Processing	✓	✓	✓	✓	✓
	Integrated Corridor Management	Western States Rural Transportation Consortium One-Stop-Shop		✓	✓		
		Weather Share		✓			
		Western States Integrated Corridor Management Tool	✓	✓			
		Integrated Corridor Management Weather Share Map	✓				
	Bicycle/Pedestrian Detection	Regional Bicycle and Pedestrian Plan for Southern Nevada			✓		✓
		Nevada County Bicycle Master Plan			✓		✓
Crash Prevention and Safety	General	Nevada Strategic Highway Safety Plan	✓		✓	✓	✓
		Nevada Strategic Highway Safety Plan - Crash Facts		✓			✓
		NDOT Safety Management Plans					
	Monitoring / Detection	KTNV 13 Article: Nevada company records traffic cameras, catches more than just traffic		✓		✓	
	Bicycle / Pedestrian Crossings	Pedestrian Safety Improvement Evaluation Guideline for Uncontrolled Crossings		✓		✓	✓
	Signalization	Advanced Signal Warning Signs: https://www.nvsafesignals.com/	✓				✓
	Animal Crossings	Deer Migration Tracking Maps				✓	✓
	Wrong Way Driving	NDOT Wrong Way Driver System	✓	✓	✓		✓
		Wrong-Way Driver Response Guidelines		✓	✓	✓	
	Rural Intersection VSL	Reno Gazette Journal: Why no snow/ice speed limit in Nevada?					✓
Road Weather Management	Visibility	NDOT Road Weather Information System (RWIS) Master Plan	✓	✓	✓	✓	✓
		NDEX Road Weather Information System					
	Vehicle Integrating Mobile Observations	Integrating Mobile Observations about Road Weather Conditions for Decision-Making		✓	✓	✓	✓
		Maintenance Decision Support System: Pilot Study and Cost-Benefit Analysis (Phase 2)			✓		✓
		SICOP Talks Winter Ops: Podcast Episode 27: Integrated Mobile Observations at the Nevada DOT			✓	✓	✓
		Rural Transportation.org: Using Vehicle Connectivity Technology for Roadway Weather Response	✓		✓	✓	✓
	Infrastructure Detection	Bridge Anti-Icing Technology					✓
Alternative Fuels	General	Nevada's Strategic Planning Framework	✓				
		Nevada Electric Highway	✓	✓	✓		✓
	Smart electric vehicle charging	Alternative Fuels Data Center: Nevada Laws and Incentives					✓
Traffic Incident Management	General	Nevada Traffic Incident Management Coalition			✓	✓	
	FirstNet	State of Nevada FirstNet Statewide Meeting	✓		✓		✓
		FirstNet – How Network Works with Today's Land Mobile Radio Networks? Brochure	✓				✓
		FirstNet for Nevada					
	Third Party Data / Artificial Intelligence	Identifying Real-World Transportation Applications Using Artificial Intelligence (AI)	✓	✓	✓	✓	✓
	CAD-TMC Integration	Statewide Pilot Project for Standardized TIM Performance Measurement and Reporting	✓		✓	✓	✓
Emergency Management	Emergency Vehicle Preemption	Clark County Traffic Signal Operations Brochure					
	HAZMAT Detection	Hazardous Materials Response Plan – Plan Overview		✓			
Traveler Information	Dynamic Message Signs	NDOT NVRoads: Freeway Message Signs Webpage	✓				
		TTI: Nevada agencies use AI platform to select STMS locations on high-risk corridors	✓		✓	✓	
		NVFAST: Dynamic Message Signs Webpage	✓				
	Highway Advisory Radio	NDOT HAR Master Plan Update	✓		✓		✓
	511	Weather Sensors Webpage					
Information Management	ATSPM	Developing a Quality of Signal Timing Performance Measure Methodology for Arterial Operations	✓	✓		✓	✓

Main Category	Subcategory	Item Collected	Comm	Ops	Partner	Data	Tech
	Drones	Drone Laws in Nevada (2022)					
Commercial Vehicle Operations	General	Nevada State Freight Plan			✓	✓	✓
		Nevada State Rail Plan			✓	✓	✓
		I-15 Freight Mobility Enhancement Plan	✓		✓	✓	✓
		I-15 Corridor System Master Plan Update	✓		✓		✓
		Nevada Freight Projects					
		Nevada Highway Freight Network					✓
	Truck Parking	Nevada Truck Parking Implementation Plan		✓	✓	✓	✓
		Urban Truck Parking Technology Exploration	✓	✓	✓	✓	✓
	Over Height Warning	Workzonesafety.org: Devices and early warning methods used to reduce hits on low-clearance structures					
	Port of Entry	Virtual WIM Brochure	✓			✓	✓
	Truck Escape Ramps	Nevada Truck Escape Ramp Brochure					
	Mobility Hubs	Lake Tahoe Mobility Hub	✓				
Work Zone Management	Smart Work Zones	National Operations Center of Excellence (NOCoE) Smart Work Zones – Peer Exchange Proceeding Report	✓	✓		✓	✓
		NDOT Smart Work Zone (SWZ) Presentation	✓	✓			✓
		RTC of Southern Nevada Smart Work Zones	✓	✓	✓	✓	✓
		Innovations: Data Driven Insights					
	Contractor Requirements in Procurement Process	Standard Plans and Specifications for Road and Bridge Construction					✓
Connected / Autonomous Vehicles	General	NDOT Automated and Connected Vehicles Webpage			✓	✓	
		Sierra Nevada Ally: Nevada Continues to Embrace an Autonomous Vehicle Future		✓			
		TTI: Connected Vehicle Data to Improve Driving in Nevada					
		Government Technology: Keeping Nevada's Drivers Safe and Connected					
		Nevada Revised Statutes: Chapter 482A – Autonomous Vehicles			✓		
		Nevada Legislative Counsel Bureau – Research Brief on Autonomous Vehicles					✓
	Vehicle Conditions	High-Resolution Micro Traffic Data From Roadside LiDAR Sensors for Connected Vehicles and New Traffic Applications					✓
		AASHTO Journal: Expansion in the Works for Nevada Smart Roadway Project					✓
Communications	Fiber	Nevada State Broadband Connectivity Strategy	✓		✓	✓	
		Public Safety Communications Revolution – Our Broadband Future Presentation	✓		✓		
	Wireless	Nevada Shared Radio System (NSRS) Existing System Analysis and P25 System Requirements Report					
		Nevada Shared Radio System (NSRS) Replacement Presentation					✓
		System Site Location Data Report for: Nevada Shared Radio System					
		NDOT Land Mobile Radio (LMR) Services					
Other Studies	General	NDOT Statewide Transportation Systems Management and Operations (TSMO) Program Plan			✓	✓	✓
		NDOT TSMO Business Case		✓			✓
		Case Study – NDOT TSMO Investment Prioritization Tool				✓	
		One Nevada Transportation Plan	✓		✓	✓	✓
		One Nevada Transportation Plan – I-15 Critical Corridor Plan	✓		✓	✓	✓
		One Nevada Transportation Plan – US-93 Critical Corridor Plan	✓		✓	✓	✓
		NDOT Rural Intelligent Transportation Systems (ITS) Strategic Deployment Plan (SDP)	✓		✓		✓
		Statewide ITS SDP (Addendum 1 to NDOT Rural ITS SDP)	✓			✓	✓
		NDOT Signal, Lighting, and ITS Design Guide	✓		✓		✓
		NDOT Smart Mobility Plan		✓	✓	✓	✓
		NDOT Fully Compliant Transportation Asset Management Plan (TAMP)				✓	
		Regional Transportation Commission of Southern Nevada (RTC SNV) Access 2050 Plan		✓			✓

6. EXISTING INVENTORY SUMMARY

An inventory of the currently deployed NDOT ITS devices are summarized below by district level. Information for the device and infrastructure inventory was gathered from NDOT's KITS software and the RadioReference.com website. All inventoried information has been summarized into geographic information system (GIS) maps.

6.1. District 1 Inventory Summary

Major roadways within District 1 include I-15 which crosses the region from the Arizona to the California border in a north/south, running through Las Vegas where it intersects with I-215 and I-515, as well as US 93 and 95. District 1 is well outfitted with ITS devices such as beacons, CCTV, detector stations, DMS, ATM gantry poles, ramp meters devices, and RWIS. Outside the Las Vegas Valley, ITS devices primarily include RWIS, and NSRS with a DMS device near Pahrump and Mina, and detector station devices located along the I-15 corridor. Inventory information for District 1 is summarized in **Table 5** and devices are displayed in **Figure 6** through **Figure 10.**

Table 5 – District 1 ITS Inventory Summary

ITS Device	Count
Ramp Meter	74
ATM Gantries	42
Detector Station	657
CCTV	1,036
Road Weather Information System	17
Dynamic Message Sign	251
Beacons	14
Total	2,091

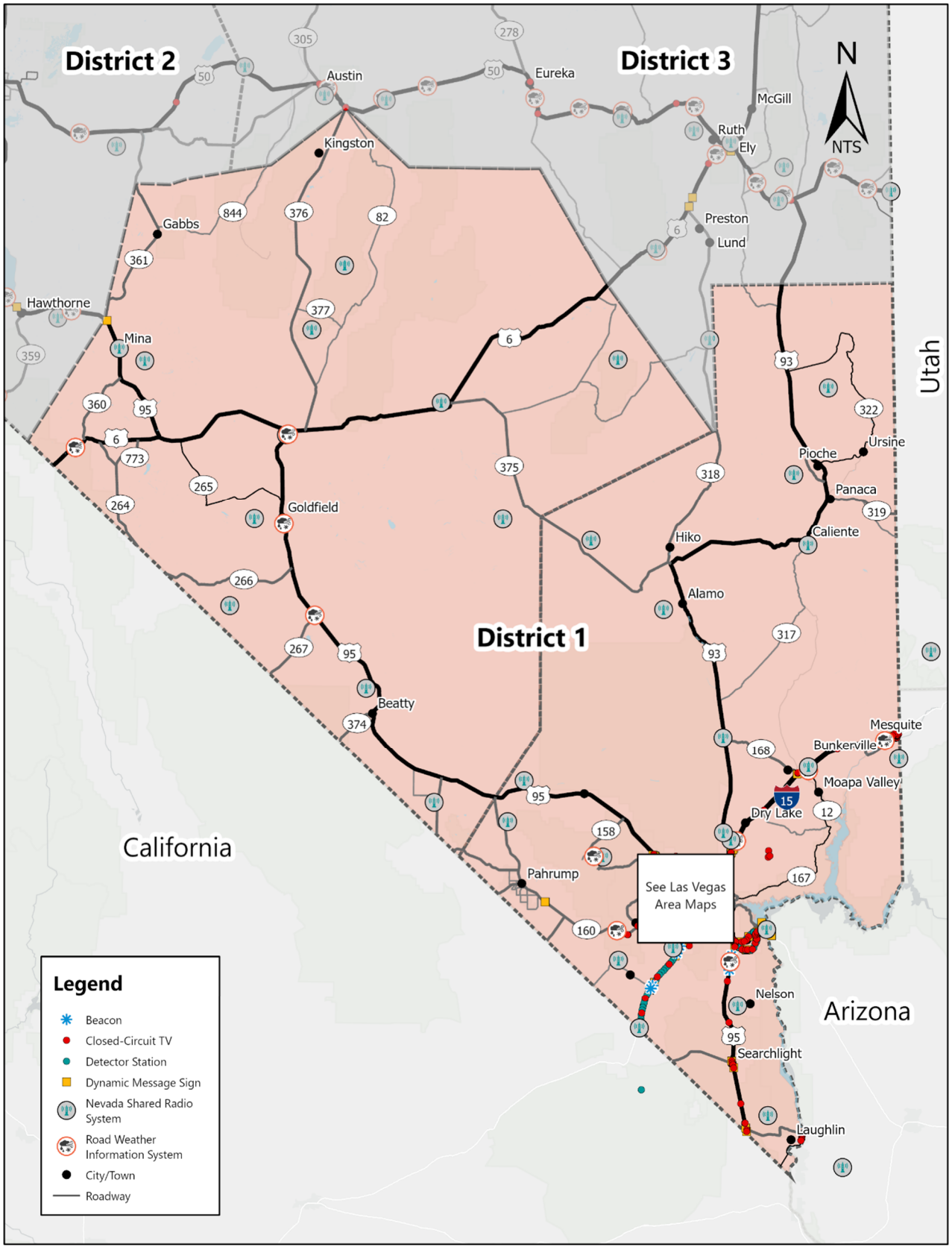


Figure 6 – NDOT District 1 Map

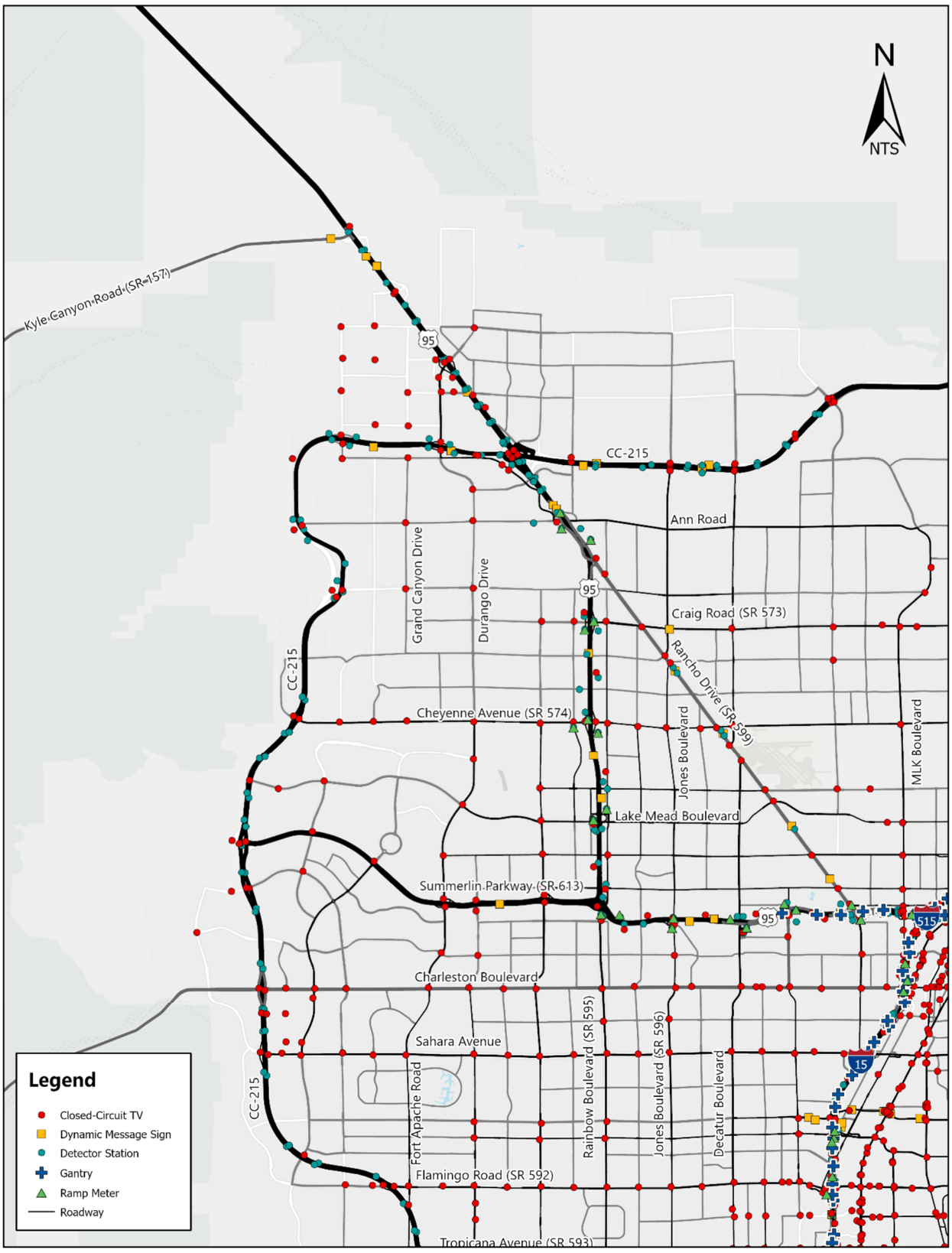


Figure 7 – Las Vegas Detail - Northwest

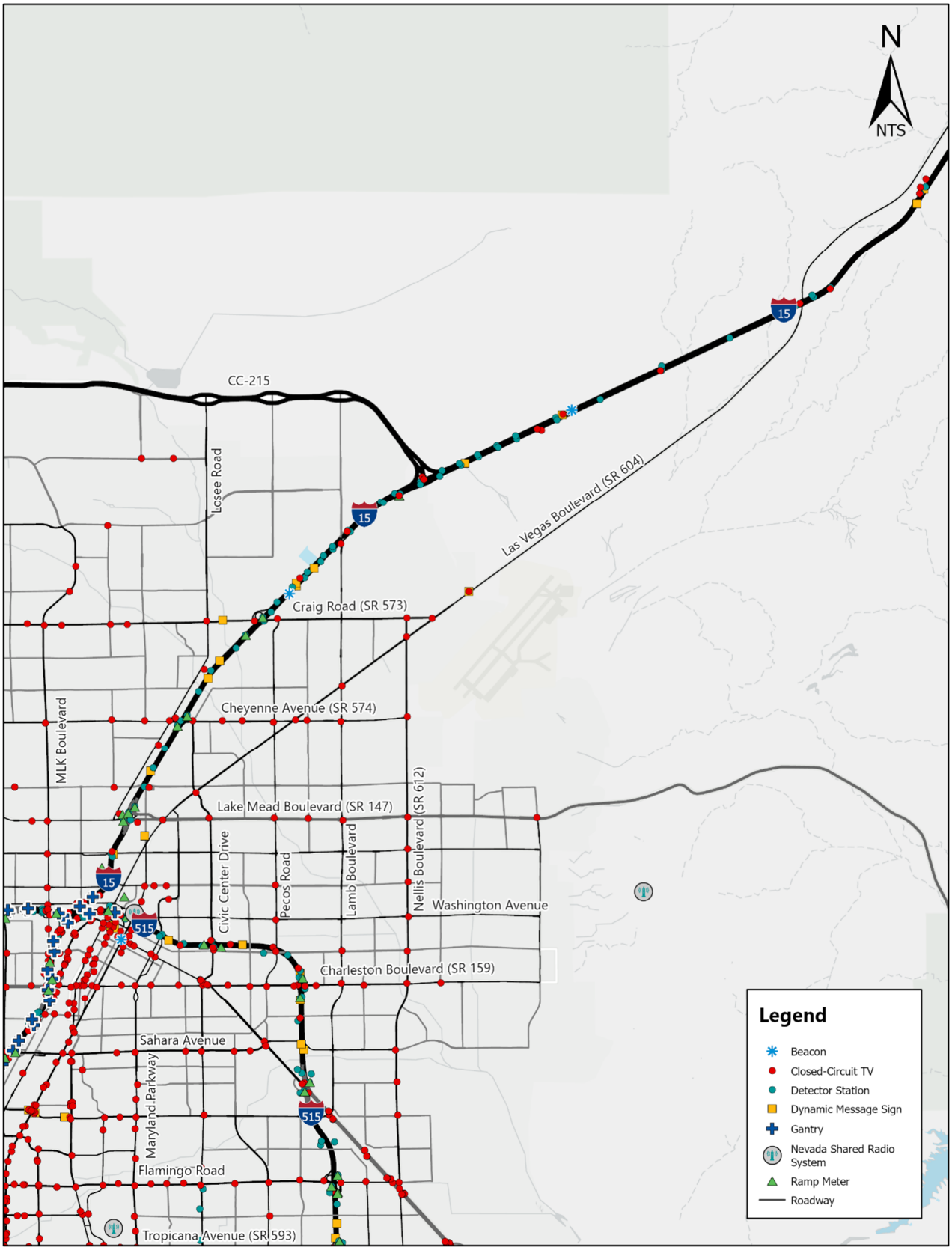


Figure 8 – Las Vegas Detail - Northeast

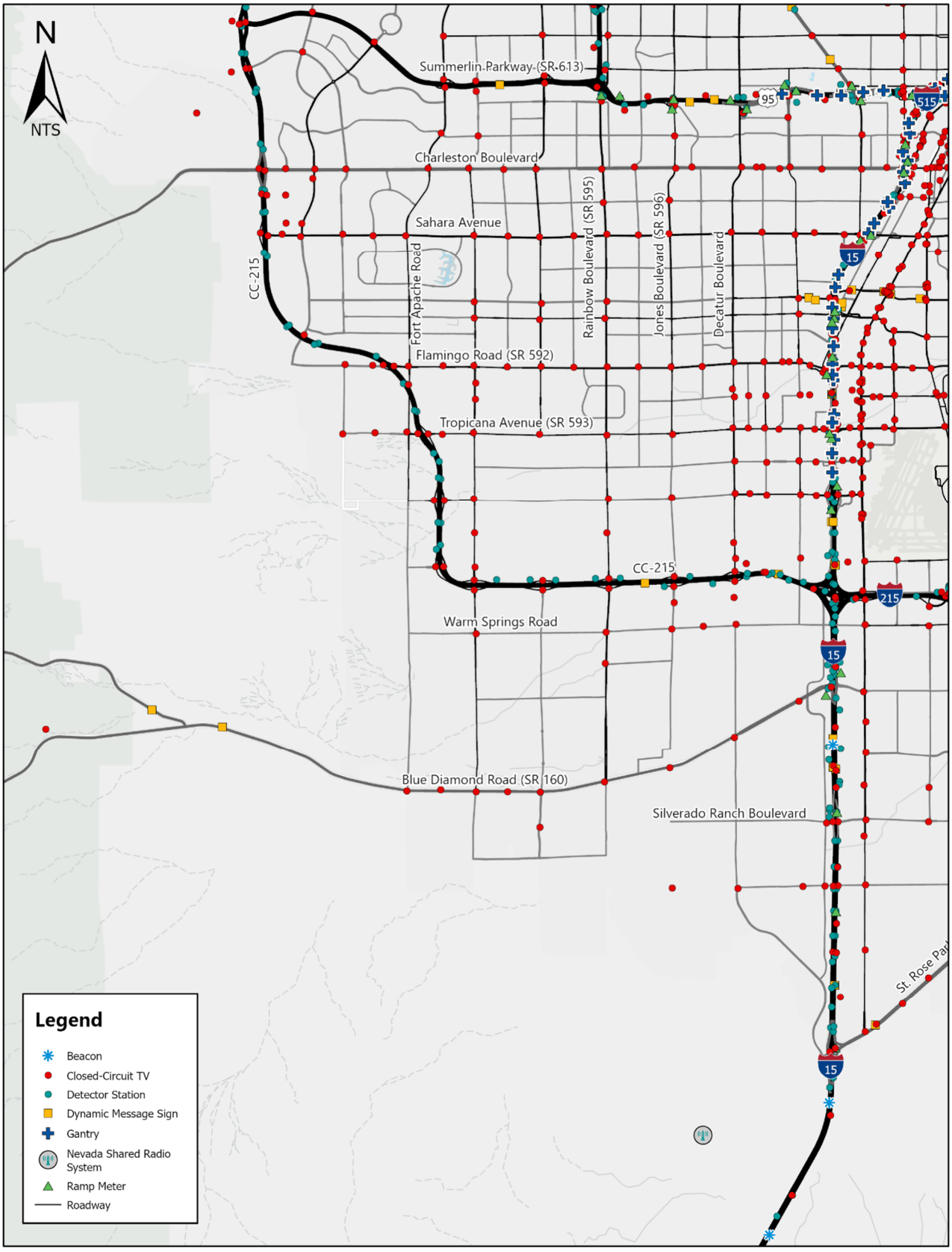


Figure 9 – Las Vegas Detail - Southwest

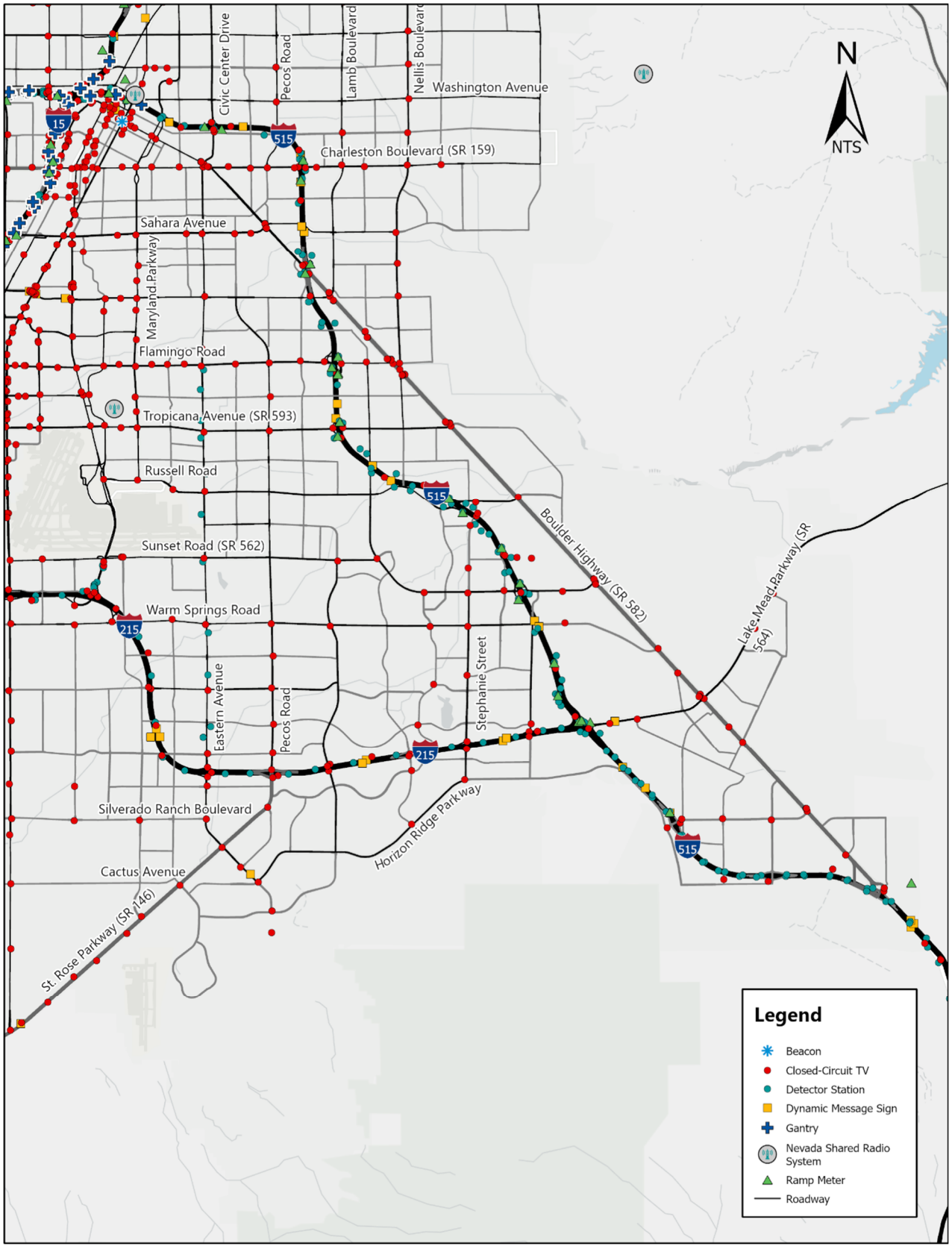


Figure 10 – Las Vegas Detail - Southeast

6.2. District 2 Inventory Summary

I-80 runs through Nevada from the Utah to California border in an east/west direction, running through District 2 from the California border to Humboldt County. US 95 and US 50 also run through the district. District 2 primarily has ITS devices in Reno-Sparks and Carson City areas, with some devices scattered throughout the region. These devices include beacons, DMS, RWIS, detector station, ramp meter, and CCTV. Within District 2, ITS devices in rural regions primarily include RWIS and NSRS. Other ITS such as CCTV, DMS, detector station, ramp meter, and beacon devices are also located in urban areas near Reno and Carson City. The inventory summary for District 2 is found in **Table 6** and depicted in **Figure 11** through **Figure 13.**

Table 6 – District 2 ITS Inventory Summary

ITS Device	Count
Ramp Meter	8
ATM Gantries	0
Detector Station	193
CCTV	153
Road Weather Information System	68
Dynamic Message Sign	80
Beacons	54
Total	556

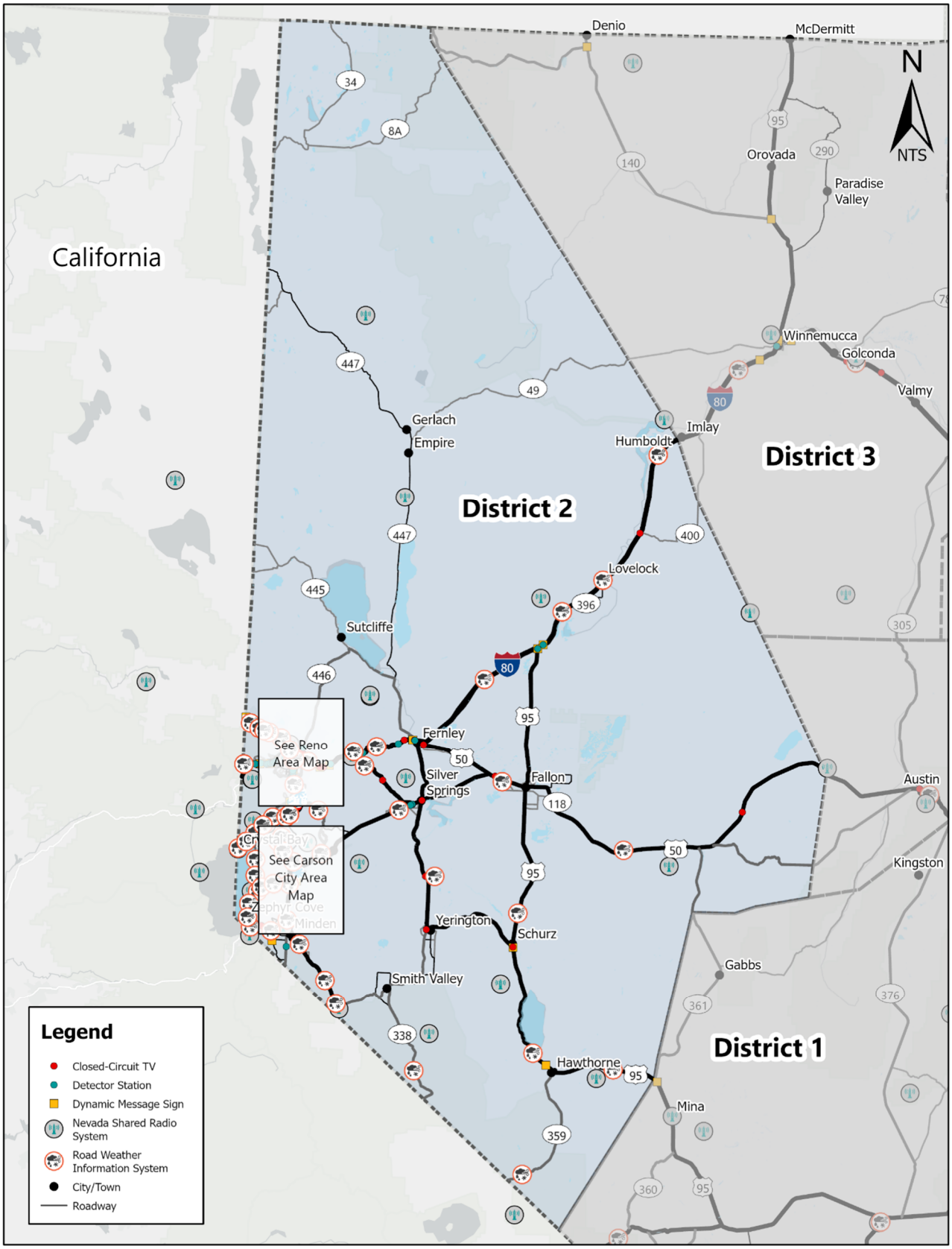


Figure 11 – NDOT District 2 Map

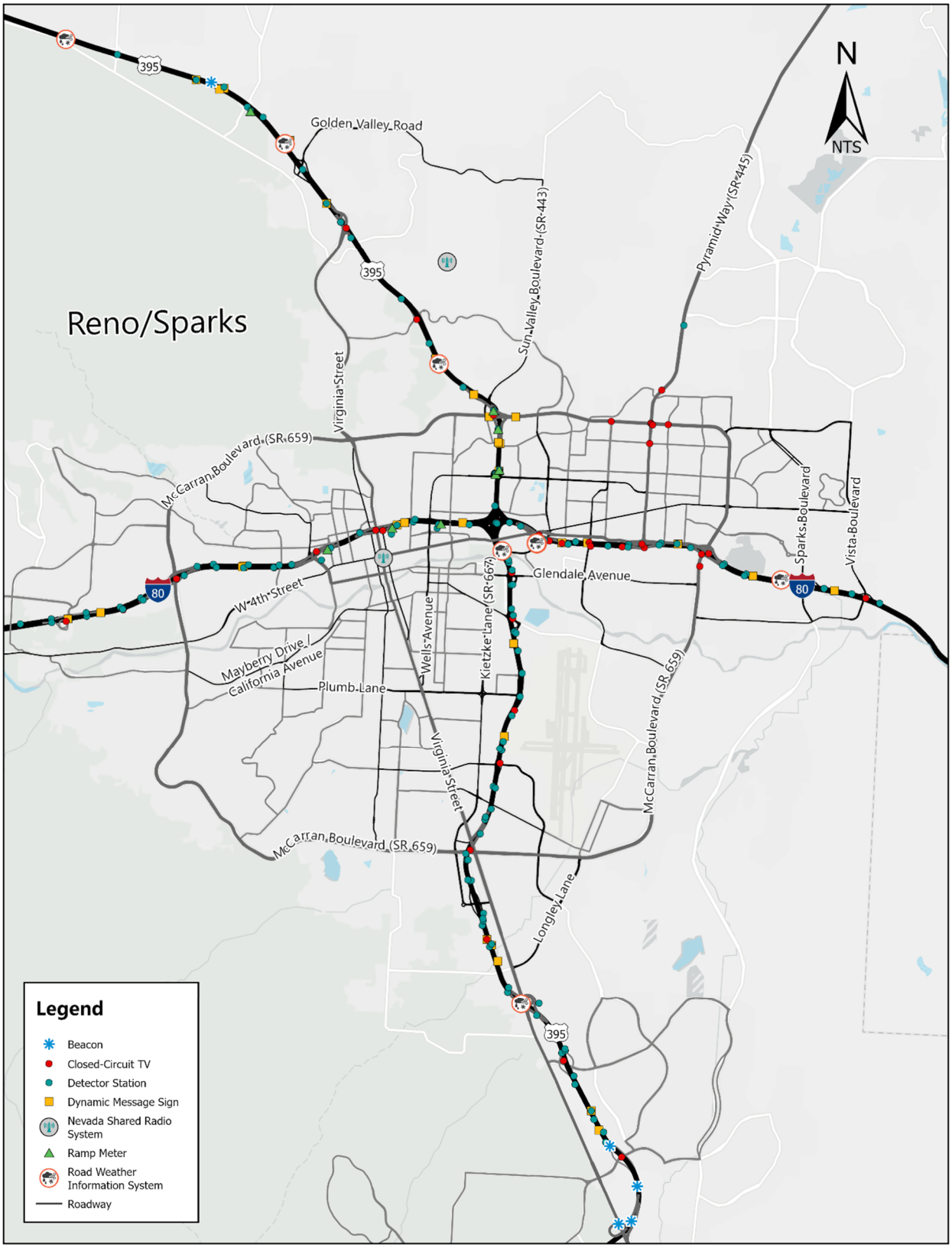


Figure 12 – Reno/Sparks Detail

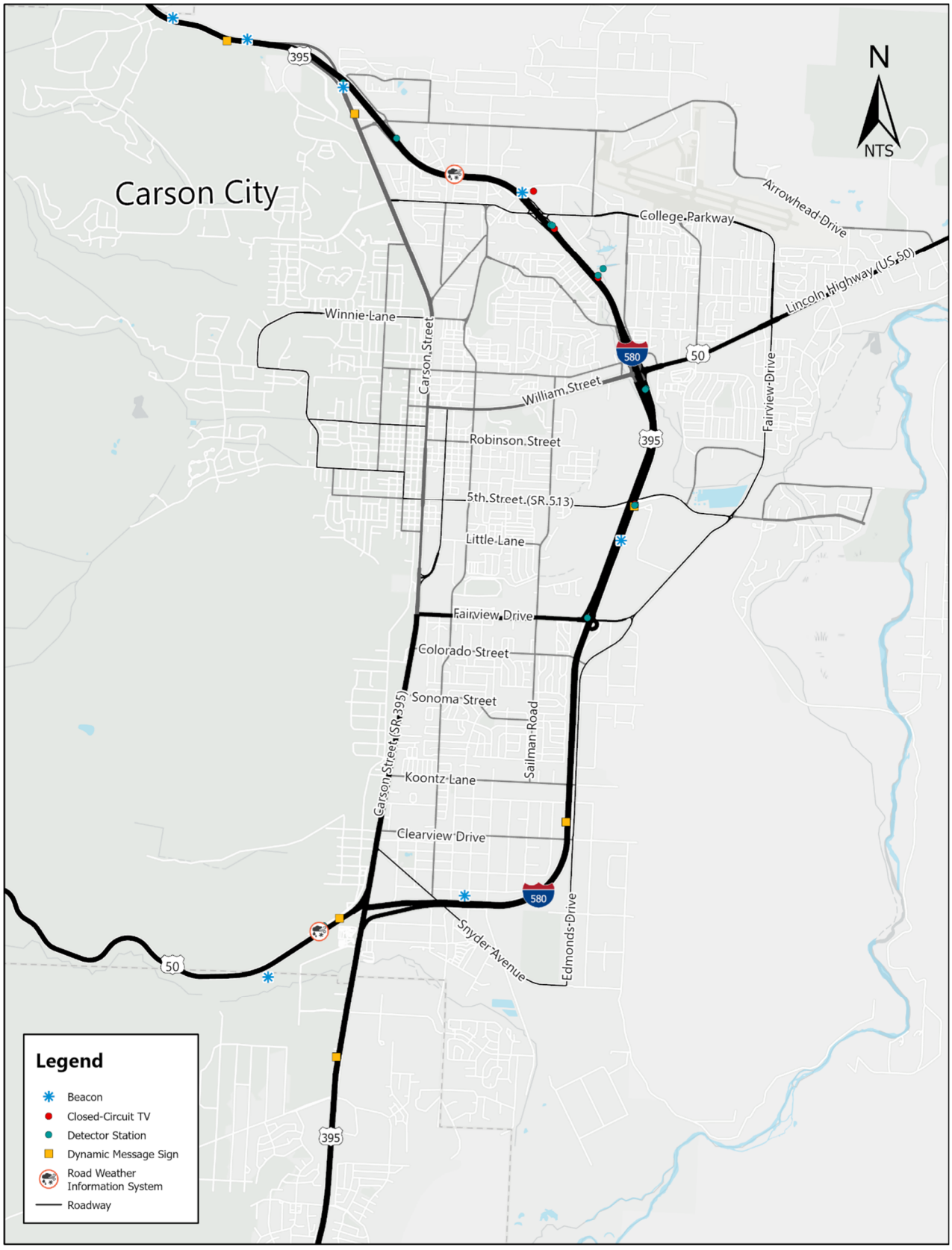


Figure 13 – Carson City Detail

6.3. District 3 Inventory Summary

I-80 runs through Nevada from the California to the Utah border in an east/west direction, running through District 3 from Imlay, Nevada on the District border, to the Utah border. US 93 and US 95 also run through the district. District 3 is outfitted with ITS devices including DMS, RWIS, detector station, and CCTV as shown in **Table 7**. A map of existing ITS devices within District 3 is provided in **Figure 14.**

Within District 3, NSRS devices are located throughout the region, with most RWIS devices located along interstates or major state routes through the region. DMS systems are located near Battle Mountain, Denio, Elko, McDermitt, Owyhee, Preston, and Winnemucca. Traffic flow detector station devices are located along Interstate-80 near Elko and Winnemucca. CCTV devices are located along I-80, US 6, US 50, and US 93.

Table 7 – District 3 ITS Inventory Summary

ITS Device	Count
Ramp Meter	0
ATM Gantries	0
Detector Station	9
CCTV	62
Road Weather Information System	58
Dynamic Message Sign	27
Beacons	0
Total	156

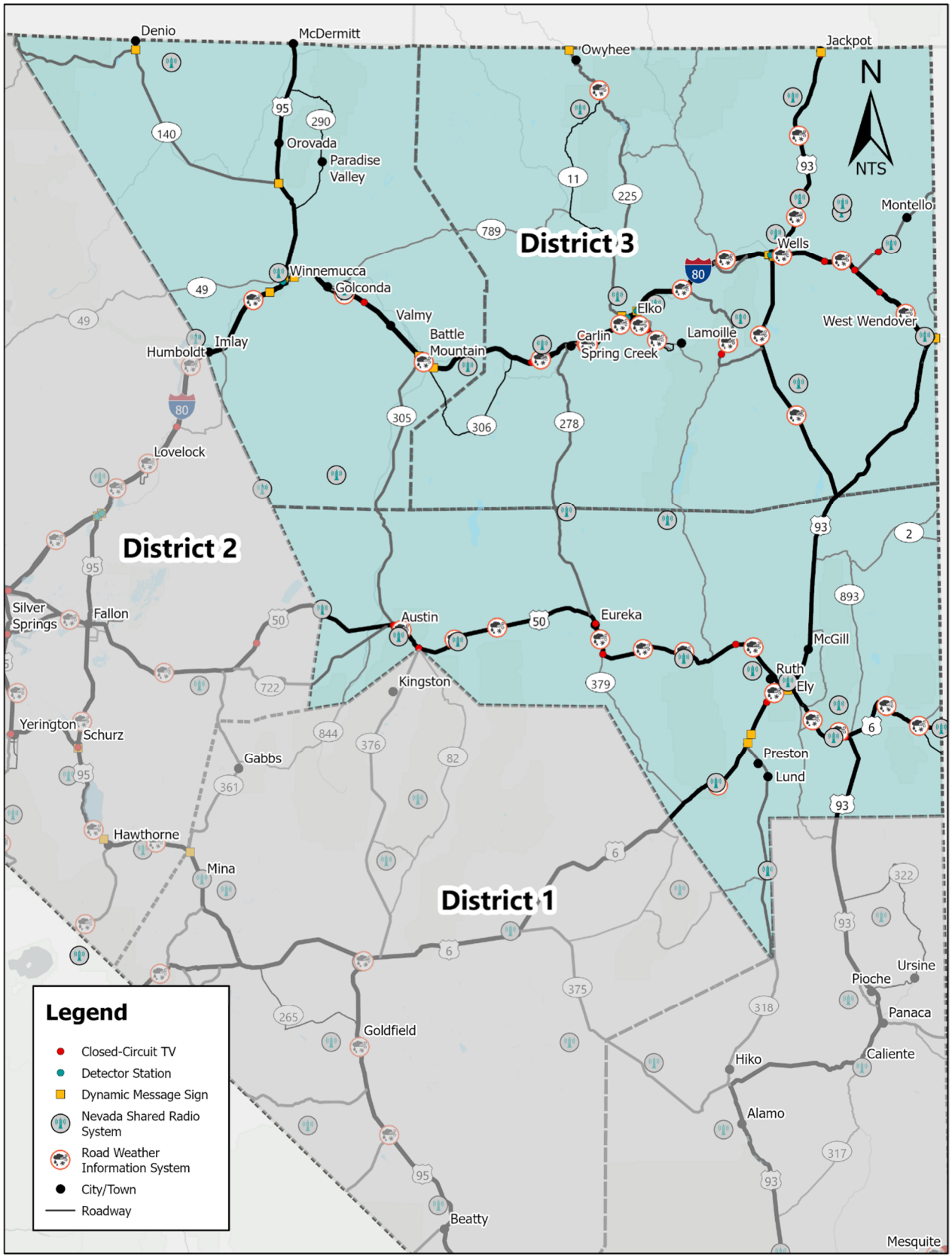


Figure 14 – NDOT District 3 Map

7. Existing Safety and Mobility Conditions

Existing crash and mobility data across the state was collected and reviewed and summarized in this section to understand the current conditions on NDOT roadways. Crash data sources include the Nevada Citation and Accident Tracking System (NCATS) five-year data from January 1, 2015 to December 31, 2019 and the Fatality Analysis Reporting System (FARS) data from 2015-2020 as found in the Nevada Strategic Highway Safety Plan (SHSP) Crash Data Dashboard. Mobility data was obtained by using the Regional Integrated Transportation Information System (RITIS) with NDOT parameters. A summary of the findings from these data sources are found in the following subsections.

7.1. NCATS Statewide Crash Data

The statewide NCATS data includes detailed crash information such as crash location, crash severity, crash type, vehicle factors, driver factors, most harmful event, driver age, weather conditions, lighting conditions, and date and time of the crash.

7.1.1. Injury Severity

A total of 243,884 crashes were recorded though the NCATS data for the five-year period from 2015 to 2019, the crashes by KABCO severity scale are shown in **Table 8**. Fatal and serious injury crashes accounted for 2.44% of total crashes. Pie-chart clusters (sized by magnitude) illustrating crashes by severity by county are shown in **Figure 15**.

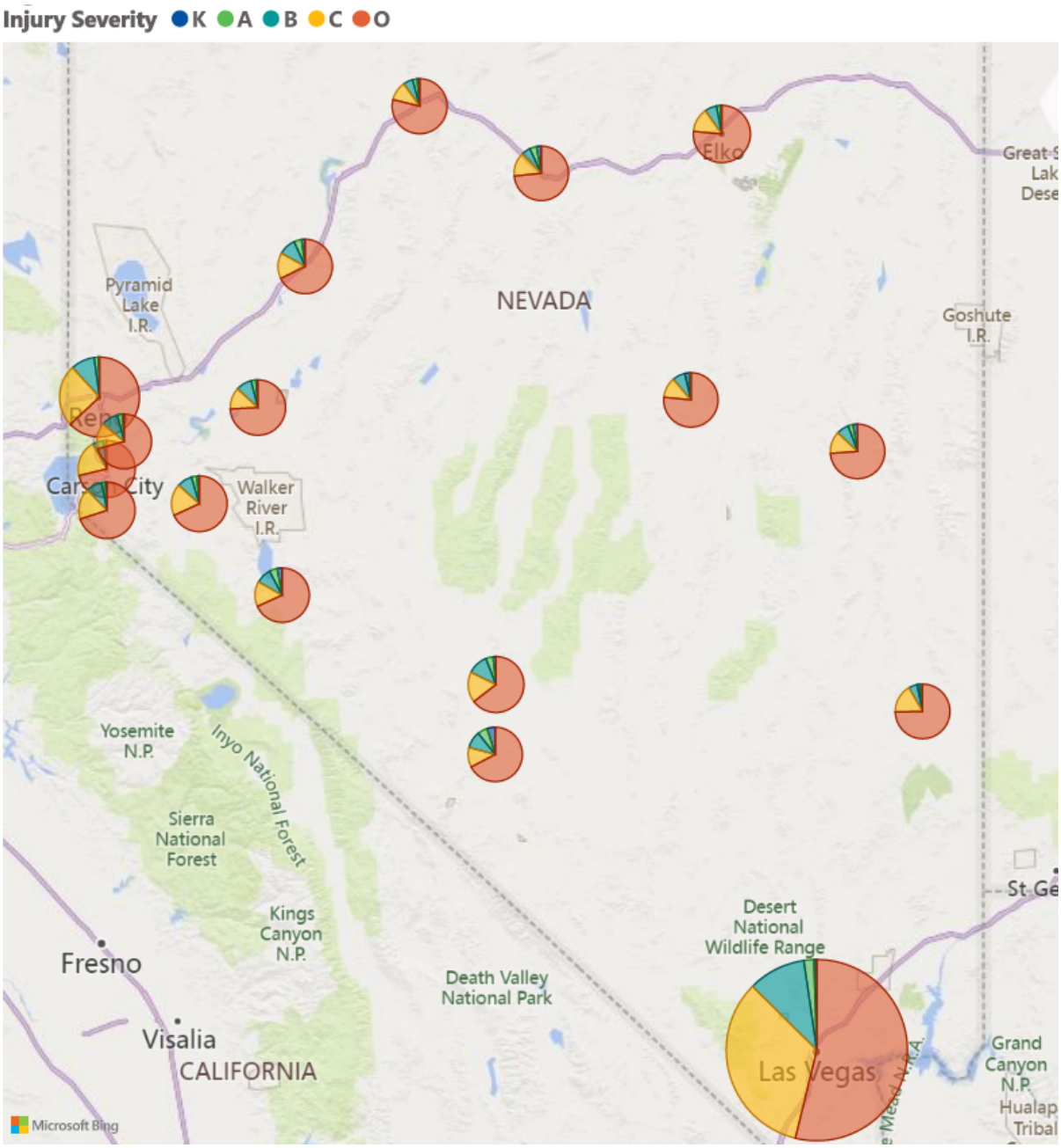
Table 8 – Crashes by KABCO Injury Severity

Injury Severity Level	Total Crashes	% of Recorded Crashes
K – Fatal Crash	1,479	0.62%
A – Serious Injury Crash	4,473	1.83%
B – Minor Injury Crash	24,278	9.95%
C - Possible/Unknown Injury Crash	74,738	30.64%
O – Property Damage Only	138,916	56.96%
Total Crashes	243,884	100%

Source: NCATS Crash Data from January 1, 2015 to December 31, 2019

Key factors for fatal crashes include dark roadway lighting, sideswiping while overtaking/meeting, exceeding the authorized speed limit, and disregarding traffic signs, signals, and road markings.

While over correcting, distracted driving, curb collision, luminaire collision, and driving too fast for conditions were shown as key factors for serious injury crashes.



Source: NCATS Crash Data from January 1, 2015 to December 31, 2019

Figure 15 – Crash by Injury Severity - County Map

7.1.2. Crash Type

An analysis of the number of crashes by the type of crash broken down by severity is shown in **Figure 16**. The most common crash types for the five-year crash period were rear end (34.67%) and angle collisions (33.94%). The crash type with the most fatal crashes was non-collision (817 crashes) followed by angle (378 crashes). NCATS data was used for the five-year period from 2015 to 2019 and input into Microsoft Power BI which produced the likelihoods mentioned above.

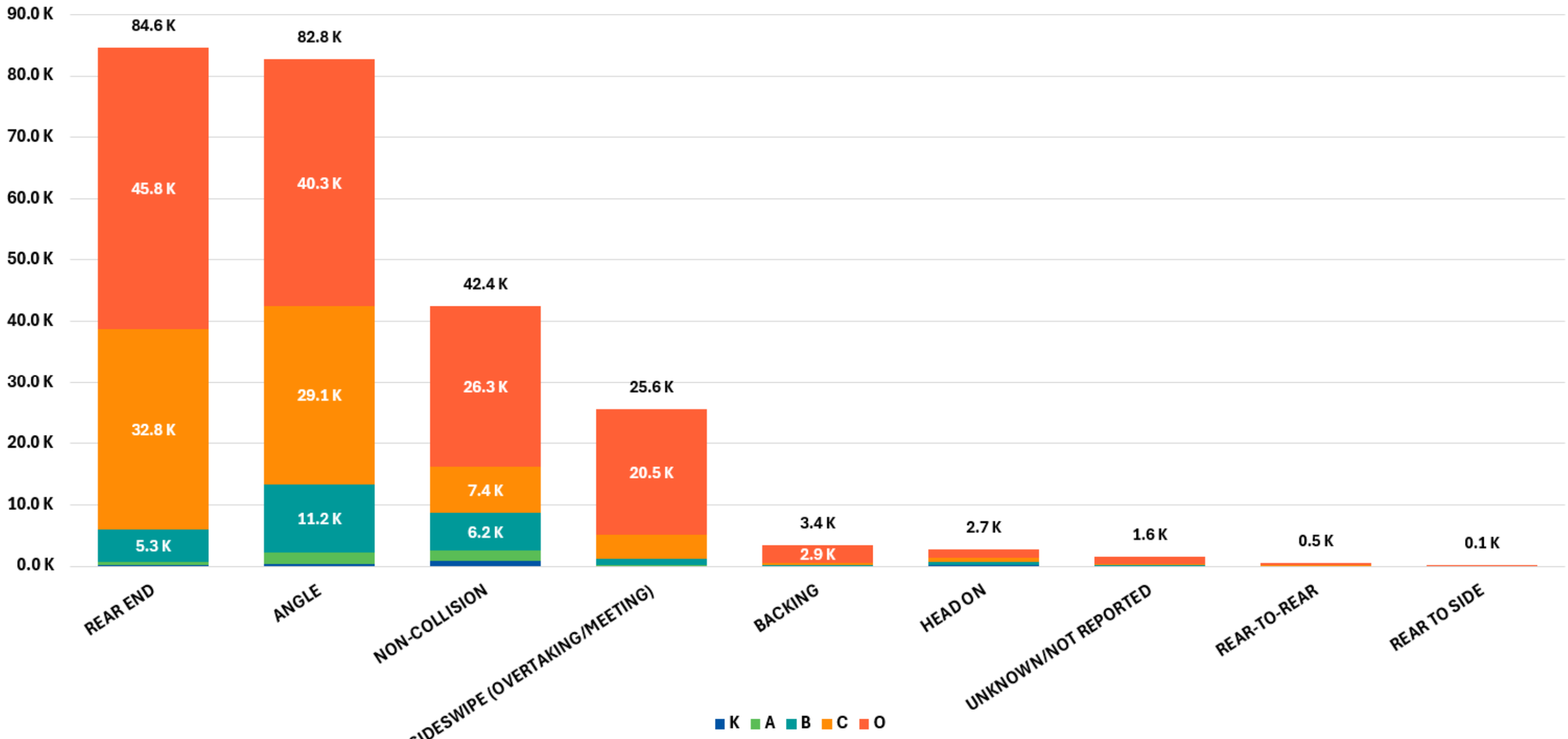


Figure 16 – Crashes by Crash Type and Injury Severity

7.1.3. Vehicle Factors

An analysis of the number of crashes and injury severity by vehicle factor is shown in **Figure 17**. The most common vehicle factor recorded was failed to yield right of way (13.52%) followed by unsafe lane change (11.95%). NCATS data was used for the five-year period from 2015 to 2019 and input into Microsoft Power BI which produced the likelihoods mentioned above.

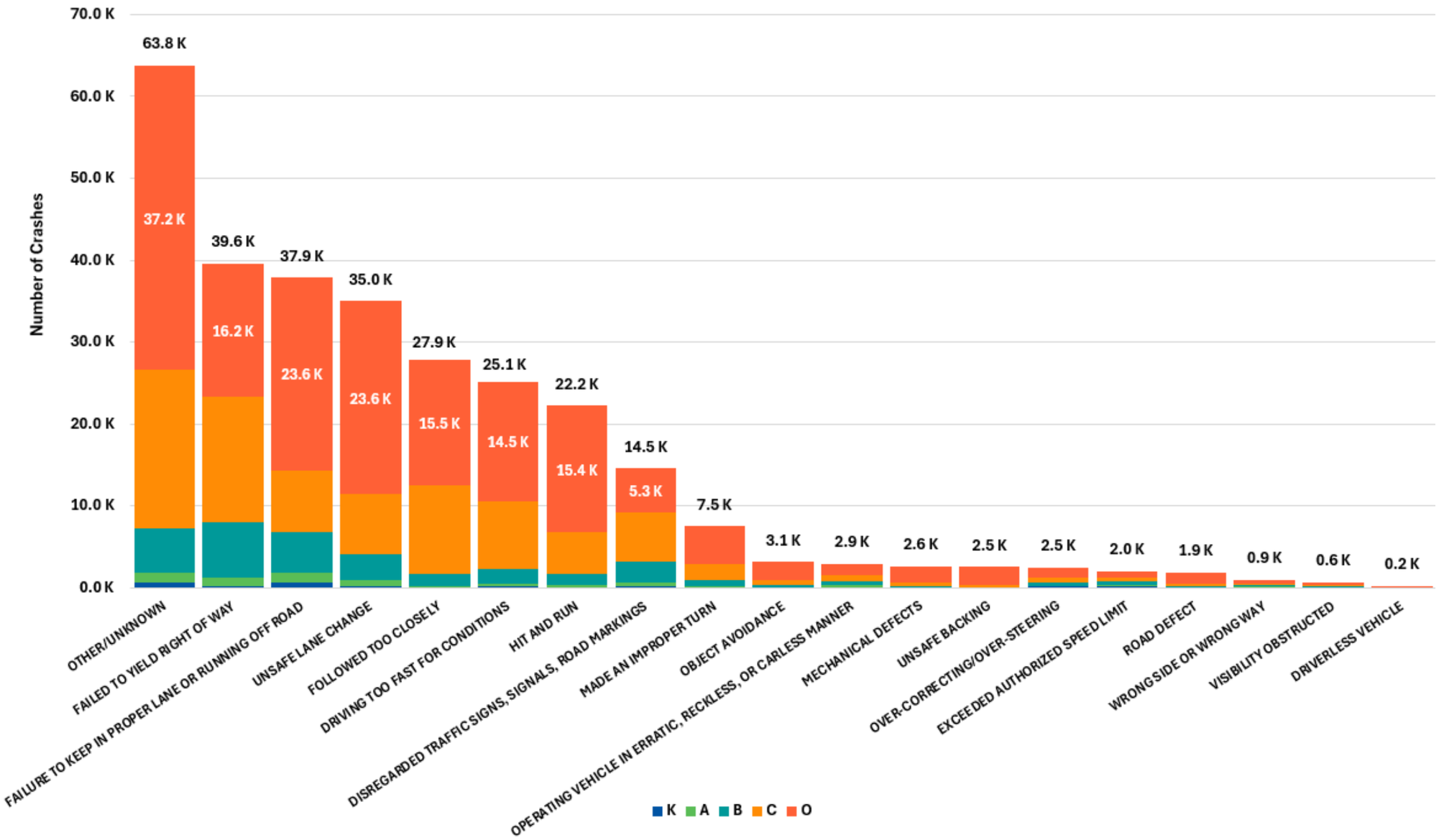


Figure 17 – Crashes by Vehicle Factor and Injury Severity

7.1.4. Driver Factors

Figure 18 shows which driver factors have the highest influence on crashes by removing the driver factors, "not reported," and "apparently normal." Crashes where the driver appeared normal accounted for 165,380 incidents (28.97%) and the driver factor was not reported for 25,940 incidents (25.91%). The most common driver factor recorded as a contributing factor to the crash is, "had been drinking" (15.45%). NCATS data was used for the five-year period from 2015 to 2019 and input into Microsoft Power BI which produced the likelihoods mentioned above.

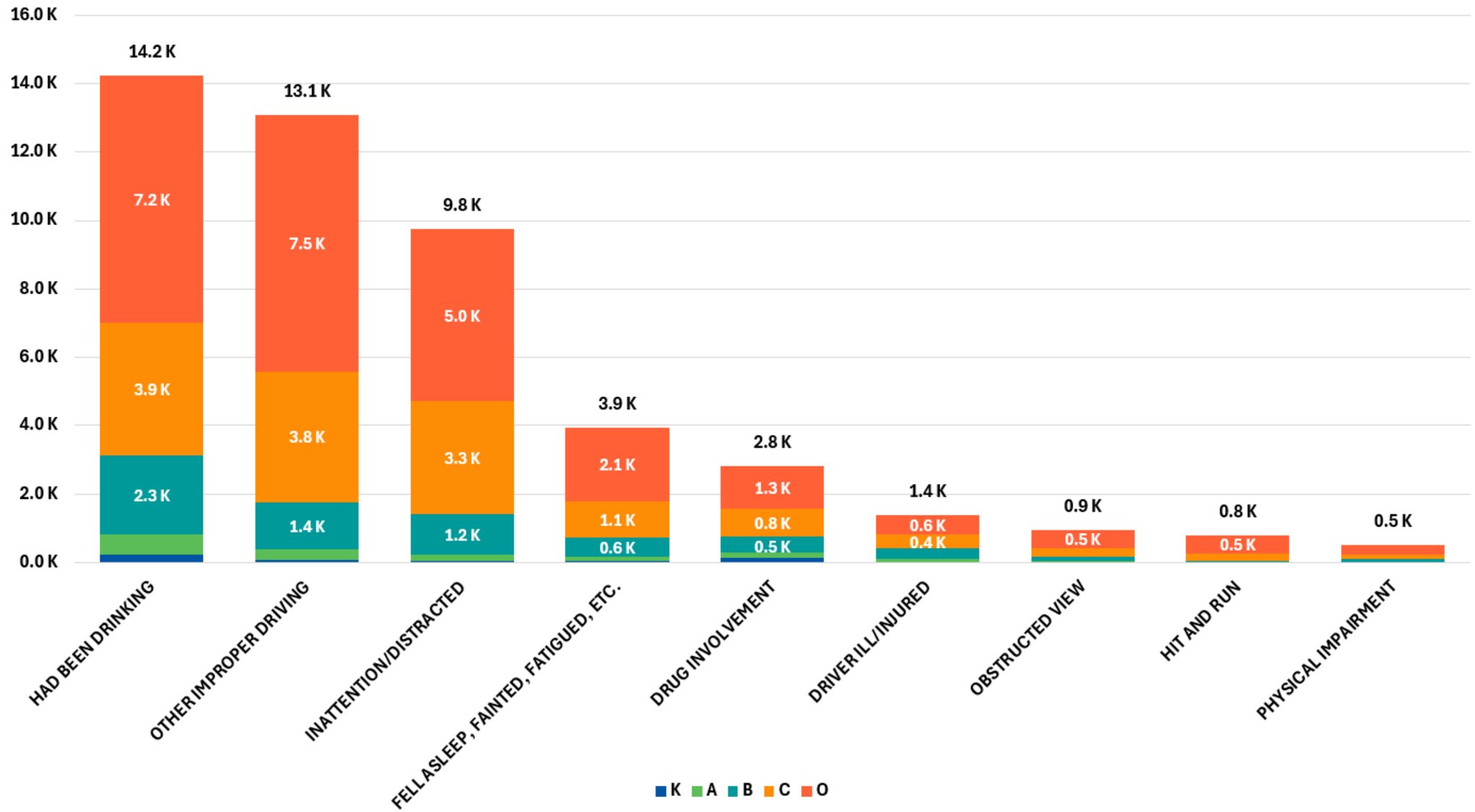


Figure 18 – Crashes by Driver Factor and Injury Severity (Without Normal and Not Reported)

7.1.5. First Harmful Event

The breakdown of crashes by the first harmful event is shown in **Figure 19**. The most common first harmful event was motor vehicle in transport (68.25%) followed by a slow/stopped vehicle (21.82%). NCATS data was used for the five-year period from 2015 to 2019 and input into Microsoft Power BI which produced the likelihoods mentioned above.

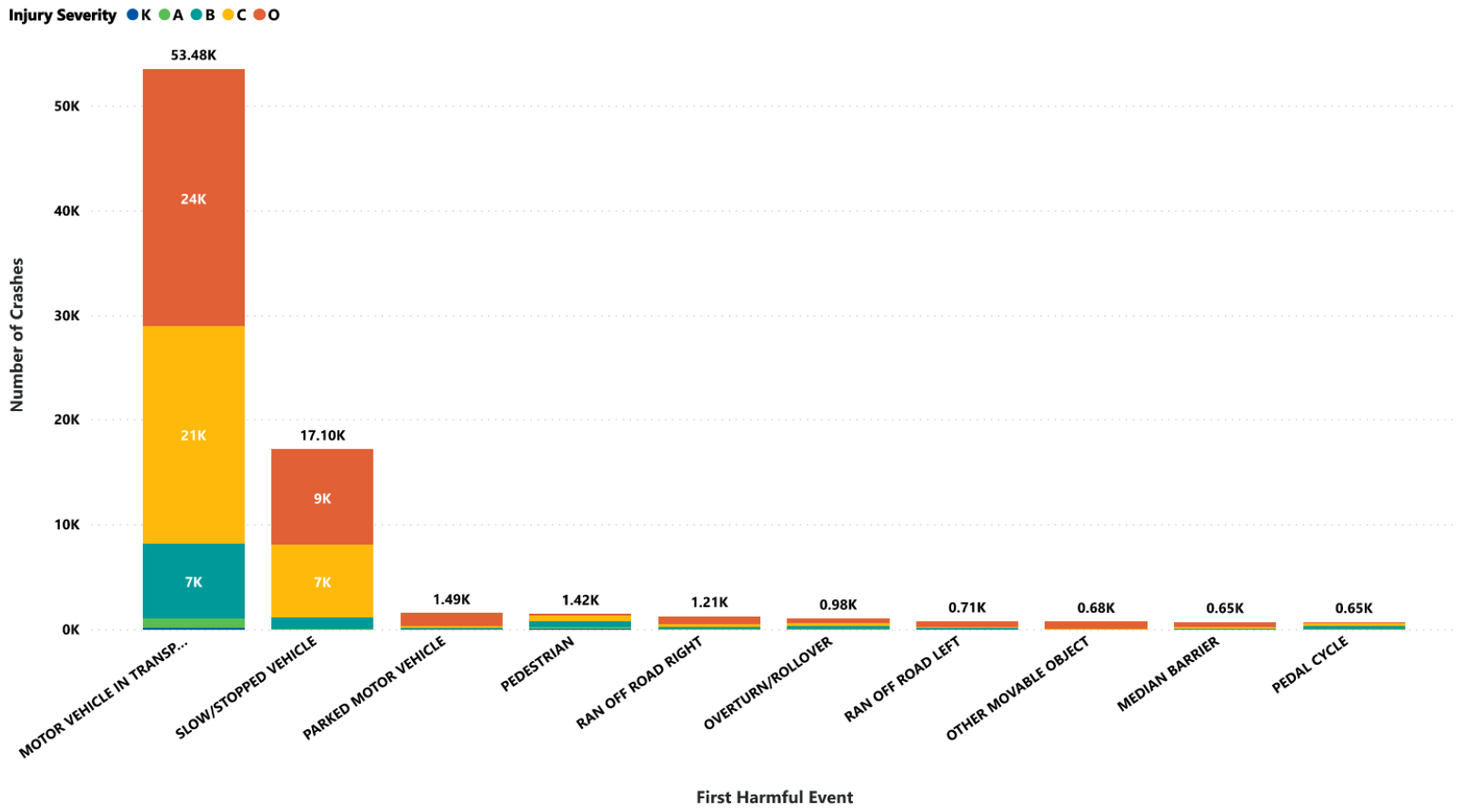
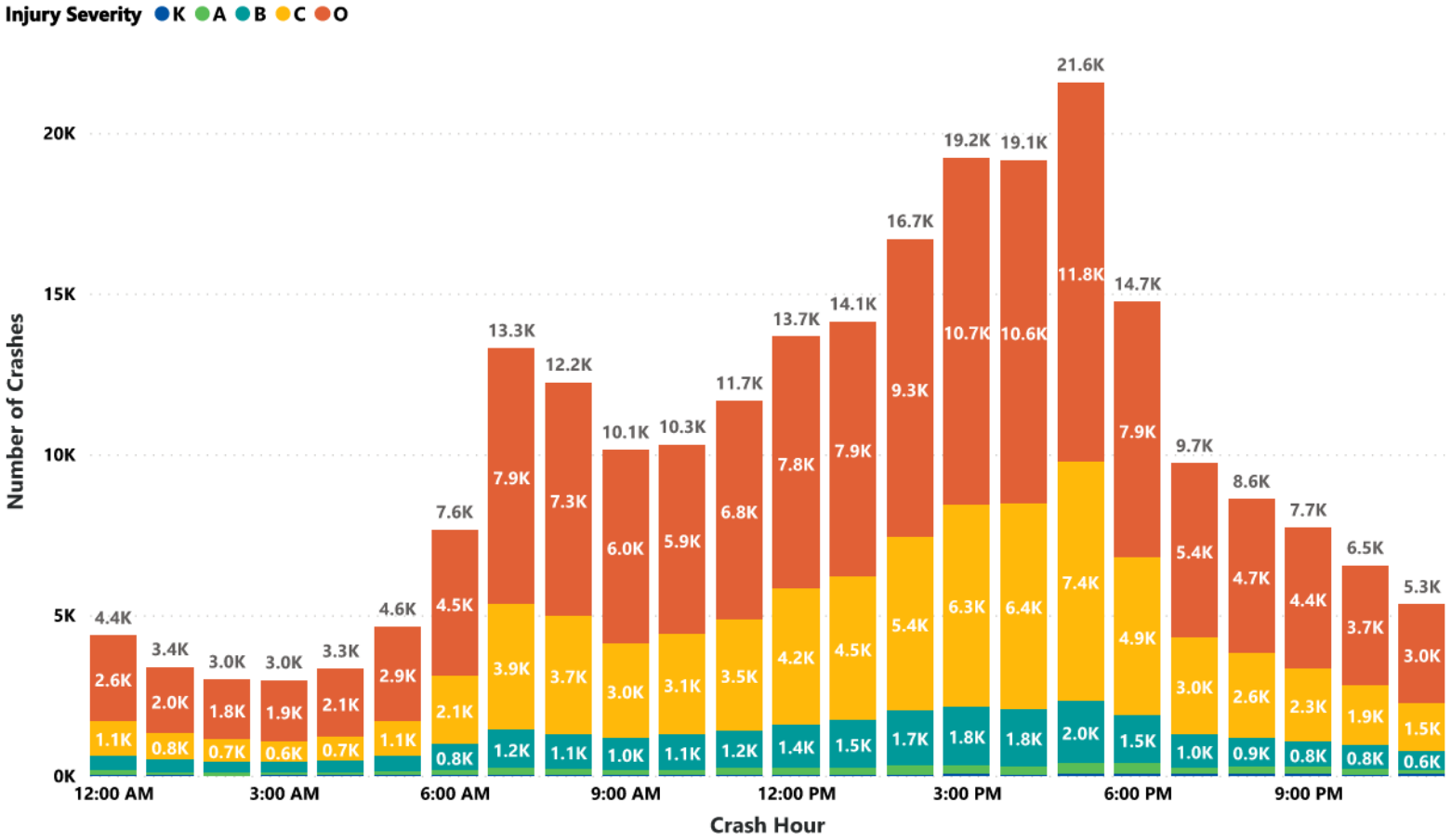


Figure 19 – Crashed by First Harmful Event and Injury Severity

7.1.6. Time of Day

Figure 20 displays number of crashes and severity by time of day, month, and year. The majority of crashes occurred between 7:00am and 5:00pm, corresponding with general traffic peak times of 6am-9am and 3pm-7pm. This trend is reflected throughout all levels of severity. Roughly 8% of crashes occur each month with December containing the highest number of total crashes (21,700/8.91%) and February containing the lowest number of total crashes (19,300/7.92%). The month with the highest number of fatal and serious injury crashes was September with 150 and 415 respectively. From 2015 to 2017 the number of crashes increased by 29% and then decreased by 14% between 2017 and 2019, resulting in an overall change between 2015 and 2019 of a 15% increase in total crashes. This trend is not consistent across all injury severities, only possible/unknown injury (C) and property damage only (O). Suspected minor injury (B) and fatal crashes (K) increased from 2015 to 2016 but then decrease slightly through 2019. Crashes resulting in a serious injury (A) have decreased annually from 2015 and 2019 by 48.35%.


Injury Severity K A B C O
Number of Crashes
0K
5K
10K
15K
20K
12:00 AM
3:00 AM
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
9:00 PM
Crash Hour
4.4K 3.4K 3.0K 3.0K 3.3K 4.6K 7.6K 13.3K 12.2K 10.1K 10.3K 11.7K 13.7K 14.1K 16.7K 19.2K 19.1K 21.6K 14.7K 9.7K 8.6K 7.7K 6.5K 5.3K
2.6K 2.0K 1.8K 1.9K 2.1K 2.9K 4.5K 7.9K 7.3K 6.0K 5.9K 6.8K 7.8K 7.9K 9.3K 10.7K 10.6K 11.8K 7.9K 5.4K 4.7K 4.4K 3.7K 3.0K
1.1K 0.8K 0.7K 0.6K 0.7K 1.1K 2.1K 3.9K 3.7K 3.0K 3.1K 3.5K 4.2K 4.5K 5.4K 6.3K 6.4K 7.4K 4.9K 3.0K 2.6K 2.3K 1.9K 1.5K
0.8K 1.2K 1.1K 1.0K 1.1K 1.2K 1.4K 1.5K 1.7K 1.8K 1.8K 2.0K 1.5K 1.0K 0.9K 0.8K 0.8K 0.6K

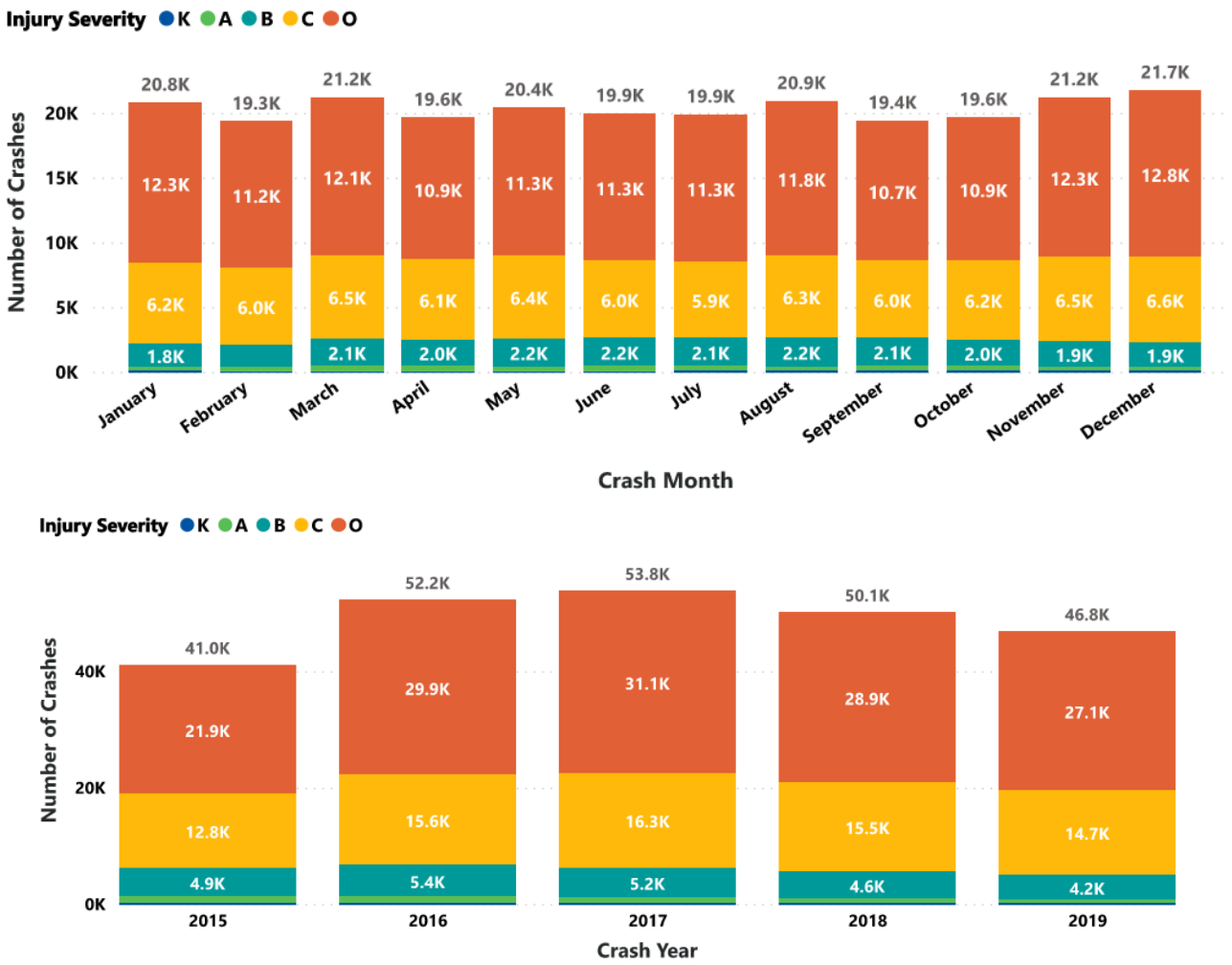


Figure 20 – Crash Severity by Time of Day

7.1.7. Weather Related Incidents

Most crashes occurred in clear weather conditions (77.66%) followed by cloudy conditions (14.68%). **Figure 21** is provided to show what other weather factors would have the most influence on the number of crashes. After removing crashes occurring in clear and cloudy weather conditions, it was determined that rain contributed to the highest number of crashes (46.16%, excluding clear and cloudy conditions). **Table 9** contains a breakdown of crash data by weather type and injury severity. From **Table 9**, it is shown that the majority of crashes occur during clear conditions, with the second most common weather conditions for all injury types being cloudy weather conditions.

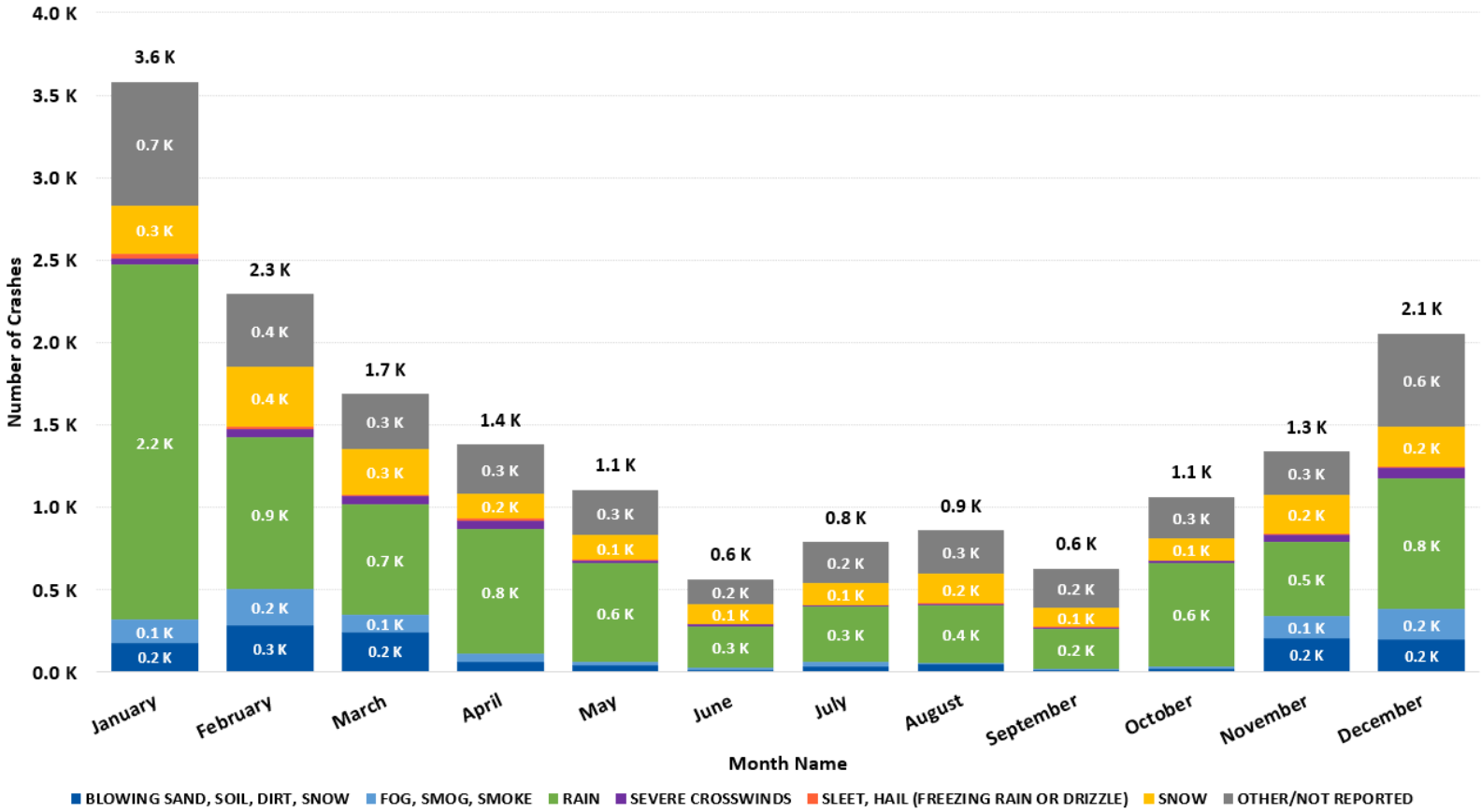


Figure 21 – Weather Related Crashes by Month

Table 9 – Crashes by Weather Type and Injury Severity

Weather Type	K	A	B	C	O	Total
Clear	1,180	3,530	17,993	54,898	98,319	**175,920**
Cloudy	228	564	3,307	10,025	19,117	**33,241**
Blowing Sand, Soil, Dirt, Snow	3	7	39	156	521	**726**
Blowing Snow	2	1	16	145	1,161	**1,325**
Fog, Smog, Smoke	2	4	81	161	713	**961**
Not Reported	20	6	32	374	2,688	**3,120**
Other	1	6	26	30	153	**216**
Rain	41	110	684	2,171	5,004	**8,010**
Severe Crosswinds	3	9	68	94	323	**497**
Sleet, Hail (Freezing Rain or Drizzle)	0	5	14	46	138	**203**
Snow	7	16	112	390	1,770	**2,295**
Total	**1,487**	**4,258**	**22,372**	**68,490**	**129,907**	**226,514**

7.1.8. Speeding–Related Crashes

As stated in the NDOT Speed Management Action Plan, speeding-related crashes tend to be more severe resulting in double the number of fatal crashes as non-speeding related crashes. Speeding-related crashes are more severe on lower speed roadways between 30-40 miles per hour (MPH). In addition, 47% of fatal and serious injury speeding-related crashes occur on arterial roadways (Functional Class 3 or 4).

7.1.9. Animal Related Incidents

Tracking animal related incidents can assist in identifying animal travel patterns and appropriate intervention needs in frequent incident areas. The five-year crash data shows that deer related animal crashes were the most frequent accounting for approximately 62% of animal crashes. No fatal crashes were recorded in the 877 animal related crashes. The majority of incidents involving deer and elk occur in the northern half of the state as well as an increase along US 93 south of Wells/I-80. There is an existing wildlife overpass on the US 93 north of the I-80, leading to reduced animal encounters north of Wells.

Figure 22 shows injuries caused by animal related incidents. The bubble size represents the number of injuries that occurred within that area. Using this visual, deer injuries are observed to occur most on the I-80 and in Washoe Valley along I-580. The highest density of all animal incidents occurs in Elko County while the highest density of "other animal" related incidents occur in Clark County.

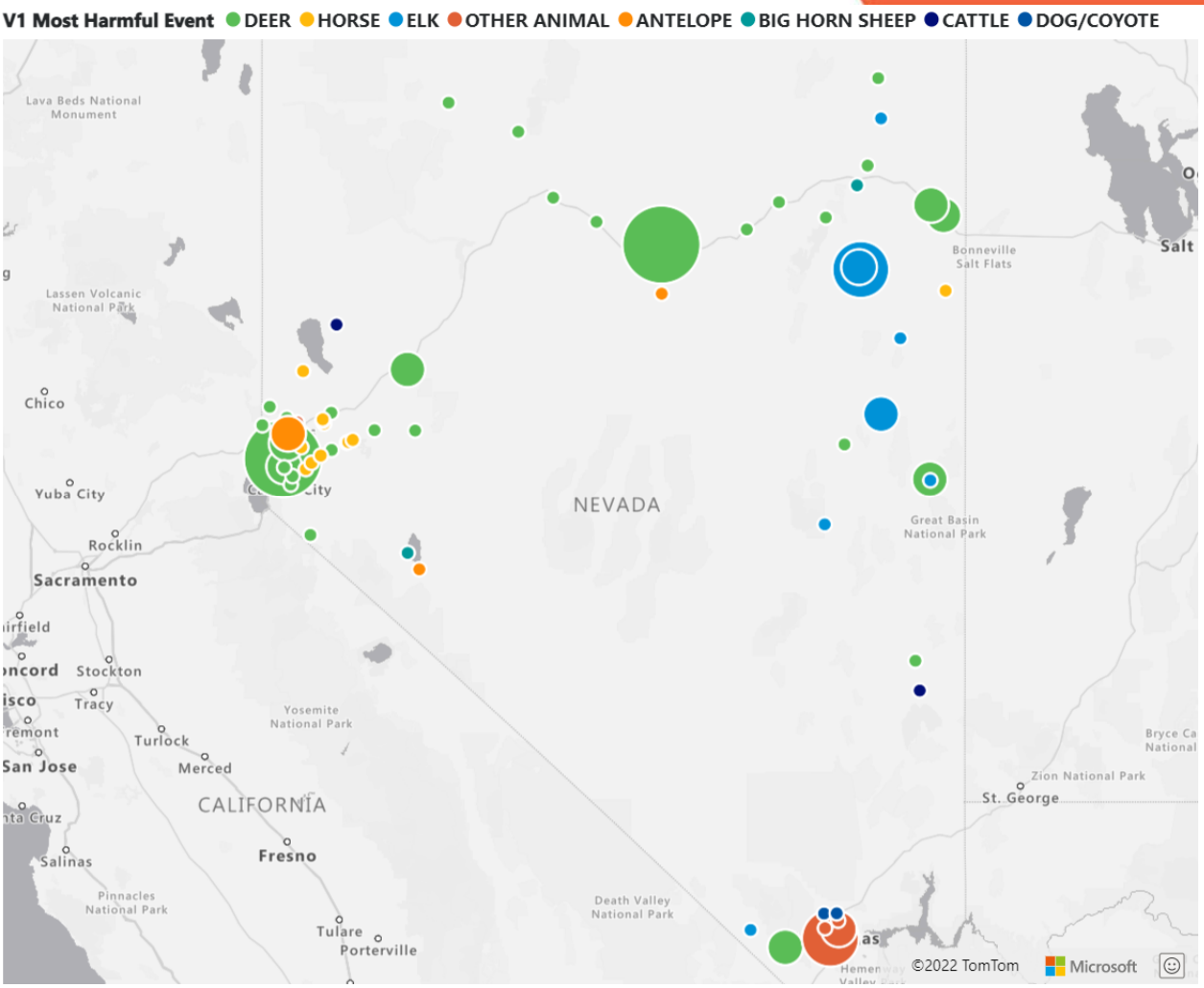


Figure 22 – Animal Related Injuries by Animal Type

7.2. Fatality Analysis Reporting System (FARS) Data

The NDOT FARS SHSP tool is available from the Nevada SHSP website. The tool provides collected metrics for fatal crashes in Nevada, including a breakdown of fatalities and fatal crashes by SHSP critical emphasis area (i.e., bicycle, commercial vehicle, distracted riving, lane departures, pedestrian, or speeding related crashes) and year (or years). The SHSP dashboard shows that a total of 1,770 fatal crashes have occurred from 2015 through 2020 with 2016 having the highest number at 304 crashes.

7.3. Existing Travel Time Reliability Conditions

In order to support the mobility data evaluation, RITIS data was used to determine patterns in travel time and speeds for NDOT roadways from 2017 to 2021. The average speed showed an increase from 2017 to 2020 with a slight decline in 2021. The greatest increase in average speed occurred between 2019 and 2020, most likely due to the impacts of COVID-19 on the travel network as shown in **Figure 23**. The average travel time has increased slightly from 2017 to 2021 (3.1 minutes to 3.8 minutes) averaging 3.7 minutes over the five-year period. Using Power BI analyzation, it appears that the I-80 and I-15 have a direct impact on increasing the average travel time and speed when averaged statewide while the I-515/US-93, I-215 and US-95 have a greater impact on decreased speeds and travel times. This could be due to their vicinity to alternate routing options when an incident occurs. Averaged statewide speeds per segment are shown in **Figure 24** with red indicating lower speeds and green indicating higher speeds.

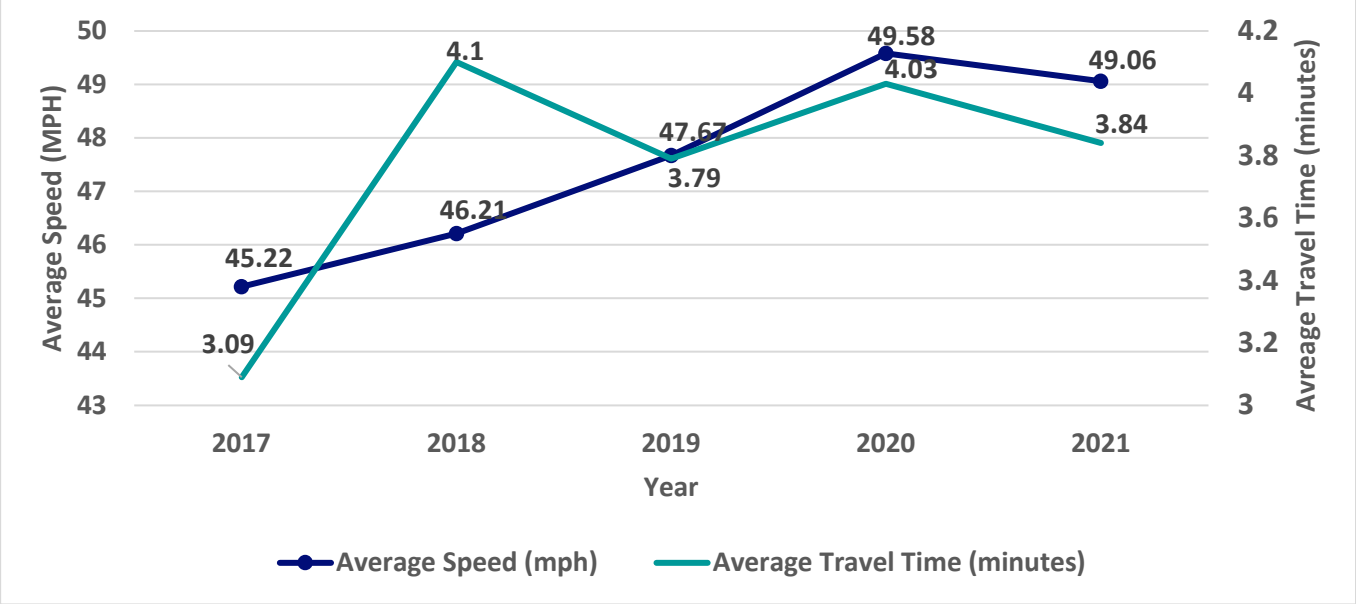


Figure 23 – Average Speed and Travel Time by Year

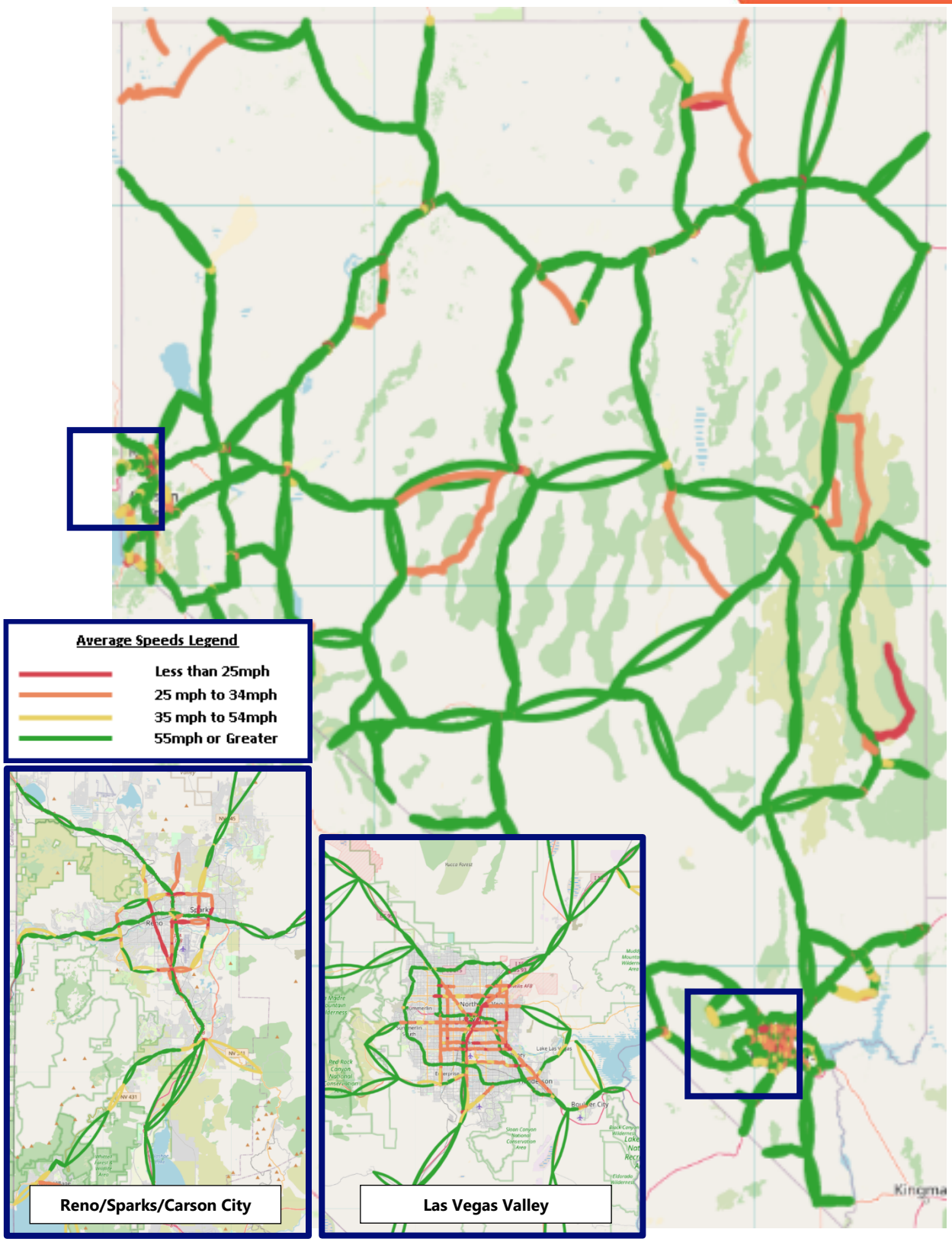


Figure 24 – Statewide Average Speeds from 2015 to 2019

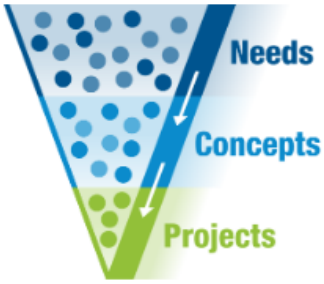
8. ALIGNMENT TO EXISTING PROGRAMS

The ITS & ATM Master Plan recommendations should be in alignment with existing programs such as the TSMO Program, One Nevada Plan, the ITS Strategic Deployment Plan, and NDOT Strategic Highway Safety Plan. Although this section references a number of existing programs, it is only reflecting ones that the ITS & ATM Master Plan outcomes will need to rely on to support implementation, ongoing performance reporting, and data management.

8.1. TSMO

The NDOT Statewide TSMO Program Plan creates the blueprints and technologies identified in the ITS & ATM Master Plan are the tools. The TSMO framework outlines the strategic approach to enhance mobility across all modes of transportation with an actionable approach that covers the TMSO goals: enhance safety, preserve infrastructure, enhance reliability, optimize mobility, optimize customer service, enhance collaboration, foster sustainability, and strengthen TSMO integration. The TSMO framework develops guidance and direction in each of the six Capability Maturity Model (CMM) focus areas of business processes; systems and technology; performance measurement; collaboration; organization and workforce; and culture. This ITS & ATM Master Plan focuses on strategy implementation to support TSMO's overarching framework. Tactical elements and TSMO tools have been developed as part of the TSMO initiative that were referenced during the development of recommendations.

8.2. One Nevada Plan



The One Nevada Transportation Plan (One Nevada Plan) is Nevada's long-range transportation plan centered on six critical goal areas and the criteria associated with those goals:

- **Enhanced Safety** – Crash Reduction Potential
- **Preserve Infrastructure** – Pavement Condition Improvement, Bridge Risk Reduction Score, Other Asset Improvement
- **Optimize Mobility** – Population Accessibility, Travel Time Reliability
- **Transform Economics** – Business Accessibility, Economic Development Potential
- **Foster Sustainability** – Reduce Environmental Risk, Green House gas Emission Reductions, Environmental Enhancements, Resilience, Reduce Future Maintenance
- **Connect Communities** – Project Connectivity, Multimodal Access, Access to Community Destinations, Equity

The One Nevada Process, a data-driven process, was established to rank projects and weight them appropriately through a "funnel" to fund the projects that rank the highest based on the six critical goals outlined in the One Nevada Plan.

It should be noted that the TSMO Investment Prioritization Tool and the One Nevada Prioritization tool are in alignment, therefore, projects from the ITS & ATM Master Plan that align with the TSMO Investment Prioritization Tool and also aligns with the One Nevada Process. The ITS & ATM Master Plan recommendations should make sure to include as much detailed information as can be provided to the Statewide Transportation Improvement Plan (STIP)/Work Program team for new projects (such as title, description, funding) as well as further out projects to be prioritized even if the funding is not identified.

8.3. ITS Strategic Deployment Plan

NDOT developed a Statewide Rural ITS Strategic Deployment Plan (SDP) in 2018 to provide guidance for ITS planning, implementation, and integration of technologies and systems to better manage the statewide transportation system in a unified manner. The SDP was largely based on the feedback from the three NDOT Districts as to what need and issue areas were present around the state. Appropriate technologies were then recommended to address the identified needs and issues identified. The original SDP Plan identified specific systems (CCTV, Pan/Tilt/Zoom, RWIS, DMS, etc.) and locations as requested by districts.

The SDP was updated in 2019 to incorporate more urbanized needs and issues. It included targeted TSMO objectives in line with the TSMO Program Plan, and the development of the TSMO Investment Prioritization Tool (TSMO IPT) to prioritize projects by the TSMO goals. The TSMO IPT was used to analyze and prioritize strategies and recommendations developed for the ITS & ATM Master Plan. NDOT has been working with each of the three NDOT Districts and updating the SDP needs list and recommended projects each year since 2018. This ITS & ATM Master Plan differs from the SDP process because this Plan looked holistically and programmatically at statewide initiatives and future direction beyond the individual needs and issues that NDOT District representatives may see as needing immediate attention.

8.4. NDOT Strategic Highway Safety Plan

Nevada's SHSP is a statewide safety plan and framework for reducing fatalities and serious injuries on Nevada's roadways. The SHSP establishes goals and strategies developed in collaboration with federal, state, local, and private-sector safety stakeholders and is updated every five years. The 2021-2025 SHSP adopted four (4) guiding principles: incorporate equity, prioritize safe speed, double down on what works, and accelerate advanced technology. Specific ITS technologies and applications can be utilized to help reduce crashes in the applicable critical emphasis areas which include Safe Speed, Lane Departures, Intersections, Pedestrians, Motorcyclists, Occupant Protection, Older Drivers, Young Drivers, and Impaired Driving. Recommendations developed as part of the ITS & ATM Master Plan considered safety and ensure that appropriate technologies with proven safety benefits are considered to meet the goals of the SHSP.

8.5. Transportation Asset Management Plan

NDOT's Fully Compliant TAMP allows for planned investments for the department's transportation assets. The TAMP provides a summary of current conditions for pavement, bridge, and ITS assets along with a plan for managing these assets over the next 10 years. The findings from the TAMP was taken into consideration as recommendations are developed for the ITS & ATM Master Plan as they relate to CCTV, DMS, flow detectors, HAR, ramp meters, and RWIS as these were analyzed in the TAMP.

9. PLANNED OR PROGRAMMED PROJECTS

Nevada's STIP functions as the state's transportation capital improvements program in which federally funded, and regionally significant projects are incorporated. The STIP is a fiscally constrained four-year plan that is organized by funding year and project obligation, it is approved by FHWA and the Federal Transit Administration. The STIP includes a project list from each Metropolitan Planning Organization's approved Transportation Improvement Plan and NDOT's rural areas. Funding for STIP projects come from a variety of sources as shown in **Table 10**. Projects that are to be added to the STIP or Work Program go through the One Nevada Process for prioritization, harmonization, and approvals.

Table 10 – Federal Funding Sources

Federal Funding
National Highway Performance Program
Surface Transportation Block Grant Program
Highway Safety Improvement Program
National Highway Freight Program
Congestion Management/Air Quality
FTA Section 5307, Urbanized Area Formula Grants
Section 5309, Fixed Guideway Capital Investment Grants (New Starts) Program
FTA Section 5311 Formula Grants for Rural Access
FTA Section 5337 State of Good Repair Grants

9.1. Programmed ITS Projects

NDOT's 2021-2024 STIP was reviewed to identify where ITS and ATM components could be implemented to align with the five strategies of the ITS & ATM Master Plan. It should be noted that NDOT owns and implements everything on the freeways in the southern part of the state, while in the northwestern part of the state, NDOT and RTC Washoe jointly implement projects on NDOT-owned facilities. A summary of the projects found in the 2021-2024 STIP for the years 2023 and 2024 were reviewed, a list of these projects is summarized in **Table 11**.

Table 11 – STIP Project List

Project ID	Lead Agency	Project Title	Fund Type	2023	2024	Project Type
EL20210001	Nevada DOT	SR 227 Roundabout-New	HSIP	$572,500	$4,500,000	Road Improvement
HU20200003	Nevada DOT	I-80 W Winnemucca Interchange	HWY Freight	$0	$3,000,000	Road Improvement
MI20210003	Nevada DOT	US 6 Mill / Fill Phase 2-New	HWY Freight	$0	$500,000	Preservation
EL20210008	Nevada DOT	I 80, Pavement Preservation Including Sign and Striping Replacement, Hydraulic, Structure, Lighting, and ITS Improvements-New	NHPP	$0	$30,500,000	ITS/System Efficiency
WA20180052	Nevada DOT	I-80/Keystone Package 2	NHPP	$13,000,000	$0	ITS/System Efficiency
XS20200001	Nevada DOT	I-80 Rosny Creek	NHPP	$32,500,000	$0	ITS/System Efficiency
XS20180025	Nevada DOT	US 50 Lake Lahontan 3R	NHPP, STBG State-Wide, STBG<5K	$38,200,000	$0	Resurfacing, Restoration, and Rehabilitation (3R)
WP20210001	Nevada DOT	US 50, and US 93 Roadway Reconstruct, Curb, Gutter, Sidewalk, Bike Lanes, ADA, Drainage, Lighting, Sewer and Water Improvements Aultman Street Ely-New	NHPP, STBG<5K	$0	$50,000	3R
XS20150002	Nevada DOT	Recreational Trails	Rec Trails	$1,344,370	$1,344,370	Other
XS20200014	Nevada DOT	District III - Install ITS - Pkg B	State	$0	$1,000,000	ITS/System Efficiency
XS20200006	Nevada DOT	SR 431, Mt. Rose Hwy., MP WA 8.00 to 24.41, SR 341 Geiger Grade, MP WA 0.00 to 6.30, MP ST 0.00 to 10.84, and MP LY 0.00 to 4.90 - Pipe Lining & Rehab D2-New	State	$0	$4,000,000	3R
CL20200053	Nevada DOT	SR 147, 3R Lake Mead Blvd	State	$18,000,000	$0	3R
CH20200001	Nevada DOT	I 80 and US 95 Trinity Expansion Ph 1, add 36 truck parking spaces – New	State	$0	$765,000	Road Expansion
CL20200054	Nevada DOT	I 11, 3R Lake Mead Drive-NEW	State	$2,000,000	$0	3R
CL20200034	Nevada DOT	I 15 Rehab/Retrofit B-781 N/S at Muddy River – New	State	$0	$2,000,000	Road Improvement
CL20200044	Nevada DOT	SR 573, Craig Road 3R	State	$8,000,000	$0	3R
ES20200001	Nevada DOT	US 6, 3R Millers Roadside Park	State	$25,000,000	$0	3R
CL20200027	Nevada DOT	SR 595, S. Rainbow Blvd., Las Vegas, from W. Tropicana Ave. to Westcliff Dr.	State	$0	$500,000	Other
CL20200043	Nevada DOT	I 15, Duck Creek 3R project	State	$8,000,000	$0	3R
CL20200033	Nevada DOT	I 515 Rehab/Retrofit I-1449, H-1446 at Boulder Hwy. and Sahara – New	State	$0	$800,000	3R
XS20190019	Nevada DOT	SR 160 from I-15 to Pahrump, MP CL 0.00 to 43.16, and MP NY 0.00 TO 7.47 SR 160, Install ITS Packages J1&J2	State	$9,000,000	$0	ITS/System Efficiency
WA20200008	Nevada DOT	US 395 N. Virginia St. improvements fm. Parr Blvd. to US 395	State	$0	$9,700,000	Road Improvement
CL20200020	Nevada DOT	SR 573, Reconstruct Craig Rd., fm. 0.008 MW of N. Rainbow Blvd. to Decatur Blvd. MP CL 0.31 to 2.26	State	$2,800,000	$0	3R
HU20190012	Nevada DOT	Winnemucca, Various locations - Pedestrian and Safety Improvements	State	$1,200,000	$0	Other
WA20200013	Nevada DOT	I 80 Replace Structure I-770 (Off-System Bridge), Garson Rd-New	State	$0	$4,000,000	Road Improvement
WA20200016	Nevada DOT	US 395A, Pedestrian/Sidewalks S. Virginia, from Damonte/Arrowcreek to I-580-New	State	$0	$2,000,000	Other
CL20200051	Nevada DOT	SR 610, 3R Lamb Blvd-NEW	State	$8,000,000	$0	3R
XS20200017	Nevada DOT	SR 376, Big Smokey Valley - 3R-NEW	State	$24,500,000	$0	3R
PE20200002	Nevada DOT	I 80 Construct New Maintenance Station Near Coal Canyon	State	$0	$0	Other
PE20110001	Nevada DOT	G-29 Bridge Replacement	State	$3,200,000	$0	Other
CL20200103	Nevada DOT	Lake Mead Pkwy, 0.035 Miles West of Boulder Highway to West Boundary of Lake Mead Recreation Area 3R	State	$7,789,200	$0	3R
DO20180007	Nevada DOT	SR 207 Kingsbury Grade	STBG State-Wide	$0	$11,500,000	3R
CH20200017	Nevada DOT	US 50, Cold Mill PBS With Open Grade Outside Lanes, Roadbed Modification, PBS with OG	STBG<5K	$21,300,000	$0	3R
WP20180001	Nevada DOT	SR487, White Pine - Baker Multi-Use Path, LPA	TAP <5K STBG, TAP FLEX STBG	$620,445	$0	Other
WA20210008	Nevada DOT	FRWA51, Enhanced Safety Improvements	HSIP	$500,000	$0	Road Improvement
WA2012128	Nevada DOT	US 395 / I 580 / I 80 Freeway Service Patrol	NHPP	$0	$384,000	ITS/System Efficiency
WA20170146	Nevada DOT	US 395 Construct Aux Lane, Travel Lane, and Ramp from McCarran Blvd to Golden Valley Structure	NHPP, STBG State-Wide	$93,390,000	$0	Road New Construction
WA20170132	Nevada DOT	Silver Lake Drive Railroad Crossing	Rail	$0	$410,000	Rail

10. ATM Capability Maturity Model (CMM) Self-Assessment Workshop

An ATM CMM Self-assessment workshop was conducted for the ITS & ATM Master Plan. The CMM workshop was organized in a hybrid environment and was conducted in two parts on July 21 and July 22, 2022. Participants were guided through a series of questions relating to five (5) of the six (6) FHWA CMM framework dimensions as follows:

- Business Processes
- Systems and Technology
- Performance Measurement
- Organization and Workforce
- Collaboration

The maturity of the sixth dimension, Culture, will be inferred from responses received on the other five (5) dimensions.

Participants included representatives from statewide internal and external partners, shown in **Table 12.**

Table 12 – List of ATM CMM Participants

Agency	In- Person	Virtual
NDOT Traffic Operations Division	X	X
NDOT District 1		X
NDOT District 2		X
NDOT District 3		X
RTC of SNV (FAST)	X	X
FHWA		X
NDOT Road Operations Center (ROC)		X

High level findings from the CMM Workshop include:

- A pro-technology culture exists within the state in support of ATM strategies and other technological solutions.
- Retaining key staff responsible for managing and operating ATM systems can frequently be a challenge at the statewide level.
- There are some processes currently in place to support future ATM deployments.
- State and local agencies are currently collecting or have the infrastructure to collect performance metrics and traffic data that support ATM strategies.

- There are opportunities to improve existing communication processes for maintenance of ITS equipment.
- A strong desire exists to understand and communicate the benefits of TSMO to executive leadership.

In general, all responses vary among agencies and regions. Levels of CMM Dimension maturity will be established based on participant responses, one-on-one interviews, and agency literature reviews.

ATTACHMENT A

ONE-ON-ONE MEETING KEY TAKEAWAYS

SUMMARY OF ONE-ON-ONE MEETING DISCUSSIONS

As part of the NDOT ITS & ATM Master Plan process, individuals were identified to be interviewed one-on-one to talk in detail about the group and processes related to ITS in the state. The overall goal of the questions during the meetings were to talk through existing gaps/challenges in the way technology is implemented and supported throughout the state, and also talk visioning for the future from their individual perspective. Questions posed during the meetings included:

1. Describe your role/involvement with ITS implementation?
2. Which corridors are priorities for you for technology deployment or improved operations?
3. What is your groups plans for the future as it relates to technology?
4. What type of active traffic management applications do you think is needed for different areas in the state? *(variable speeds, lane control, traffic monitoring, hard shoulder running, etc.)*
5. What timing do you think is important for some active traffic management strategies to be put in place? *(right away, not for 5 years because we need X, Y, Z in place)*
6. What reservations or pain points do you anticipate with implementation of emerging technologies? *(do not have data we need to make decisions, not enough staff, performance isn't clear, strategic partnering is needed between agencies, etc.)*
7. What partnerships would you like NDOT to explore to support operations?
8. How do you think this could be incorporated into your agency's planning and programming processes?
9. How capable/mature/ready is NDOT for adopting additional technology?

NDOT – TOTS | MARCH 2022

Attendees:

- Jim Whalen (NDOT)
- Juan Hernandez (NDOT)

Notes:

- NDOT is moving to EAMS – Agile Asset. It does not support everything we do at the department.
- Maintenance is a huge challenge for the state/division, maintenance is more reactive than proactive.
- Have ITS devices being put into the inventory.
- There should be a process in place for recording equipment.
- Have IT staff in each district.
- Requires different skills.

- Maintenance contracts for ITS, this gives money to the districts for deploying new ITS devices. but does not seem to cover the maintenance of existing devices.
- Traffic Ops should be responsible for the contracts not the districts.
- Use the contracts as preventative maintenance and for asset management.
- Operator should have the option of putting in the trouble ticket right there.
- Needs to be visibility of NDEX on ITS network.
- Dashboarding is ongoing process – can be updated, dashboarding for Asset Management. Jim wants to build in Life Cycle Costing Tool and automate the TAMP process.
- If the Districts could see the data, that could give them a better tool to use.
- 3GIS is being used.
- Broadband sharing – working on sharing with private sector.
- Need processes/procedures for public/private sharing.
- Standardize on the 144 cable – allocate buffer tubes to specific uses.
- Need to do lifecycle replacement.

NDOT – TRAFFIC OPERATIONS PROGRAMS & OPERATIONS

Attendees:

- LaShonn Ford (NDOT)
- Juan Hernandez (NDOT)

Notes:

- AI in rural areas is not reliable – would need a lot of verification.
- NDOT does not have the ability to effectively use the tools we have today.
- Putting policies in place to require our users to actually use them – consistency across Districts.
- The collaboration part is the hardest to implement.
- Integrate with the One Nevada Plan.
- Asking for new devices when we do not have full use of what we have – get back to the fundamentals.
- Working with the OEMs.
- Multi-modal is not looked at.
- Systems engineering prior to design, construction and integration.
- Look at staff and consultant support.

NDOT DISTRICT 1 | APRIL 2022

Attendees:

- Mario Gomez (NDOT)

Notes:

- Need a replacement and training program.
- ITS should be based on bottlenecks and congestion in urban parts.
- District staff needs to know the "why" as to be able to build better infrastructure.
- Travel time reliability is more visible in D1.
- Maintenance is not supported well enough.
- Need better training and more staff if the infrastructure is going to grow.
- Sometimes there is overlap in responsibilities for what RTC does versus what NDOT does in maintenance.
- More equal to guys from FAST.
- Customers are traveling public and call NDOT, they do not call FAST.
- Work order processing system is run by RTC, so NDOT gets reports, but doesn't get the original work order management.
- NDOT techs need access to cameras at the ROC.
- Need the ability to directly communicate with the incident commander.
- Expanding fiber and ITS systems to include rural areas.
- DMS, CCTV, RWIS, speed feedback signs, permanent VSL, portable VSL for smart work zone.
- ATM should be done at every system-to-system interchange – not everywhere, but a few miles in advance of the system interchanges.
- Henderson, Centennial Blvd, I-15 and 215 (North Las Vegas).

NDOT DISTRICT 2 | MARCH 2022

Attendees:

- Alex Wolfson (NDOT)
- Juan Hernandez (NDOT)

Notes:

- Better system for collecting travel times and ensure the information is shared with the public.
- Interstate travel time (Reno/Truckee).
- Consolidate everything into one program.
- Look for commercial on-the-shelf options than custom ones.
- Determine what ITS devices can be used, even if temporary, to help with construction delays as scoping and planning of a project is happening.
- Coordination with Caltrans and NDOT for ITS devices, they originally had 3 DMS in Nevada that should be maintained locally.
- NDOT should be subscribing to Caltrans information.
- City of Reno DMS signs should be connected to NDOT's network and operated by NDOT.

- ROC – consolidating.
- NDOT needs to be careful not to mess with signals.
- More effort to blur the jurisdictional lines.
- No motivation to stay where you are at from a career perspective.
- official business to be directed to a distribution list as opposed to one point of contact.
- NDOT is doing well with fiber sharing.
- Infrastructure for future autonomous vehicles.
- Build conduit for when technology comes in.
- D2 congestion management and weather management.
- D2 ATM deployments desired along key corridors.

NDOT DISTRICT 3 | APRIL 2022

Attendees:

- Sami Yousuf (NDOT)
- David Brown (NDOT)
- Eric Trujillo (NDOT)
- Shaun Deforest (NDOT)
- Juan Hernandez (NDOT)

Notes:

- DMS signs will be very helpful to detour traffic.
- DMS signs at the junctions of US95/SR266 and US95/SR373.
- US95 is finding good detour routes when incidents happen.
- Having DMS signs at key junctions would help inform travelers.
- Main focus when they evaluated the DMS was US6 and US 95.
- Weather stations at summits in the area.
- There are not many weather stations.
- Weather station then that could be monitored.
- District 3 – there used to be a meteorologist.
- Being in remote areas they can't be everywhere, so anything that can help them monitor remotely would be helpful for them.
- Getting messages out more efficiently.
- Having more facilities for weather related issues.
- Leaving Winnemucca – not nothing to inform travelers from other state.
- Lack of dispatch with NHP and D3 dispatch need for improvement.
- Turnover challenges.
- Not getting a lot of knowledge from the technology.
- Having ITS technology installed but maintained by other local agencies (county), State can install but county maintain.

- ITS maintenance contract – the budget may need to be increased so that existing devices can be maintained.
- Portable messaging boards, those are outdated and need more.
- Equipment operator simulators for training.
- Any technology to help with work zones.

NDOT FREIGHT | MARCH 2022

Attendees:

- Tim Mueller (NDOT)
- Nate Brown (NDOT)
- Amy Cummings (Parametrix)
- Vern Keeslar (Parametrix)
- Juan Hernandez (NDOT)

Notes:

- Truck Parking availability systems would be helpful.
- Weather event notifications for flooding in the south and snow in the north.
- Notifications on different incidents – trucks driving wrong way (driving behaviors).
- TPAS at 6 locations – 3 on I-80 and 3 on I-15 – test locations, want to see if these work before expanding.
- Freight Team to provide list of projects not already accounted for in other studies.
- Getting freight incident info way earlier – like a text alert with a broader area of geofencing.
- Road conditions, wind conditions, low bridge structures.
- Prioritizing where truck climbing lanes are needed.
- Get information on road closures.
- Distribution list (statewide road closures).
- What has seemed to have been important in the past for freight operators has been the highway advisory radio and ready variable messaging boards. They get technology messages on their in-board computers. This is not consistent with the HAR Master Plan, although feedback on the use or none use of HAR's was not obtained during that Plan's development.
- ROCs are the ones that put out the messages when the incident occurs.
- CV data can be provided to freight in-vehicle.
- HARs are extremely useful for freight where HAR is not redundant.

NDOT PLANNING | MARCH 2022

Attendees:

- Kevin Verre (NDOT)

- Jillian Emery (NDOT)
- Candice Day (Jacobs)

Notes:

- Outlined goals in One Nevada Plan.
- Looking at things earlier.
- Historically hard to get sole ITS projects out there. It is best to package with other STIP projects.
- Considerations for broadband and equity.
- Identifying any measures that can be interpreted into the scoring methodology would help.
- NDOT wants to have a list of projects in the concept to project phase.
- There is an EV plan, this is a priority not only for one group.
- EV plan would require additional facilities such as restrooms.
- Equity is a big one on a federal and local level.
- Not getting enough of data quick enough. Example is crash data.
- Data scientist.
- Becoming more centralized (NDEX).

NDOT SUSTAINABLE AND EMERGING TRANSPORTATION (SET) | APRIL 2022

Attendees:

- Kandee Worley (NDOT)
- Juan Hernandez (NDOT)
- Rod Schilling (NDOT)
- Seth Daniels (NDOT)

Notes:

- I-80 for EV upgrades.
- Multimodal – all (95,93,6,80...).
- Responsibility is to make sure the communications is in place.
- Rules and regulations have to be the same across states.
- Opportunity charging – pilot project along Las Vegas Blvd and nugget/USA parkway.
- Close dead zones.
- Cannot be commercial cellular providers.
- In pavement charging at 50-mile hops – utilize public/private partnerships.

NDOT SLI | APRIL 2022

Attendees:

- Kevin Maxwell (NDOT)
- Fredrick Tydeman (NDOT)
- Jae Pullen (NDOT)
- Casey Sylvester (NDOT)
- Juan Hernandez (NDOT)

Notes:

- Maintenance for ITS contract is ongoing for 8 years.
- Maintenance contract may be working.
- Discrepancy between current funding for ITS maintenance versus desired funding.
- Need responsive maintenance now.
- WWD: make it an active system. #1 priority: warn others. #2 priority: would be to get a ping on their cellphone IP address to call them and stop them.
- Department should be having their own network.
- Getting rid of HARs and the blazer signs in Vegas.
- Phase out travel time signs if other apps are being used.
- The report will be coming out soon, Fred to send once it is available.
- Have a dashboard that each of the chiefs can use – channel into outward phasing dashboard so that anyone can see real time.
- Rural areas – to put in power drop.
- SR253 – fiber sharing.
- Weather systems – monitoring.
- Animal crossing warning – infrared.
- Adaptive lighting pilot going on.
- Detection of vehicles approaching and pedestrians.
- Gun Shot & detection.
- Power Monitoring.
- Smart work zone.
- Automated Enforcement. Install ALPRs.
- HOV – they are testing detection.
- Travel Time Delay Monitoring.
- ROW management plan is needed.
- Vehicle data should be pulled at any points possible – V2I, V2X.
- V2V platooning.
- Smarter traffic signal systems.
- CV used for road condition information and traveler information.
- TPAS – doing a pilot and if it "does well", deploy that around the state.
- Getting rid of HAR and trailblazers.

- Make sure there is a need for infrastructure beyond what Google/Waze provides.
- Scrum process for project delivery (agile process).
- Alternative energy agreement (hydrogen and solar).
- More staff needed as more TSMO strategies are implemented.
- Hit 1/3 of preventative maintenance.
- Five master agreements and considering adding lighting and other traffic control systems (example RRFBs) to master agreements.
- Agreements – NDOT owns the devices. Permits – local agency owns the devices.
- Not in favor of ITS assets to go into TAMP.
- big picture plan to ensure asset is beneficial.
- Will need construction buy in for asset management.
- Resident engineers report to district engineer and have unofficial report to HQ under different change of command.
- Think of modular units – so one panel for multiple devices.
- Battery backups for northern Nevada for winter where SNV could mostly use solar.
- Traffic studies procedures and policies, traffic modeling, NEPA, TMP analysis, ICE.
- Need flow detectors better in southern Nevada.
- HOV Cameras.
- CV analysis.
- Temporary speed reductions.
- Temporary permits for special events.
- Consultant use versus NDOT personnel – ok with 50/50 split.
- NDOT should no longer looks at specialty projects – would be better to group projects together.
- Washoe TMC should not care who owns what or where.
- Do away with the District ROC concept, lean into local TMCs.
- SWZ – not doing it today.
- Specified SWZ on projects before, but it did not end up being too useful.
- Replace signs on a 7-year basis.
- Ideal would be inspectors could update asset inventory data in the field.
- NDOT does lidar data 1/3rd of the state every year.

NDOT STRUCTURES | APRIL 2022

Attendees:

- David Chase (NDOT)

Notes:

- NDOT Traffic Ops should be with roadway/structures/construction with them rubbing elbows.
- Roadway is king - Traffic Ops need to get a much stronger tie to Roadway.

- Project development process – 2-year and 5-year chunks.
- ATM would have more value if there was more ATM around the area – too small for now to be ultimately effective.
- HOV did not go over well as 24x7 – lean into how Caltrans has learned the HOV sides of things.
- Have Traffic Ops slow down and evaluate what has been used, not go forward so fast.
- NDOT will start an initiative and not provide any positions for it.
- Use consultant support as a metering mechanism.
- Need documented roles and responsibilities to support transition.
- Tie it back to safety – the purpose for ITS.
- need more of a zipper merge with the One Nevada Plan.
- Need a process in place where ITS folks are talking regularly to roadway / structures / construction folks – folks at the top are required to be the connection between divisions, which gives an excuse to not connect division-to-division.
- Over height systems that provide warning.
- Need to be willing to protect NDOT facilities even if infrastructure is not on NDOT ROW – advanced detection on local jurisdiction.
- Deicing system is on I-580 between Reno and Carson – maintenance issue is annoying and does not actually solve the sliding issue.
- Routine maintenance process usually serves as eyes and ears.
- Structures is building in redundancy – ITS should as well with third-party data.

NDOT CONSTRUCTION | APRIL 2022

Attendees:

- Samuel Lompa (NDOT)

Notes:

- WiFi and Cellular is tough around the state.
- Since going to 5G there is lower coverage.
- Connectivity to field labs is important.
- Traffic control is an issue in the rural areas.
- Nothing standardized with SWZ requirements.
- NDOT does not dictate traffic control, that is on the contractor to do.
- Lean into technologies that tells the vehicle better information faster – but there needs to be a way to hold folks accountable.
- If we tie the hands of the contractor, they will start bidding higher.
- Revamped the trenching detail with Rod last year – significant reduction in cost and scale.

NDOT SAFETY

Attendees:

- Lacey Tisler (NDOT)
- Juan Hernandez (NDOT)

Notes:

- Need to pull data analytics – near miss, crash, speeding, bike/ped detection quantity, better data at intersections, data.
- TO utilizes safety funds, towing incentive funds, speed management, etc. – safety provides the funds.
- A lot of data is crash data – almost all law enforcement uses the same data.
- Feasible to use third-party data.
- AI would need to be rolled out across all existing cameras if it's used – would have a difficult time with pilot projects. If it's a "known" solution, then yes.
- They present data for justification.
- High Crash Corridors (yearly) – hardest is to find the rural corridors to show when we have Vegas that overrepresents.
- Safety for all users.
- Smart work zones.
- Find a way to get good and accurate bike and ped counts.

NOAA | JUNE 2022

Attendees:

- Chris Smallcomb

Notes:

- NOAA issues almost daily email briefing matrix for the next 7 days that are used by NDOT to make staffing decisions.
- When there is a potential flood event, via EOC, NDOT has a rep there and they hear live briefings.
- Snow events – have traffic operation center operational 24x7 and have crews give NOAA a call usually NDOT or schools call. NOAA then can provide guidance. NOAA is not road conditions forecasters they just give them the weather information.
- RWIS are used to compare against forecast, they then use that data from RWIS to correct the forecast. Real time monitoring and correction for weather, especially for wind and air temperature and road temperature data they still make use of road condition data even though they do not do road conditions. Road condition data is very helpful. Used in conjunction with other weather station networks.
- NV Energy that are installing their own weather network for fire warnings.

- If they ever feel a RWIS station might not be providing accurate data, they reach out to NDOT.
- Weather service has 144 field offices and they have always been 24/7. Always 24/7 with the idea to response to weather inquiries.
- Believes NOAA provides a good service there are times when volume of requests is more than available forecasters.
- Road condition – would be a role for private sector vendor but need to know key weather areas based on living in the area.
- RWIS stations are most useful for snow and wind. Not for flood currently. Need precipitation data.

NHP | JUNE 2022

Attendees:

- James Simpson (NHP) – Captain D2
- Eric Kemmer (NHP) – Captain

Notes:

- Usually announcements are not heard on local radio as most people use other radio XM radio or smart phones.
- Coordination with D2 ROC has been great.
- NDOT ROCs enter into their Spillman CAD and the CAD-CAD interface allows NHP to see their entries on the CAD feed.
- Want to make sure that all communication goes through dispatch so that it is recorded and officially dispatched
- D3 engineer showed them how to use the heatmap/ track crashes. Educating staff on available tools.
- 511 is accessible in the vehicle, makes sense to leverage what is already in place.
- Message boards, flashing beacon signs.
- With roadway closures, the DOT does not like to provide detours, they leave that to the driver so avoid liability.

CAMPO | JUNE 2022

Attendees:

- Christopher Martinovich (CAMPO)
- Kelly Norman (CAMPO)
- James Jacklett (CAMPO)

Notes:

- There were WWD projects that Carson was not aware of the WWD detection. From ITS perspective there is no communication with NDOT.
- There is still general lack of communication for roles/responsibilities – such as power outages who takes care of those.
- The days of the county being able to maintain NDOT infrastructure are limited.
- Statewide approach doesn't fit CAMPO, there are all types of regions. It should be based on regions since it needs to be different across the state.
- Having additional information to driver is a good thing,
- Looking at northern rural road operations center including Lake Tahoe. Would not include Washoe. A mini FAST for rural perspective.
- NDOT should take it on an economy of scale.
- For this MP – pilot versus fully implement without thinking of the full picture.
- CAMPO is not included in NDOT's performance metrics – not aware of them.
- Wants more data available at a local level.
- Hard accelerations, hard decelerations data – crash data from NDOT is behind, is there a source that can provide a better picture for safety performance.
- The big public/private data work on state level but does not work on local level.

LOCAL AGENCY RESPONSES | JUNE 2022

Agency	Urban/ Rural	Responses
District 1		
Lincoln County	Rural	Lincoln County has a myriad of challenges as it relates to technology and our highways. Certainly technology could be used for all different monitoring practices throughout the County. Higher volume highways would be US 93, SR 318 and SR 319. Basic traffic monitoring is key, especially as it relates to safety. The partnership between NDOT and the County has been positive. Certain projects that have seemed a priority for the County, have not been prioritized on a statewide level. Actual construction of projects is the challenge on our end. The County's volumes of traffic and number of incidents is comparatively low. There are certain highways (such as SR 322) which access cherished state parks and other areas where major rebuilding is necessary.
Nye County	Rural	In Nye County, it is likely that no ATM technologies would be needed unless it is lane control in specific locations. The County works with NDOT frequently for maintenance purposes.
District 2		
City of Sparks	Urban	Primary corridors and areas of concern in the City are Pyramid, McCarran, Glendale, the I-80 interchanges and any routes that parallel that would be affected by slow-downs or closures. The interchanges are State owned inside the City of Sparks and impact the citizens when issues arise. The City desires queue detection and warning devices for areas where there is heavy congestion during certain times of the day or when the primary routes are blocked or

		closed. Initiate changes in speed limits or signal timing automatically to compensate for the incident, alterations that also go back to standard operations automatically after the need to compensate is no longer needed. Methods to notify drivers that routes ahead may be congested/closed and alternative routes should be sought out. Automated equipment can be used to gather accurate travel times and make the information available. Zipper lanes on interstates are desired specifically as is relates to performing maintenance or installing improvements. Permitting process with NDOT could be improved. There is a desire to establishing more robust agreements when it comes to maintenance of lighting, landscape, and sidewalks/paths.
City of Fernley	Rural	As the City of Fernley constructs more signals with development, there needs to be more coordination of signal phasing and timing through NDOT corridors. The current relationship is under a master service agreement that NDOT constructs needed signals along NDOT corridors, and the City maintains them. The current City-NDOT partnership is limited to submission of applications for NDOT encroachment permits and the comments the city receives from those permits. The City would like a more collaborative partnership with NDOT where both agencies are coordinating when it comes to traffic management within the City. The City would like to establish consistent coordination regarding project and resource prioritization. The City hopes to establish and maintain relationships with District II staff, and perhaps have quarterly or biannual meetings to discuss issues, changes, etc.
Douglas County	Rural	Fiber connection to the signals on US-395 and on US-50 at the state line are needed for coordination and for monitoring signal operation. Due to the size of the county and the location of the signals, it takes a lot of hours to respond to a signal complaints. Connection to signals would also allow for real time changes to signal timing in the event of a fire or other incident management situations. On US-395 south of Gardnerville in the Pinenut Range, there is a large speed differential between vehicles. This area may benefit with the use of variable speeds. Currently there is only some minor coordination with NDOT in the event of a traffic incident or construction on NDOT roadways through the NDOT permit office.
District 3		
City of Elko	Rural	Updated traffic signal timing and connectivity would be desired. The City of Elko Public Works has had a great working relationship with District 3 for many years now.
City of Winnemucca	Rural	The traffic lights that are located on state-owned facilities is challenging to maintain for the City as it is cumbersome and costly to maintain, and it is challenging to sustain the training and skills necessary to take care of state owned traffic signals.

ATTACHMENT B

ITS AND ATM STRATEGY SUMMARY

ITS Strategy (* currently in Nevada)	Definition	Technologies Involved	Operational Use Cases	Application Geography	Benefits
Freeway and Arterial Traffic Management*	Real-time traffic management capability on any facility to be able to support traffic monitoring, situational awareness, and incident response for traveling public.	**Required:** Mainline detection or visual to determine real-time conditions, Communication to central **Optional:** CCTV, Arterial detection for alternate routes, Dynamic message signs	• Any facility	• All roadways	• Reduced travel time • Reduced travel delay • Improved responder safety
Adaptive Ramp Metering **(ARM)**	The deployment of traffic signals on ramps to dynamically control the rate at which vehicles enter a freeway facility. Utilizes traffic-responsive or adaptive algorithms (as opposed to pretimed or fixed-time rates) that can optimize either local or system-wide conditions.	**Required:** Ramp meter signals, Ramp detection, Mainline detection, Software management system **Optional:** Communication to central	• Recurring congestion • Planned special events	• Limited-access facilities	• Delayed onset of mainline breakdown • Reduced mainline travel delay • Improved travel time reliability • Reduced ramp delay • Reduced vehicle hours traveled • Reduced crash rates
Adaptive Signal Control Technology **(ASCT)**	The continuous monitoring of arterial traffic conditions and queuing at intersections and the dynamic adjustment of signal timing to smooth traffic flow along coordinated routes and to optimize one or more operational objectives (such as minimize overall stops and delays or maximize green bands). Also known as responsive and/or multimodal preferential signal control.	**Required:** Traffic signal, Advanced detection, Software management system **Optional:** Traffic video camera, Connected vehicle device, Communication to central	• Variability and unpredictability in demand • Excessive delay and stops	• Arterials	• Reduced arterial travel time • Reduced arterial travel delay • Improved arterial travel time reliability • Reduced number of stops • Reduced intersection delay • Reduced queue lengths • Increased arterial speeds
Dynamic Junction Control **(DJC)***	The dynamic allocation of lane access on mainline and ramp lanes in interchange areas with high traffic volumes, and where the relative demand on the mainline and ramps changes throughout the day. Through the use of signs, mainline lanes can be closed or become an exit, shoulders can be opened, and so forth to accommodate entering or exiting traffic.	**Required:** Lane control sign, Ramp detection, Mainline detection, Software management system, Communication to central	• Large variations in mainline and ramp volumes • Heavy weaving/merge areas • Work zones • Planned special events	• Interchanges • On/off ramps	• Reduced travel time • Reduced travel delay • Reduced ramp delay • Increased travel speeds
Dynamic Lane Reversal **(DLR)**	The use of lane control signals to manage the reversal of one or all lanes to dynamically allocate capacity of congested roads, allowing capacity to better match traffic demand throughout the day. Lane reversal could include changing the number of available lanes per	**Required:** Dynamic overhead lane control signs, Mainline detection or visual to confirm lanes are clear before use, Software management system, Communication to central	• AM/PM directional shift in managed lanes and/or arterials • Emergency	• Limited-access facilities • Multilane arterials	• Increased throughput during lane reversal operations • Decreased travel times • Decreased crash rates • Improved level of service

ITS Strategy (* currently in Nevada)	Definition	Technologies Involved	Operational Use Cases	Application Geography	Benefits
	direction by physically moving barriers or by signage.	**Optional:** Movable barrier	management • Planned special events		
Dynamic Lane Use Control **(DLUC)***	The use of lane control signals for dynamic closing or opening of individual traffic lanes as warranted and providing advance warning of the closure(s), typically through dynamic lane control signs, to safely merge traffic into adjoining lanes. Often installed in conjunction with DSPL, and also supports the ATM strategies of DShL and DJC.	**Required:** Dynamic lane control signs, Mainline detection, Software management system, Communication to central **Optional:** Redundant detection	• Incident management • Shoulder use • Reversible lanes • Managed lanes	• Some or all lanes on a facility • Bridges • Tunnels	• Increased capacity when used with dynamic shoulder use • Increased lane-level volumes • Reduced secondary crashes • Compliance with posted signage during different flow conditions • Improved responder safety
Dynamic Shoulder Lane **(DShL)**	The dynamic enabling of the use of the shoulder as a travel lane(s) utilized by specific types of vehicles or occupants. The use of shoulder lanes can be based on congestion levels during peak periods and in response to incidents or other conditions as warranted during peak or nonpeak periods. This strategy is frequently implemented in conjunction with DSpL and DLA. Static, time-of-day approaches are not generally included in the definition.	**Required:** Mainline detection, Shoulder detection or visual to confirm lanes are clear before use, Software management system, Communication to central **Optional:** Dynamic message sign	• Recurring congestion • Incident management • Managed lanes (occupancy-based or vehicle-based) • Ability to use shoulder to accommodate traffic	• Any facility with available shoulders	• Improved level of service when shoulders are in operation • Reduced travel time • Increased travel time reliability • Reduced crash rates • Reduced crash severity
Queue Warning **(QW)***	The real-time display of warning messages (typically on dynamic message signs and possibly coupled with flashing lights) along a roadway to alert motorists that queues or significant slowdowns are ahead, thus reducing rear-end crashes and improving safety. QW may be included as part of DSpL and DLA strategies. Static QW signs are not included in this definition.	**Required:** Mainline detection, Dynamic message sign, Software management system **Optional:** Flashing lights, Travel time devices along alternate routes, Communication to central	• Recurring congestion • Incident management • Work zones	• Spot specific, in advance of known problem areas	• Reduced rear-end crashes where the warning is in effect • Increased travel speeds • Reduced speed differential
Dynamic Speed Limit **(DSpL)***	The adjustment of speed limit displays based on real-time traffic, roadway, and/or weather conditions. Can either be enforceable (regulatory) speed limits or recommended speed advisories and can be applied to an entire roadway segment or individual lanes. This "smoothing" process helps minimize the differences between the lowest and highest vehicle speeds.	**Required:** Dynamic speed limit signs, Software management system **Optional:** Mainline detection, Visibility / weather detection, Communication to central	• Recurring congestion • Weather • Incident management • Work zones • Regulatory or advisory speeds	• Spot specific	• Reduced difference between posted speed versus actual speed • Reduced speed variability • Reduced spatial extent of congestion • Reduced temporal extent of congestion

ITS Strategy (* currently in Nevada)	Definition	Technologies Involved	Operational Use Cases	Application Geography	Benefits
					• Reduced crash rates • Reduced crash severity
Dynamic Merge Control (DMC)*	The dynamic management of the entry of vehicles into merge areas with a series of advisory messages approaching the merge point that prepare motorists for an upcoming merge and encouraging or directing a consistent merging behavior. It can help create or maintain safe merging gaps and reduce shockwaves upstream of merge points.	**Required:** Mainline detection, Dynamic message sign, Software management system **Optional:** Redundant detection	• Recurring congestion • Heavy weaving/merge areas • Work zones	• Limited-access facilities • Arterials • Spot specific	• Reduced rear-end crashes where the merge is in effect • Increased travel speeds • Reduced speed differential • Reduced delay
Integrated Corridor Management (ICM)	When congested traffic conditions occur on one roadway, traffic on adjoining roadways or freeway interchanges in the corridor, are also impacted. ICM is the approach of managing traffic as a network as an origin to destination network of roadways operated by various jurisdictional entities, rather than freeways or arterials.	**Required:** Software management system for arterial traffic signals, Communications to traffic signals **Optional:** Alternate routing signal timing plans, ATSPM, Arterial signal coordination with ramp metering	• Freeway-arterial coordination • AM/PM directional shift in managed lanes and/or arterials • Recurring congestion • Weather • Incident management • Work zones	• Freeway corridor specific where there are arterial alternates	• Reduced delay • Increased throughput • Reduced travel time • Reduced number of stops • Reduced queue lengths
Emergency Transportation Operations	Improved management of traffic incidents, natural disasters, security events, and other emergencies on the highway system.	**Required:** Alternate routing, Emergency information to media, Dynamic message sign, 511 **Optional:** Highway advisory radio, FirstNet, CAD-CAD integration, Internet of things, Artificial intelligence	• Incident management	• All roadways	• Reduced crash rates • Reduced crash severity • Improved responder safety
Freight Technology and Operations*	Technologies that improve efficiency and productivity, increase global connectivity, and enhance freight system performance. Applications are both in-vehicle, freight owner-manager systems as well as the DOT infrastructure that can support freight mobility and routing.	**Required:** Dynamic message sign **Optional:** Freight parking detection, Freight parking availability dynamic message sign, Asset tracking (vehicle location), On-board status monitoring, Gateway facilitation,	• Freight management • Parking management	• All roadways • Rest areas • Freight parking areas • Bridges	• Increased safety of freight vehicles • Increased efficiency of freight movement

ITS Strategy (* currently in Nevada)	Definition	Technologies Involved	Operational Use Cases	Application Geography	Benefits
		Freight status information, Network status information, 511, Traveler information			
Managed Lanes*	Specific lanes where operational strategies are proactively implemented and managed in response to changing real-time conditions. Pricing, vehicle eligibility, and access control are the three typical categories of managed lanes.	**Required:** Managed lane detection, Access control signage, CCTV or other monitoring capability **Optional:** Pricing, Dynamic pricing, Tolling, Detection enforcement	• Managed lanes • Heavy weaving/merge areas • AM/PM directional shift in managed lanes and/or arterials • Recurring congestion • Incident management	• Urbanized roadways	• Increased throughput • Reduced queue lengths • Increased travel speeds • Reduced travel time • Reduced travel delay
Planned Special Events Traffic Management*	Special events cause different types of nonrecurring traffic management challenges from incidents or work zones.	**Required:** Alternate routing, Planned special event information to media, Dynamic message sign, 511 **Optional:** Internet of things, Artificial intelligence	• Incident management	• All roadways	• Reduced travel time • Reduced travel delay
Road Weather Management	Technologies used to support the identification of current weather conditions impacting road users as well as the predictive weather forecasts that can support maintenance and resource planning.	**Required:** RWIS **Optional:** Pavement sensors, Flood detection, Vehicle fleet sensors, Connected vehicle data, Weather data exchange	• Weather	• All roadways	• Improved safety • Reduced crashes • Reduced delay • Reduced queue lengths
Real-Time Traveler Information*	Collecting real-time data and turning that data into information to support the traveling public through methods such as 511, social media, traveler alerts, and websites.	**Required:** 511, Web presence **Optional:** Application development, third-party data	• Recurring congestion	• All roadways	• Reduced travel time • Increased reliability
Ramp Management	The application of control devices, such as traffic signals, signing, and gates to regulate the number of vehicles entering or leaving the freeway, to achieve operational objectives.	**Required:** Ramp detection **Optional:** Emergency vehicle preemption	• Recurring congestion	• Urbanized roadways	• Reduced travel delay •

ITS Strategy (* currently in Nevada)	Definition	Technologies Involved	Operational Use Cases	Application Geography	Benefits
Traffic Incident Management (TIM)*	Technologies, software, and processes to support unplanned roadway events that affect or impede the normal flow of traffic. The National Incident Management System (NIMS) protocol utilized during incident command can utilize technologies and integration of data to support incident management.	**Required:** On-scene NIMS interagency communications **Optional:** CAD-TMC integration, CAD-CAD integration, Unmanned aircraft systems	• Incident management	• All roadways	• Reduced crashes • Improved responder safety • Reduced secondary crashes
Work Zone Management (WZ)	Managing traffic during construction and assessing work zone impacts on the traveling public. Work zone management techniques includes providing better information to the traveler through the work zone and creating a safer environment for the workers in the construction area.	**Required:** Smarter work zone technologies **Optional:** Portable CCTV, Portable dynamic message sign, Portable queue warning, Portable lane merge, Portable variable speed limit, Portable vehicle detection, Portable safety applications such as wearable alarm systems and intrusion detection	• Recurring congestion • Work zones	• Spot specific	• Reduced speed variability • Improved safety • Reduced crashes • Reduced delay • Increased throughput • Reduced travel time • Reduced number of stops • Reduced queue lengths
Connected and Autonomous Vehicle Application **(CAV)**	Vehicles are becoming more capable of communicating with the in-field infrastructure and with other vehicles around itself. Technologies in this realm are advancing faster than public agencies can deploy which means it will be important to focus on foundational investments that will be used by the CAV future.	**Required:** Communications network, Connected vehicles, Connected field devices **Optional:** Internet of things, Artificial intelligence	• Recurring congestion • Limited volume roadways	• All roadways	• Reduced crashes • Reduced delay •

ATTACHMENT C

REVIEW OF EXISTING STUDIES (DETAIL)

REVIEW OF EXISTING DOCUMENTS

This summary provides a review of existing documents as they have been collected to identify relation and context in the development of the Nevada Statewide ITS & ATM Master Plan (ITS Master Plan). Each existing document summary provides study name, completion date, author for context, and a brief summary describing what the document is and the purpose it serves. Each of the existing documents has been reviewed specifically related to the five ITS strategy areas defined in the goals and objectives of the project as follows:

Strategy	Goal	Objective
Communications (Comm)	Install reliable communications on critical routes statewide to connect ITS devices	Increase percentage of routes covered by communications infrastructure, increase connectivity to NDOT devices
District Operations (Ops)	Standardize District operational hubs dedicated to active traffic management and operations support	Provide redundant cross-district operational capabilities based on standardization of operational procedures to support continuous operations
Partnership (Partner)	Improve communication and collaboration between NDOT and other partners to support a variety of purposes	Create seamless operations across jurisdictions throughout the state and leverage partners for additional data, real-time situational awareness to support regional active traffic management
Data	Centralize and optimize data for decision-making and improving safety, mobility, reliability, and collaboration	Increase data sharing quantity, availability, quality, reliability, and use of data
Technology (Tech)	Identify programs and candidate locations for ITS foundational and emerging technologies to improve safety, mobility, reliability, and collaboration	Reduce travel times, reduce travel delay, and increase travel time reliability through new technologies installed and new pilot programs

Under each of the strategy areas, a summary of how the existing document provides context or guidance for the ultimate strategies and recommendations. In some cases, that contextual information includes locations, functions, data needs, or context to support future direction. In other cases, there is no specific context that document provides in that strategy area, which is designated as not applicable, or "N/A". A summary of contextual information by strategy area were used to support the deployment and implementation recommendations. The following table summarizes the strategy area influence from each of these documents:

Main Category	Subcategory	Item Collected	Comm	Ops	Partner	Data	Tech
Freeway Management	General	ITS Architecture Update 2019	✓	✓		✓	
	Managed Lanes	Managed Lanes and Ramp Metering Manual	✓		✓		✓
		Feasibility of Using Video Cameras for Automated Enforcement on Red-Light Running and Managed Lanes		✓	✓	✓	✓
		Southern Nevada HOV Plan Update and Addendum		✓	✓	✓	✓
	ATM	ATM Concept of Operations Update	✓	✓	✓	✓	✓
		ATM SOPs Draft Checklists		✓			
		Active Transportation Demand Management Cohort Meeting Notes					
	Third Party Data	Waycare: https://waycaretech.com/	✓	✓		✓	✓
Arterial-Freeway Coordination	General	CAMPO Regional Arterials Study	✓	✓	✓	✓	✓
		Traffic Prediction and Responses through Data Mining and Data Stream Processing	✓	✓	✓	✓	✓
	Integrated Corridor Management	Western States Rural Transportation Consortium One-Stop-Shop		✓	✓		
		Weather Share		✓			
		Western States Integrated Corridor Management Tool	✓	✓			
		Integrated Corridor Management Weather Share Map	✓				
	Bicycle/Pedestrian Detection	Regional Bicycle and Pedestrian Plan for Southern Nevada			✓		✓
		Nevada County Bicycle Master Plan			✓		✓
Crash Prevention and Safety	General	Nevada Strategic Highway Safety Plan	✓		✓	✓	✓
		Nevada Strategic Highway Safety Plan - Crash Facts		✓			✓
		NDOT Safety Management Plans					
	Monitoring / Detection	KNTVB 13 Article: Nevada company records traffic cameras, catches more than just traffic		✓		✓	
	Bicycle / Pedestrian Crossings	Pedestrian Safety Improvement Evaluation Guideline for Uncontrolled Crossings		✓		✓	✓
	Signalization	Advanced Signal Warning Signs: https://www.nvsafesignals.com/	✓				✓
	Animal Crossings	Deer Migration Tracking Maps				✓	✓
	Wrong Way Driving	NDOT Wrong Way Driver System	✓	✓	✓		✓
		Wrong-Way Driver Response Guidelines		✓	✓	✓	

Main Category	Subcategory	Item Collected	Comm	Ops	Partner	Data	Tech
	Rural Intersection VSL	Reno Gazette Journal: Why no snow/ice speed limit in Nevada?					✓
Road Weather Management	Visibility	NDOT Road Weather Information System (RWIS) Master Plan	✓	✓	✓	✓	✓
		NDEX Road Weather Information System					
	Vehicle Integrating Mobile Observations (IMO)	Integrating Mobile Observations about Road Weather Conditions for Decision-Making		✓	✓	✓	✓
		Maintenance Decision Support System: Pilot Study and Cost-Benefit Analysis (Phase 2)			✓		✓
		SICOP Talks Winter Ops: Podcast Episode 27: Integrated Mobile Observations at the Nevada DOT			✓	✓	✓
		Rural Transportation.org: Using Vehicle Connectivity Technology for Roadway Weather Response	✓		✓	✓	✓
	Infrastructure Detection	Bridge Anti-Icing Technology					✓
Alternative Fuels	General	Nevada's Strategic Planning Framework	✓				
		Nevada Electric Highway	✓	✓	✓		✓
	Smart electric vehicle charging	Alternative Fuels Data Center: Nevada Laws and Incentives					✓
Traffic Incident Management	General	Nevada Traffic Incident Management Coalition			✓	✓	
	FirstNet	State of Nevada FirstNet Statewide Meeting	✓		✓		✓
		FirstNet – How Network Works with Today's Land Mobile Radio Networks? Brochure	✓				✓
		FirstNet for Nevada					
	Third Party Data / Artificial Intelligence	Identifying Real-World Transportation Applications Using Artificial Intelligence (AI)	✓	✓	✓	✓	✓
	CAD-TMC Integration	Statewide Pilot Project for Standardized TIM Performance Measurement and Reporting	✓		✓	✓	✓
Emergency Management	Emergency Vehicle Preemption	Clark County Traffic Signal Operations Brochure					
	HAZMAT Detection	Hazardous Materials Response Plan – Plan Overview		✓			
Traveler Information	Dynamic Message Signs	NDOT NVRoads: Freeway Message Signs Webpage	✓				
		TTI: Nevada agencies use AI platform to select STMS locations on high-risk corridors	✓		✓	✓	
		NVFAST: Dynamic Message Signs	✓				

Main Category	Subcategory	Item Collected	Comm	Ops	Partner	Data	Tech
		Webpage					
	Highway Advisory Radio	NDOT HAR Master Plan Update	✓		✓		✓
	511	Weather Sensors Webpage					
Information Management	ATSPM	Developing a Quality of Signal Timing Performance Measure Methodology for Arterial Operations	✓	✓		✓	✓
	Drones	Drone Laws in Nevada (2022)					
Commercial Vehicle Operations	General	Nevada State Freight Plan			✓	✓	✓
		Nevada State Rail Plan			✓	✓	✓
		I-15 Freight Mobility Enhancement Plan	✓		✓	✓	✓
		I-15 Corridor System Master Plan Update	✓		✓		✓
		Nevada Freight Projects					
		Nevada Highway Freight Network					✓
	Truck Parking	Nevada Truck Parking Implementation Plan		✓	✓	✓	✓
		Urban Truck Parking Technology Exploration	✓	✓	✓	✓	✓
	Over Height Warning	Workzonesafety.org: Devices and early earning methods used to reduce hits on low-clearance structures					
	Port of Entry	Virtual WIM Brochure	✓			✓	✓
	Truck Escape Ramps	Nevada Truck Escape Ramp Brochure					
	Mobility Hubs	Lake Tahoe Mobility Hub	✓				
Work Zone Management	Smart Work Zones	NOCoE Smart Work Zones – Peer Exchange Proceeding Report	✓	✓		✓	✓
		NDOT SWZ Presentation	✓	✓			✓
		RTC of Southern Nevada Smart Work Zones	✓	✓	✓	✓	✓
		Innovations: Data Driven Insights					
	Contractor Requirements in Procurement Process	Standard Plans and Specifications for Road and Bridge Construction					✓
Connected / Autonomous Vehicles	General	NDOT Automated and Connected Vehicles Webpage			✓	✓	
		Sierra Nevada Ally: Nevada Continues to Embrace an Autonomous Vehicle Future		✓			
		TTI: Connected Vehicle Data to Improve Driving in Nevada					
		Government Technology: Keeping Nevada's Drivers Safe and Connected					
		Nevada Revised Statutes: Chapter			✓		

Main Category	Subcategory	Item Collected	Comm	Ops	Partner	Data	Tech
		482A – Autonomous Vehicles					
		Nevada Legislative Counsel Bureau – Research Brief on Autonomous Vehicles					✓
	Vehicle Conditions	High-Resolution Micro Traffic Data From Roadside LiDAR Sensors for Connected Vehicles and New Traffic Applications					✓
		AASHTO Journal: Expansion in the Works for Nevada Smart Roadway Project					✓
Communications	Fiber	Nevada State Broadband Connectivity Strategy	✓		✓	✓	
		Public Safety Communications Revolution – Our Broadband Future Presentation	✓		✓		
	Wireless	Nevada Shared Radio System (NSRS) Existing System Analysis and P25 System Requirements Report					
		Nevada Shared Radio System (NSRS) Replacement Presentation					✓
		System Site Location Data Report for: Nevada Shared Radio System					
		NDOT Land Mobile Radio (LMR) Services					
Other Studies	General	NDOT Statewide Transportation Systems Management and Operations (TSMO) Program Plan			✓	✓	✓
		NDOT TSMO Business Case		✓			✓
		Case Study – NDOT TSMO Investment Prioritization Tool				✓	
		One Nevada Transportation Plan	✓		✓	✓	✓
		One Nevada Transportation Plan – I-15 Critical Corridor Plan	✓		✓	✓	✓
		One Nevada Transportation Plan – US-93 Critical Corridor Plan	✓		✓	✓	✓
		NDOT Rural Intelligent Transportation Systems (ITS) Strategic Deployment Plan (SDP)	✓		✓		✓
		Statewide ITS SDP (Addendum 1 to NDOT Rural ITS SDP)	✓			✓	✓
		NDOT Signal, Lighting, and ITS Design Guide	✓		✓		✓
		NDOT Smart Mobility Plan		✓	✓	✓	✓
		NDOT Fully Compliant Transportation Asset Management Plan (TAMP)				✓	
		Regional Transportation Commission of Southern Nevada		✓			✓

Main Category	Subcategory	Item Collected	Comm	Ops	Partner	Data	Tech
		(RTC SNV) Access 2050 Plan					

C1. Freeway Management

Existing documentation as it relates to freeway management is included in the following subsections.

C1.1 General

Study Name: NDOT Nevada Architecture 2019 Summary Assessment

Completion Date: April 2019
Author: NDOT (Consultant: Kimley-Horn)
Summary: The Nevada Architecture 2019 Summary Assessment summarizes the 2019 Update to the ITS Architectures originally developed for the Northern Regional ITS Architecture in 2004 and the Southern Regional ITS Architecture in 2005. An update from the original architecture had been completed in 2007 to ensure the National ITS Architecture (NIA) updates were incorporated. The 2019 update provided comprehensive documentation of the existing and future plans for the ITS infrastructure systems, and agency responsibilities for ITS functionality within Nevada. The document summarizes new service packages in the National ITS Architecture, updates to the Northwest, Southern, and Statewide Nevada ITS Architectures, the Architecture Maintenance Plan, and the federal compliance for the updated architecture.

- **Communications Strategies:** Implementation of national standards for communication between ITS devices and data collection and data exchange is recommended by the plan. The plan also recommends the implementation of DSRC capable field devices to enable CV roadside equipment.
- **District Operations Strategies:** A greater ability for device communication with technology such as CVs will be needed.
- Partnership Strategies: N/A – The ITS Architecture was updated as part of this project to include recommendations developed by the project.
- **Data Strategies:** Data must be shared with state, local, and public entities per federal regulations. Data is typically stored at the Nevada Data Exchange, the state repository that houses all traffic, incident, and weather-related data.
- Technology Strategies: N/A – The ITS Architecture was updated as part of this project to include recommendations developed by the project.

C1.2 Managed Lanes, Ramp Metering, and Reversible/Flex Lanes

Study Name: Managed Lanes and Ramp Metering Manual

Completion Date: December 2013
Author: NDOT (Consultant: Jacobs Engineering Group Inc.)

Summary: The Managed Lanes and Ramp Metering Manual provides an update to the 2006 version of the "HOV/Managed Lanes and Ramp Metering Manual". The update outlines the NDOT policies and procedures that guide managed lanes and ramp metering facilities in Nevada. The manual consists of five sections:

- Part 1: Introduction and Policies
- Part 2: Implementation Plan
- Part 3: Design Manual
- Part 4: Ramp Metering Performance Measurement Plan
- Part 5: Public Outreach Primer (remained unchanged from 2006 Manual)

- **Communications Strategies:** Ramp meters must be phased in sequence and provide communication to the Traffic Management Center. Radio frequencies or optical scanning should be used for electronic toll collection systems.
- District Operations Strategies: N/A
- **Partnership Strategies:** Plan recommends partnership between NDOT, local agencies and federal agencies, including MPO's, transit providers, local roadway implementing agencies, enforcement agencies, the FHWA and FTA.
- Data Strategies: N/A
- **Technology Strategies:** Any ITS technology recommendation related to managed lanes and ramp metering from the ITS Master Plan will need to reference this document. Plan recommends consideration of electronic toll technology, including automatic license plate recognition technology.

Study Name: Feasibility of Using Video Cameras for Automated Enforcement on Red-Light Running and Managed Lanes

Completion Date: December 2009
Author: NDOT
Summary: The feasibility, effectiveness, legality, and public acceptance aspects of automated enforcement on red light running and HOV occupancy requirements using video capturing systems within Nevada were evaluated as part of this study. Red-light running is a major cause of fatal crashes at signalized intersections and many studies have proved the effectiveness of red-light running cameras in reducing these types of crashes. Automated enforcement is not legal in Nevada, but the results of this study could be used to support legislative changes in this matter. A poll of 1,833 individuals was completed as part of this effort to measure public acceptance. Major findings from the poll include:

- Approximately 63% of respondents would support automated red-light running enforcement
- Approximately 58% of respondents would support legislation to permit giving traffic citations to drivers running red lights based on video evidence
- Crash data from 2005 to 2008 indicated red-light running accounted for a significant portion of total crashes in urban areas

- Local agencies identified key steps required success in red-light camera enforcement to include public education, media campaigns, crash statistics, revenue sharing, selection of intersections, and selection of technology and vendors.
- Research shows that video camera enforcement has proven effective at determining compliance with vehicle occupancy requirements in HOV and high-occupancy toll lanes, but enhancements would be required for implementation
- As of 2009 none of the research had identified an effective and reliable system for implementation as a primary HOV occupancy enforcement strategy.
- 43% of respondents would support the use of photo-HOV occupancy enforcement
- 40% of respondents would support legislation for HOV lane occupancy enforcement

The study recommends that the State grant temporary provisions permitting the use of video cameras at certain intersections to evaluate the safety effects of this technology. The information found in this document provides for new and innovative ITS technologies to increase NDOT's capabilities to increase safety and ensure better reliability, mobility, and overall performance of the transportation system. General recommendations of the latest technology as of 2022 from this study can be included in the ITS & ATM Master Plan.

- Communications Strategies: N/A
- **District Operations Strategies:** Plan outcomes would require significant operational capabilities, including IT capabilities to collect, examine, and disburse data collected through photo-HOV technology.
- **Partnership Strategies:** Partnership between NDOT, NHP, and other local law enforcement and municipal entities would likely be required. Legislative approval would be required to legalize red-light enforcement technology in Nevada.
- **Data Strategies:** Plan requires secure data processing, transfer, and storage.
- **Technology Strategies:** Photo-HOV occupancy enforcement technology. The plan proposes use of automated enforcement technology. Several different types of camera system are discussed, including camera systems capable of viewing the entire intersection area, giving context to red-light violations. The plan also suggests that radar detection for HOV occupancy would not be feasible.

Study Name: Southern Nevada HOV Plan Update

Completion Date: July 2015
Author: NDOT (Consultant: Jacobs)
Summary: The Southern Nevada HOV Plan Update provides additional information about future high-occupancy vehicle (HOV) lane facilities in Southern Nevada. The Original Plan, completed in 2007, included information about the usefulness of HOV facility implementation to alleviate expected future congestion. Changes to the Original Plan include:

- Implementation and programming of the highest priority elements of the HOV system recommended in the Original Plan
- Updates to the RTC's Regional Travel Demand Model to account for mode-choice elements
- Update to the NDOT Managed Lanes and Ramp Metering Manual

An evaluation of the candidate HOV lane corridors and HOV direct-access ramps around the Las Vegas Valley was conducted. The evaluation criteria followed the NDOT Managed Lanes and Ramp Metering Manual as follows:

- Congestion and bottlenecks
- HOV demand
- Travel time savings
- Transit service
- Available space
- Connectivity and continuity

The evaluation resulted in the following list high potential for successful HOV facilities for implementation, these recommendations will be taken into consideration for the evaluation of priority corridors as part of the ITS & ATM Master Plan.

- I-15 from St. Rose Parkway to Lake Mead Boulevard
- I-515 from I-215 to I-15
- US 95 from I-15 to Elkhorn Road
- I-215 from I-15 to I-515
- CC-215 (Southern and Western Beltway) from I-15 to Summerlin Parkway
- Summerlin Parkway from US 95 to Rampart Boulevard

Some segments warrant multiple HOV lane facilities by year 2035, these include:

- I-15 from I-215 to US 95/I-515
- US95 from I-15 to Summerlin Parkway
- I-215 from I-15 to Airport Connector

HOV Direct-Access Ramps

- Along I-15
  - Blue Diamond Road (Ramps to/from the north – from/to the west)
  - Hacienda Avenue (ramps to/from the south)
  - Harmon Avenue (ramps to/from the north)
  - Meade Avenue (ramps to/from both directions)
  - I-15/I-215 interchange direct-access flyover ramps (ramps to/from the north – from/to the east and ramps to/from the north – from/to the west)
- Other Freeways
  - Maryland Parkway on I-515 (ramps to/from both directions)
  - Smoke Ranch Road on US 95 (ramps to/from both directions)
  - Elkhorn Road on US 95 (ramps to/from the south)
  - Airport Connector on I-215 (ramps to/from the north - from/to the west)
  - Sunset Road on CC-215 (ramps to/from both directions)

Additional short- and long-term recommendations are included in the report, such as additional HOV considerations, direct access/flyover facilities, and some other facilities which have already been constructed.

- Communications Strategies: N/A
- **District Operations Strategies:** Implementation of additional HOV lanes and facilities would require additional operational strategies, including tolling techniques, pricing policies, enforcement mechanisms, and management strategies. Bus rapid transit operations was identified as a possible future expansion of this project.
- **Partnership Strategies:** The City of Las Vegas is identified as a partner with NDOT in the US 95 Northwest expansion project.
- **Data Strategies:** HOV infrastructure can be used to implement coincident ITS devices. The plan calls for vehicle occupation counts, and other data tracking such as travel time, time savings, and modifications to usage and rideshare statistics after a period to ensure the HOV system is providing the intended benefits.
- **Technology Strategies:** Plan recommends congestion control measures, including tolling technology.

Study Name: Southern Nevada HOV Plan Addendum

Completion Date: October 2018
Author: NDOT (Consultant: HDR and CA Group)
Summary: The Southern Nevada HOV Plan Addendum – Direct Access Drop Ramp Reevaluation (HOV Addendum) updated the Southern Nevada HOV Plan. The HOV Addendum provides new information, including updated development plans since the previous publishing. Additional major developments, such as Allegiant Stadium, and the planned monorail extension to Mandalay Bay. The report specifically outlines the review, refinement, and application of the Regional Transportation Commission of Southern Nevada's (RTCSNV) travel demand model for development of HOV facilities at the 2040 horizon year. The addendum only analyzes HOV direct-access and system-to-system HOV ramp locations along I-15 south of I-515 and I-515 directly east of I-15. There is some potential for priority corridor identification due to the use of the interstate highway system. This document provides an evaluation of current and planned HOV facilities in Las Vegas, which address future needs and potential ITS and ATM strategies which benefit NDOT's traffic congestion and safety performance of the transportation system.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** The City of Las Vegas was identified as a stakeholder/partner in this project.
- **Data Strategies:** HOV infrastructure can be used to implement coincident ITS devices. The plan calls for occupation counts, and other data tracking to ensure the HOV system is providing the intended benefits. Additional ITS and ATM strategies may become available in the future via emerging technologies as well.
- Technology Strategies: N/A

C1.3 ATM

Study Name: NDOT Active Traffic Management (ATM) System Concept of Operations

Completion Date: Updated March 2019

Author: NDOT (Consultant: Kimley-Horn)
Summary: NDOT pursued the development of a Concept of Operations (ConOps) in 2014 for its first ATM system that would be deployed on segments of I-15 and US-95. After the ConOps was completed, as part of Project NEON, NDOT initiated the development of ATM software along with the construction of ATM components, anticipated to be completed in February 2019. The 2019 ConOps update achieves the following objectives:

- Summarize changes made to the ATM system during system development and implementation;
- Update roles and responsibilities for the ATM system per existing agency roles and initiatives; and
- Identify new and updated concepts and operation scenarios for the ATM system to allow enhanced support for public safety, incident management, and traffic management.

- **Communications Strategies:** The plan identifies the benefits NDOT has by doing much of its own in-house ITS central software, so there are few data communications issues as ITS capabilities expand. The ease of data communication is magnified because few proprietary communication protocols are used.
- **District Operations Strategies:** Implementation of the ATM system requires vast operations capabilities and management of specific applications and user-interfaces. The plan recommends use of real-time and location data to operate efficiently.
- **Partnership Strategies:** A co-located operations center operated by NDOT, RTC, and NHP already exists, and is controlled by FAST.
- **Data Strategies:** The plan recommends that data be communicated consistently via DMS and ATM and that collected data and data strategies allow for flexibility of collection intervals in the future.
- **Technology Strategies:** The plan recommends that manual entries be allowed on specific ATM signs, with additional capabilities to allow new technology in the future. Hard shoulder running should be able to be implemented in the future according to NDOTs wishes.

Study Name: NDOT ATM SOPs Draft Checklists

Completion Date: N/A
Author: NDOT
Summary: This document provides checklists for initiation, monitoring, and close out of planned and unplanned events which negatively impact major road facilities on Nevada's transportation network. The checklists cover steps which should be taken to ensure drivers are made aware of closures or hazards involving shoulders, lanes, or an entire roadway via DMS. A list of incidents or events to look for is also included with each type of closure or restriction. This document provides guidance to help NDOT quickly ensure information is being delivered effectively to road users and maintenance or emergency response crews. The use of ITS and ATM strategies improve NDOT's capabilities to ensure safety, reliability, mobility, and overall performance of the transportation system.

- Communications Strategies: N/A

- **District Operations Strategies:** Plan outlines operation procedure for ATM and DMS messaging based on current road conditions as observed through CCTV or other devices.
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: NDOT Active Transportation Demand Management Cohort Meetings Notes

Completion Date: N/A
Author: NDOT
Summary: This document summarizes the beginning conversation as part of a Federally funded cohort of agencies to discuss active traffic demand management strategies including ATM, integrated corridor management, and other types of active strategies. The information in this document reports what NDOT has experienced thus far in the use of the ATM system and as the Cohort continues over time may offer additional insights from which NDOT can learn from others.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C1.4 Third Party Data

Study Name: Rekor.ai (previously Waycare Tech)

Completion Date: January 2022
Author: Rekor Systems, Inc
Summary: Rekor AI provides roadway intelligence information to help increase safety and efficiency of road networks. Rekor assists transportation departments, government agencies, law enforcement, and engineering firms with roadway monitoring and response, real-time traffic analysis, public safety, and live and archival traffic views. Rekor is an emerging AI application.

- **Communications Strategies:** Website outlines need to better communicate data in real-time, along with perceived benefits of faster data analysis using AI and other proprietary technology.
- **District Operations Strategies:** Rekor already partners with RTC of Southern Nevada and NDOT as part of contracts to provide incident management support using data processing and analysis. A partnership between NDOT and Rekor Systems would require operational changes to data architecture, storage, security systems, and other operations.
- Partnership Strategies: N/A.
- **Data Strategies:** Data management and increased data collection efforts as well as an increased ability to collect additional data types is a main capability of Rekor Systems.

- **Technology Strategies:** Website documents that many types of technology, both existing devices and emerging ones, can be used to gather data that are useable by the software.

C2. Arterial-Freeway Coordination

C2.1 General

Study Name: Carson Area Metropolitan Planning Organization (CAMPO) Regional Arterials Concept Inventory

Completion Date: August 2019
Author: CAMPO
Summary: In response to rapid population growth, an Arterials Study was including a Regional Arterials Concept Inventory (RACI) which looked at high-level concept improvements and took an unconstrained look at possible improvements in the area. The RACI provided vital data for analysis, and functions as a forum for local and regional planning organizations and governments. The main goals of the RACI were to provide a planned hierarchy of adequately spaced roads of varying type to better address flexible transportation needs of both goods and people. Multi-modal travel was also examined as part of the study. An important finding of the study is that travel demand across the area is expected to double by 2045. This document provides important information about the future to improve safety, reliability, mobility, and overall performance of the transportation system in the Carson Area.

- **Communications Strategies:** Plan recommends updating infrastructure to respond to CAV vehicles and other vehicle to vehicle communications. The plan also recommends deployment of Signal Phase and Timing (SPaT) to use DSRC communications.
- **District Operations Strategies:** An important finding of the study is that travel demand across the area is expected to double by 2045. The plan recommends the establishment of a "Combined Transportation, Emergency & Communications Center" to aid in operational management and address current and future growth in the Capital region.
- **Partnership Strategies:** Plan recommends creation of a stand-alone agency with a primary focus on transportation operations and management for the region. Local and reginal planning organizations also participated in the CAMPO development.
- **Data Strategies:** Plan encourages increasing data sharing capabilities between devices and agencies based on example studies. Additionally, a RACI was conducted.
- **Technology Strategies:** The plan recommends deployment of Signal Phase and Timing (SPaT) to use DSRC communications.

Study Name: Traffic Prediction and Responses through Data Mining and Data Stream Processing

Completion Date: March 2015
Author: NDOT (Consultant: AEM Corporation)

Summary: This study assesses the ability of existing traffic operations data streams to incorporate data mining and data stream processing into decision making processes. Given the large number of sensors in the Las Vegas Resort Corridor, the quality and type of data generated, there is potential for proactive traffic management to occur. Potential improvements to the ITS infrastructure are also recommended, including development of additional data collection capabilities, and development of sensor priority schemes to better predict/manage traffic based on locations of high congestion or interest.

- **Communications Strategies:** Study recommends improvements in sensor communication and inclusion of data related to special events, construction zones, incidents, and weather to proactively manage traffic and stream data. Information is currently relayed from the device to the TMC via fiber. It is noted that wireless communication needs to be further examined for efficiency and reliability.
- **District Operations Strategies:** Study suggests making operational improvements related to what types of data are streamed, especially concerning special events, construction zones, incidents, weather, and historical traffic data.
- **Partnership Strategies:** Plan recommends possible partnerships between hotels, casinos, resorts, and conference centers to coordinate efforts and collect data.
- **Data Strategies:** Plan recommends increased levels of data mining, such as collecting more of the data available or utilizing devices full capability, and the incorporation of data streaming to allow for greater data collection using both existing and future architecture. Increased data analysis capabilities can help detect problems in real-time and analyze historical data to identify trends.
- **Technology Strategies:** Currently, FAST uses two types of sensors: Image Sensing System (ISS) and Wavetronix radar sensors which use both wired and wireless connections. Plan recommends continued use of innovation, including new and emerging technologies. ITS devices, network capabilities, and open-source software are included.

C2.2 Integrated Corridor Management (ICM)

Study Name: Western States Rural Transportation Consortium One-Stop-Shop

Completion Date: Updated June 2020
Author: Western Transportation Institute
Summary: The One-Stop-Shop provides travelers in the west with real-time data for use during trip planning. The available data includes routing, imagery, weather, elevations, rest areas, and other points of interest. The One-Stop-Shop is updated periodically to help incorporate user feedback.

- Communications Strategies: N/A
- **District Operations Strategies:** Website communicates data from sensors to aid in trip planning in the Western States.
- **Partnership Strategies:** Website was created using a partnership between Utah State University and State DOTs.
- Data Strategies: N/A

- Technology Strategies: N/A

Study Name: Weather Share

Completion Date: Updated June 2020
Author: Western Transportation Institute
Summary: The Weather Share interactive map contains clickable datapoints which include Active CMS, CCTV Camera, Construction information, RWIS with Road Temp less than or equal to 32 degrees Fahrenheit, Inactive CMS, Chain Restriction, Incident, and Commercial Vehicle information. The data is updated regularly.

- Communications Strategies: N/A
- **District Operations Strategies:** Website communicates data from sensors to aid in trip planning in the Western States.
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Western States Integrated Corridor Management Tool

Completion Date: Updated May 2010
Author: Western Transportation Institute
Summary: The Integrated Corridor Management tool helps coordinate individual network operations between parallel facilities and routes to help create an interconnected system across multiple state DOTs.

- **Communications Strategies:** Website communicates data from sensors to aid in trip planning in the Western States.
- **District Operations Strategies:** Website goal is to move focus from individual system components to an integrated approach for system optimization.
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Integrated Corridor Management Weather Share Map

Completion Date: Updated May 2010
Author: Western Transportation Institute
Summary: The Integrated Corridor Management Weather Share map is like the regular Weather Share map; however, it separates interactive data by state DOT. Users must first zoom towards or click on a state before data points will appear.

- **Communications Strategies:** Website communicates data from sensors to aid in trip planning in the Western States.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A

- Technology Strategies: N/A

C2.3 Bicycle/Pedestrian Detection

Study Name: Regional Bicycle and Pedestrian Plan for Southern Nevada

Completion Date: April 2017
Author: RTC SNV (Consultant: Alta and CH2M)
Summary: The guiding vision of the Regional Bicycle and Pedestrian Plan for Southern Nevada is to "develop a safe, connected, and convenient walking and bicycling system that serves as a viable transportation and recreation asset, while advancing the region's economic, education, health, and environmental goals." The goals of the plan include increasing comfort, safety, access, education, equity, and health. The study identified several concerns, among these were safety, weather, and inconvenience. Three desired improvements are also listed: better network facilities, more regional paved trails, and more safe routes to school. Recommendations from the study include wider and more separated paved bike lanes and sidewalks, with more regional paved shared use paths, and safer routes to school. Development of a more robust bicycle and pedestrian network will help increase the safety and efficiency of transportation in Southern Nevada.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** Plan suggests partnerships with existing local organizations such as bicycle clubs, advocacy groups, PTOs, and business sponsors. Other public-private partnerships should be considered.
- Data Strategies: N/A
- **Technology Strategies:** Bike lane crossings at entrance and exit ramps are cited as potentially needing design features (which could include technology) to support active transportation movement across freeway facilities. Additional detection at "enhanced intersections" that may connect to traffic signals for actuation or timing adjustments is a demonstrated need. This also includes active warning beacons and other types of signalized and protected crossings.

Study Name: Nevada County Bicycle Master Plan

Completion Date: December 2016
Author: NCTC (Consultant: Fehr & Peers)
Summary: The Nevada County Transportation Commission's vision is to provide reliable bicycling facilities by increasing safety, design quality, and implementing support facilities. Development of a bicycling master plan will improve the jurisdictions access to funding and will help increase bikeable access to the City of Grass Valley, Nevada City, and the Town of Truckee. All three of these locations have dense downtown areas where bicycle access would be ideal in the future. The vision and goals of this study promote safety, efficiency, and mobility in rural and more urban areas.

- Communications Strategies: N/A
- District Operations Strategies:

- **Partnership Strategies:** Plan suggests partnerships between the nine local bike shops and Nevada County law enforcement and other agencies.
- Data Strategies: N/A
- **Technology Strategies:** Signal bike detection in the bike lane or video image detection that may connect to traffic signals for actuation or timing adjustments is noted in the plan. This also includes active warning beacons and other types of signalized and protected crossings.

C3. Crash Prevention and Safety

C3.1 General

Study Name: Nevada Strategic Highway Safety Plan

Completion Date: February 2021
Author: NDOT (Consultant: Kimley-Horn)
Summary: Nevada's Strategic Highway Safety Plan (SHSP) is a statewide safety plan and framework for reducing fatalities and serious injuries on Nevada's roadways. The SHSP establishes goals and strategies developed in collaboration with federal, state, local, and private-sector safety stakeholders. The SHSP is updated every five years. The SHSP Action Plan is a supplemental document to the SHSP and identifies the specific action steps and output measures for strategies within the SHSP. The Action Plan is updated annually, or as action steps are completed. The 2021-2025 SHSP adopted four (4) guiding principles: incorporate equity, prioritize safe speed, double down on what works, and accelerate advanced technology. The SHSP supports advanced technologies as a safety measure by partnering with technology providers, health and safety groups, manufacturers, and government agencies.

- **Communications Strategies:** Plan recommends advanced technology implementation due to the ability for road users to communicate with the built environment and each other.
- District Operations Strategies: N/A
- **Partnership Strategies:** Plan recommends establishing partnerships with technology providers, health and safety groups, manufacturer, and government partners to prioritize safety. Opportunities to partner with large corporations or institutions are also recommended. Specifically named partners are located on page vi of the report (there are 21 partners including NDOT).
- **Data Strategies:** Annual data review is recommended to ensure performance measure targets are met. A strong emphasis on improving data availability, quality, and analysis capabilities is given.
- **Technology Strategies:** NDOT should consider use of infrastructure and technology to manage target speeds and increase safety. CAV technology adoption is recommended because of increased communication capabilities with the built environment and other vehicles. Waycare (Rekor) AI technology implementation is also suggested. NDOT should examine existing partnerships between DOTs and Rekor and consider its own partnership.

Study Name: Nevada Strategic Highway Safety Plan – Crash Facts

Completion Date: February 2021
Author: NDOT (Consultant: Kimley-Horn)
Summary: The SHSP – Crash Facts is a supporting document to the SHSP, providing fatal and serious injury crash details by SHSP emphasis area. The current crash facts include information from 2015-2019.

- Communications Strategies: N/A
- **District Operations Strategies:** Key corridors highlighted within the crash facts with prevalent safety challenges should be considered for technology and operational improvements.
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** Key corridors highlighted within the crash facts with prevalent safety challenges should be considered for technology and operational improvements.

Study Name: NDOT Safety Management Plans

Completion Date: N/A
Author: NDOT
Summary: Safety Management Plans (SMPs) analyze safety issues and concerns in specific areas by incorporating crash data, accessibility, public and stakeholder input and roadway engineering with a goal to improve safety, mobility, and connectivity for all road users. Many SMPs have not been conducted on NDOT roadways. ITS could likely be used on the roadways examined, however unless NDOT maintains specific roads or intersections located along the corridor of a completed SMP, there likely are no ITS devices in place.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C3.2 Monitoring/Detection

Study Name: Nevada company records traffic cameras, catches more than just traffic

Completion Date: August 2020
Author: KNTV 13 Investigates
Summary: This news article discusses camera footage captured by NDOT traffic cameras. The footage, which has only recently started being recorded, has provided valuable information to investigators looking into an airplane crash, a freeway shooting, or other criminal misconduct. Legally, the footage cannot be used to issue traffic citations. In the future, the camera system may be able to help increase safety and efficiency through observability. CCTV cameras are an important aspect to ITS technology.

- Communications Strategies: N/A

- **District Operations Strategies:** National Traffic Video records footage from CCTV cameras and can subsequently provide to law enforcement. Footage cannot be used to issue citations but can be used to show other criminal misconduct. NDOT should consider new uses of shared camera images prior to policy changes.
- Partnership Strategies: N/A
- **Data Strategies:** Article states that a third-party company records the footage. Data storage is paid for by insurance companies and attorneys who purchase the video.
- Technology Strategies: N/A

C3.3 Bicycle/Pedestrian Crossings

Study Name: Pedestrian Safety Improvement Evaluation Guideline for Uncontrolled Crossings

Completion Date: Updated April 2018
Author: NDOT
Summary: Pedestrian Safety Improvement Evaluation Guideline for Uncontrolled Crossings provides a decision matrix for selecting the appropriate pedestrian improvement at roadways based on average daily traffic, posted speed limit, and general roadway cross section. The outlined process helps to increase the safety of pedestrian crossing in urban areas, providing opportunities for ITS or ATM technologies to be implemented.

- Communications Strategies: N/A
- **District Operations Strategies:** Plan provides a decision matrix and variable solutions for safety improvement implementation.
- Partnership Strategies: N/A
- **Data Strategies:** Data collected in the field at locations of interest by the person evaluating the location. Other data, such as pedestrian crash data, physical characteristics of the location, volumes, generators, and other data can be used as well.
- **Technology Strategies:** Plan recommends use of RRFB, overhead RRFB, curb extensions, enhanced lighting, and PHB to increase safety. Several alternate designs are also presented, such as pedestrian fencing, curb extensions, and the danish crossing.

C3.4 Signalization

Study Name: Advance Signal Warning Systems (https://www.nvsafesignals.com/)

Completion Date: N/A
Author: NDOT
Summary: NDOT is updating the use and placement of Advance Signal Warning Systems (ASWS) across the state. The goal is to implement a unified approach across the state so that ASWS can be reliable and easily identified in all instances. The webpage also states that "this will enhance the safety of the traveling public and promote safer driver behavior" with a continued comment that reductions in travel speeds have resulted from similar changes in other states.

Uniformity of ASWS will help increase safety, reliability, mobility, and overall performance of the transportation system in Nevada.

- **Communications Strategies:** Signals may need to be outfitted with equipment to communicate with ASWS systems.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** A study was conducted in 2019 to establish guidelines for ASWS system selection and implementation. Some signals may change timing based on ASWS system installed. Static, passive, and active systems exist that can be implemented. Plan recommends implementation of different systems at different locations based on field conditions.

C3.5 Animal Crossings

Study Name: Deer Migration and Tracking Maps

Completion Date: January 2010
Author: Nevada Department of Wildlife
Summary: This map shows the movement patterns of five mule deer throughout the movement's seasons of Fall 2008-Fall 2009. This resource can be used to help determine the best locations for wildlife warning systems on Nevada's roads.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- **Data Strategies:** Data was collected via tracking collars/devices on animals. This can show priority corridor areas for animal crossing safety concerns.
- **Technology Strategies:** Priority corridor areas are shown for animal crossing safety concerns.

C3.6 Wrong-Way Driving (WWD)

Study Name: NDOT Wrong Way Driver System

Completion Date: Webpage
Author: NDOT
Summary: This webpage provides information about the NDOT Wrong Way Driver System. Signs are placed on offramps, which use closed-circuit cameras to automatically detect wrong way drivers and attempt to alert them using flashing lights. The webpage also provides safe driving tips, including what to do if a wrong-way driver is encountered. The Wrong Way Driver System can use ITS capabilities to increase safety, reliability, mobility, and overall performance of the transportation system.

- **Communications Strategies:** ITS technology can instantly communicate with road users, alerting drivers of their direction of travel. WWD can alert NDOT or FAST of the presence of wrong way drivers immediately.
- **District Operations Strategies:** Automated WWD alerts are sent to NDOT ROC and FAST TMC. The outlined response protocol should be followed, and DMS should be updated accordingly.
- **Partnership Strategies:** Partnership with DPS Dispatch, DPS – NHP, Wrong-Way Driver Detection Systems, Local Police or Fire, Local media, and NDOT ROC or FAST TMC staff should communicate in a timely manner when WWD notifications are received to disseminate information.
- Data Strategies: N/A
- **Technology Strategies:** High visibility, real-time warning detectors are located at various locations. Red flashing beacons are triggered to alert the driver, and an automated alert will be sent to operations staff. NDOT should pursue WWD technologies.

Study Name: Wrong-Way Driver Response Guidelines

Completion Date: April 2020
Author: NDOT Traffic Operations Division
Summary: Statewide guidelines were developed for response to notification of a wrong-way driver (WWD) to create a standardized and effective procedure used by NDOT, RTC FAST, and DPS-NHP in response to wrong-way driver notifications. Additionally, the document defines when alert messaging is required, the process to confirm a WWD incident, and when messaging can be terminated.

- Communications Strategies: N/A
- **District Operations Strategies:** This document defines operational procedures, responsibilities, and actions as related to wrong-way driver notification and action. Specific DMS messages for Type 1 and Type 2 DMS boards are provided. Messages will be used in both directions, on all potential routes of travel, up to 10 miles from the reported location, or where DMS are available.
- **Partnership Strategies:** Notification of a wrong-way driver is suggested to be coming from DPS – Dispatch, DPS – NHP, Local Police, Local Fire, and Local Media. The establishment of an official Wrong-Way Driver Detection System (WWDDS) that interacts and is integrated into the NDOT ATMS will likely require updating of these guidelines to incorporate automated WWD detection from in-field devices as well as notifications.
- **Data Strategies:** The established WWDDS will be owned and managed by NDOT and provide automated notifications of a wrong-way driver.
- Technology Strategies: N/A

C3.7 Rural Intersection VSL

Study Name: Why no snow/ice speed limit in Nevada?

Completion Date: January 2016
Author: Mark Robison, Reno Gazette Journal
Summary: At the time of publication, Nevada had only implemented variable speed limits (VSL) in two areas in Washoe County, however there were plans for further implementation in Las Vegas (which has since been implemented). VSL for snow/ice had not been implemented mainly due to rapidly changing conditions, and NDOT wanted to ensure drivers were not feeling pressured to drive at speeds other than what they felt comfortable with. VSL can impact and improve safety, reliability, mobility, and overall performance of the Nevada Transportation system.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** VSL is operated using electronic signs which allow for speed limit adjustment during inclement weather. NDOT should consider VSL implementation where appropriate, as has been done in other western states such as Utah and Wyoming.

C4. Road Weather Management

C4.1 Visibility

Study Name: NDOT Road Weather Information System (RWIS) Master Plan

Completion Date: March 2021
Author: NDOT (Consultant: Atkins)
Summary: The NDOT RWIS Master Plan was developed to guide the state's use of RWIS technology to harness its full range of benefits which can improve traffic operations, safety, and travel time reliability. The Plan reviews nationwide practices and provides a summary and pros and cons of emerging technologies., The Plan also develops recommendations for implementation, maintenance, and performance tracking of the devices. Collected data is stored in the 511 system, with some data being publicly available for up to 30 days before being migrated to storage, while other data is only available to NDOT.

Several technologies, including Environmental Sensor Stations (ESS) which are typically used to measure atmospheric, pavement, water level, and/or visibility conditions. Typical sensors include a thermometer, anemometer, visibility sensor, wind vane, rain gauge, and pavement sensor. RWIS systems in the field have communications, ESS, and central systems which develop forecasts and provide weather information in readable forms to a user. Site selection guidelines have been developed to improve data accuracy by deploying devices in similar conditions. Emerging RWIS technology which should be considered for integration into RWIS capabilities include:

- Mobile RWIS - which are attached to road maintenance vehicles
- Remote monitoring sensors - which measure pavement friction in winter conditions by communicating with maintenance vehicles

- Intelligent Decision Support Systems (IDSS) - can be added to existing RWIS and are customizable. Real-time data can be computed in a similar manner to current MDSS capabilities which provide treatment recommendations to maintenance crews.
- Connected Vehicle (CV) Technology – data are collected via built in sensors in connected vehicles and relayed in real time to data hubs. CVs are an emerging technology, and capabilities for data collection and use should be examined further.

Performance management recommendations include two main categories, operations and maintenance, and road network improvements. Additionally, system upgrades, emerging technology integration, and a more robust site selection framework or prioritization criteria should be considered for permanent implementation into the RWIS project.

- **Communications Strategies:** Integration of WebRelay to enable performance measurement using historical data.
- **District Operations Strategies:** Plan recommends development of standardized performance measurements and system upgrades to allow remote video monitoring.
- **Partnership Strategies:** Partnerships with meteorological companies to obtain data which can be used for planning, including the National Weather Service has been beneficial in the past.
- **Data Strategies:** Data is produced in real-time by sensors at various locations. Data can be communicated to decision makers but is also stored for different periods of time. Data is also stored long term by NDOT. Data types gathered by RWIS devices include air temperature, wind speed, wind direction, gust speed, gust direction, visibility, relative humidity, dew point, precipitation, precipitation rate, pavement temperature, icing sensors, pavement subsurface temperatures.
- **Technology Strategies:** New and emerging technology can be incorporated into RWIS system capabilities. Recommended technologies include Portable ESS and Intelligent Decision Support Systems (IDSS). Other emerging technologies include Mobile RWIS and other proprietary products.

Study Name: NDEX Road Weather Information System

Completion Date: Website
Author: NDOT
Summary: The NDEX RWIS website provides NDOT ITS weather data in different visual and graphical formats including a map view, a table view, and a temperature and speed graph. For data within the most recent 24-hour period, data is displayed in 5-minute increments. For data within the most recent 30-day period, data is displayed in hourly increments. For data beyond the most recent 30-day period, data is displayed in daily increments. The temperature and speed graph is limited to the most recent 24-hour period.

Per the RWIS Master Plan, data collected by the sensors are sent to Road Operations Center and Traffic Management Center operators through polling software. ATMS software also processes and transfers weather data to internal NDOT systems as well as public websites.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A

- Data Strategies: N/A
- Technology Strategies: N/A

C4.2 Vehicle Integrating Mobile Observations (IMOs)

Study Name: Integrating Mobile Observations about Road Weather Conditions for Decision-Making

Completion Date: June 2019
Author: NDOT
Summary: This presentation outlines NDOT's Weather Responsive Management Strategies (WRMS) framework and provides information on NDEX device types. Per the presentation, NDEX has 135 NDOT Environmental Sensor Stations (ESS) and approximately 60 Mobile Environmental Sensor Stations (mESS).

- Communications Strategies: N/A
- **District Operations Strategies:** For traffic management purposes, it is recommended to email alerts to the Road Operations Center, include the NOAA watch, warning, and alert information, and integrate with 511 and Spillman CAD.
- **Partnership Strategies:** Continue to provide mESS and ESS data to the Weather Data Environment (WxDE).
- **Data Strategies:** Continue to provide mESS and ESS data to the Weather Data Environment (WxDE).
- **Technology Strategies:** It is recommended to implement snowplows with Cirus spreaders.

Study Name: Maintenance Decision Support System: Pilot Study and Cost-Benefit Analysis (Phase 2)

Completion Date: July 2014
Author: NDOT
Summary: This project provides information on the development of in-vehicle hardware that supports a Maintenance Decision Support Systems (MDSS) for NDOT, as well as the development of software capable of collecting and processing road and weather data. The MDSS is intended to help operations managers more efficiently utilize winter maintenance resources by collecting and interpreting road and weather data. The study concludes that implementation of an MDSS would results in significant cost savings while maintaining the same level of service. The study also highlights challenges to an MDSS in Nevada including substantial areas with little to no cell phone coverage and a lack of understanding of where along snowplow routes material is being used.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** NDOT may need to license from Concaten/IWAPI or find an alternative method of transferring data to and from snowplows if the Concaten/IWAPI patents are not challenged or an agreement is not reached.

- Data Strategies: N/A
- **Technology Strategies:** NDOT may need to license from Concaten/IWAPI or find an alternative method of transferring data to and from snowplows if the Concaten/IWAPI patents are not challenged or an agreement is not reached.

Study Name: Podcast Episode 27: Integrated Mobile Observations at the Nevada DOT

Completion Date: October 2019
Author: SICOP Talks Winter Ops
Summary: This podcast discusses NDOT's involvement with IMO with input from Rod Schilling, Chief Traffic Operations Engineer. Specifically, the winter maintenance vehicle fleet is being fitted with IMO technology to collect mobile weather data in real-time. NDOT integrates the stationary ESS, National Weather Service, and mobile fleet data platforms.

NDOT Maintenance has an agreement with the National Center of Atmospheric Research to utilize the Pikalert platform for MDSS. IMO data is currently being utilized for the MDSS. There are nine snowplows and one freeway service patrol van with the IMO3 platform on a 32-mile corridor along I-580 between Reno and Carson City in District 2. The corridor includes 18 Dedicated Short-Range Communication (DSRC) sites. Maintenance supervisors validate data from the snowplows. The Pikalert platform uses a cloud web-based system. Data is currently stored on the mESS server.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** Continue to collaborate with Maintenance, Districts, and IT personnel. Develop user groups to share Pikalert modules (i.e. blow-over forecasting) between states.
- **Data Strategies:** Determine common solutions for NDOT's departmental data needs.
- **Technology Strategies:** Continue to prepare to support emerging technologies.

Study Name: Using Vehicle Connectivity Technology for Roadway Weather Response

Completion Date: September 2020
Author: Austin Barrington, Rural Transportation.org
Summary: NDOT's dedicated short-range communications (DSRC) program aims to connect snowplows, service patrol vehicles, and roadside units using cellular signals and on-board instruments to provide real-time road and atmospheric conditions. This data will help NDOT's Enhanced Maintenance Decision Support System (EMDSS) make decisions for roadway treatment during inclement weather. This system has the potential to increase safety, reliability, mobility, and overall performance of the transportation system, especially during inclement winter weather storms.

- **Communications Strategies:** Data flows between sensor equipment mounted in vehicles to data centers is illustrated in the document. The data is then converted and sorted before being disbursed to other locations such as DMS, HAR messages, or other weather and road condition providers.
- District Operations Strategies: N/A

- **Partnership Strategies:** Other users benefit from this program, including local cities and counties, the 511 programs, as well as NHP and WAZE users.
- **Data Strategies:** Data storage requirements at NDEX locations and the cost of implementing additional technologies should be considered. Recurring data plan costs do exist due to LTE and Cellular technologies used by some devices.
- **Technology Strategies:** Additional devices will be added as technologies emerge. NDOT should consider continuous development of this project due to the benefits of decision making provided by the system.

C4.3 Infrastructure Detection

Study Name: Bridge Anti-Icing Technology

Completion Date: Webpage
Author: NDOT
Summary: This webpage provides information on the bridge anti-icing technology that NDOT is installing on four bridges along I-580 between Reno and Carson City. The technology comprises of pavement sensors that spray anti-icing solution when activated by wet weather pavement temperatures close to freezing. The benefits of the technology include safer roadways and increased winter mobility, cost savings due to a reduction in the quantity of chemical needed, and reduced driver distraction as the sensors, nozzles, and spray are not easily visible.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** Automatic nozzles that deploy when condition thresholds are met are in place at several bridge locations. NDOT should consider additional sites for deployment.

C5. Alternative Fuels

C5.1 General

Study Name: Nevada's Strategic Planning Framework

Completion Date: April 2016
Author: State of Nevada
Summary: Nevada's Strategic Planning Framework was created as part of Governor Sandoval's Second Inaugural Address. The framework outlines transportation metrics to be achieved before 2020:

- Reduce congestion on state highways
- Increase % of incidents cleared within Quick Clearance Guidelines
- Improve conditions of bridges
- Support expanded public transportation options
- Reduce rate of fatalities to below the national average by 2020

- Increase % of primary seat belt usage
- Encourage planning to promote the needs of those with disabilities

The framework also outlines natural resource management metrics to be achieved before 2020:

- Complete an "electric highway" system serving the entire state
- Significantly reduce the percentage of imported fossil fuels over the next 10 years
- Reduce carbon emission to a level at or below accepted federal standards

The resource management section references building an "electric highway" system by 2020 and to reduce carbon emission to a level below accepted federal standards. No other ITS related strategies are suggested in the document.

- **Communications Strategies:** To support the "electric highway" system completion, consider providing tie-in locations to communications network along highway system.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Nevada Electric Highway

Completion Date: Webpage
Author: Nevada Governor's Office of Energy
Summary: The Nevada Electric Highway (NEH) aims to expand the electric vehicle (EV) charging infrastructure in Nevada. Plans to install charging stations at strategic but cost-effective locations along U.S. 95 between Las Vegas and Reno have been followed, with several phases. The initial plan has since identified key priority corridors (I-80, I-15, US 95, US 93, and US 50), and Governor Sandoval has worked with other western states to "coordinate and encourage EV infrastructure development along major interstates." Increasing the state EV network will help to improve reliability, mobility, and overall performance of Nevada's transportation network.

- **Communications Strategies:** Not specifically mentioned in this document, potential for technology to exist/be created that gives real-time availability of charging location. EVs likely already use GPS data to locate charging stations.
- **District Operations Strategies:** Maintenance of EV charging station located on NDOT rest areas will require maintenance efforts.
- **Partnership Strategies:** Plan recommends partnerships with local entities such as municipalities, service stations, NDOT, NV Energy, or others.
- Data Strategies: N/A
- **Technology Strategies:** Plan recommends installation of battery charging stations at strategic locations throughout the state. Priority Corridors: I-80, I-15, US 95, US 93, US 50.

C5.2 Smart Electric Vehicle

Study Name: Alternative Fuels Data Center: Nevada Laws and Incentives

Completion Date: Updated August 2021
Author: U.S. Department of Energy
Summary: The Alternative Fuels Data Center webpage lists incentives, laws, and regulations related to alternative fuels and advanced vehicles for Nevada, primarily geared towards information for private citizens.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** Funding has been authorized for transit options that utilize autonomous technology in any county with a population of 700,000 or more.

C6. Traffic Incident Management

C6.1 General

Study Name: Nevada Traffic Incident Management Coalition

Completion Date: Webpage
Author: NDOT
Summary: The Nevada Traffic Incident Management (TIM) team aims to detect, respond to, and remove traffic incidents to restore traffic capacity as safely and quickly as possible. TIM coalitions are made up of the following partnerships: NDOT, State of Nevada Department of Public Safety, Law Enforcement, Fire and Rescue, Local Ambulance Agencies, Local Emergency Management Offices, Public Works, Environmental Agencies/Hazardous Materials Responders, Towing and Recovery, Federal Highway, Homeland Security, and Federal Transit Administration, Media and Agency Public Information Officers, and Traffic Management Centers. The TIM Coalitions meet to discuss regional and statewide incident management policy and procedures as well improve collaboration between all groups necessary for a safer and more efficient incident management. TIMs help maintain overall safety, reliability, mobility, and performance of transportation systems in both rural and urban areas throughout Nevada.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** Current and future public and private partnerships between the following agencies are being developed: NDOT, State of Nevada Department of Public Safety, Law Enforcement, Fire and Rescue, Local Ambulance Agencies, Local Emergency Management Offices, Public Works, Environmental Agencies/Hazardous Materials Responders, Towing and Recovery, Federal Highway, Homeland Security, and Federal Transit Administration, Media and Agency Public Information Officers, and Traffic Management Centers.
- **Data Strategies:** TIM does collect data; however, specifics are not given. Some data, such as CCTV and DMS, are linked to their website.
- Technology Strategies: N/A

C6.2 FirstNet

Study Name: State of Nevada FirstNet Statewide Meeting

Completion Date: September 2015
Author: Nevada FirstNet
Summary: FirstNet's vision for public safety is to "provide emergency responders with the first nationwide, high-speed, wireless broadband network dedicated to public safety." After adoption, Nevada FirstNet was implemented in phases.

- **Communications Strategies:** Mobile data terminals, including LTE devices, smart phones, and Land Mobile Radios will be used to allow first responders to communicate in the field using a dedicated network. 20 MHz of bandwidth in the upper 700Mhz range has been dedicated for FirstNet.
- District Operations Strategies: N/A
- **Partnership Strategies:** Plan recommends planning with state, local, and tribal public safety agencies.
- Data Strategies: N/A
- **Technology Strategies:** High power tower sites, high power devices, and other solutions such as SATCOM will be deployed.

Study Name: How will the FirstNet Network Work with Today's Land Mobile Radio Networks?

Completion Date: July 2014
Author: FirstNet
Summary: This document addresses questions about integrating the FirstNet system with existing LMR networks. FirstNet can communicate with existing LMR technology. FirstNet will help increase the overall safety of Nevada's transportation network.

- **Communications Strategies:** Will be used to send data, video, images, and text. Video streaming will eventually be developed.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** LMR access will be extended to smartphones, tablets, and PCs.

Study Name: FirstNet for Nevada

Completion Date: Webpage
Author: FirstNet
Summary: FirstNet is a single, nationwide broadband network designed to be used specifically by first responders. FirstNet provides a priority broadband network for first responders and includes deployable devices for use during planned and unplanned events. FirstNet helps increase safety and reliability of Nevada's transportation network because it allows first responders to better communicate and operate effectively.

- Communications Strategies: N/A

- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C6.3 Third Party Data/AI

Study Name: Identifying Real-World Transportation Applications Using Artificial Intelligence (AI)

Completion Date: July 2020
Author: U.S. Department of Transportation (USDOT)
Summary: AI allows "machines to learn from experience, adapt, and perform tasks" that typically require human interaction to accomplish. Benefits in productivity, efficiency, and quality of life have been predicted because of the adoption of AI. More specifically, AI can benefit the "transportation ecosystem" Enabling the adoption of AI into safety planning and implementing AI tools to improve transportation system reliability and mobility are of critical interest to increases the quality of Nevada's transportation network. This document details specific applications of AI in urban arterial networks, multimodal corridors, regional systems management, rural freeway corridors, and underserved communities.

- **Communications Strategies:** AI removes some of the need for communication of data or communication between devices because it can be embedded into device systems and make decisions based on observed data, imagery, or even sound.
- **District Operations Strategies:** Implementation of AI into existing and future devices may be a large undertaking because there are many possible applications of AI based on spatial, network, and infrastructure design and needs.
- **Partnership Strategies:** Establishing public private partnerships, including cross-boundary partnerships and coordination between agencies may be beneficial for AI success.
- **Data Strategies:** AI implementation would require increased data storage capabilities. AI applications have already been implemented for video analytics, anomaly detection, safety analysis, and data fusion. AI learns from data, so it will be necessary to gather and store large amounts of data to ensure AI is functioning properly.
- **Technology Strategies:** AI is an emerging technology, and applications are therefore still being developed. Existing technology (or lack thereof) in the field can aid the deployment of successful AI programs due to varying amounts of data collection capabilities. Urban traffic control centers may not be sufficiently equipped with technology to properly utilize AI capabilities.

C6.4 CAD-TMC Integration

Study Name: Statewide Pilot Project for Standardized TIM Performance Measurement and Reporting

Completion Date: July 2016
Author: NDOT

Summary: The report includes information about the development of a statewide project aimed at standardizing TIM performance metrics. Two of the main goals of the study are a comparison of Nevada's TIM program to other leading agencies TIM programs and an assessment of the quantity and quality of incident data available in Nevada. Expanding TIM metrics will have an impact on the safety, reliability, mobility, and overall performance of Nevada's transportation system. The document included the development of an interactive prototype for a TIM dashboard.

- **Communications Strategies:** Data communication between agencies is required. Methods to streamline this process should be considered.
- District Operations Strategies: N/A
- **Partnership Strategies:** The existing Open Roads Partnership sets incident clearance goals. Other partnerships include state and local first responder agencies. Increased outreach to partner agencies and communication about incidents has been a made a priority by other DOTs and NDOT should consider this to increase TIM efficiency.
- **Data Strategies:** Primary data for TIM performance measures are transportation related data, are received from law enforcement, or some combination of the two. TIM data is limited to urban areas due to lack of ITS coverage. EMS CAD systems are also useful for TIM, along with towing, 511, public safety answering points and social media or crowd sourced applications.
- **Technology Strategies:** TIM operations as well as general incident reporting methods utilize ITS such as CCTV to record data about incidents and communicate with responding units. NDOT should consider examining how TIM staff can better utilize existing ITS devices.

C7. Emergency Management

C7.1 Emergency Vehicle Preemption

Study Name: Clark County Traffic Signal Operations Brochure

Completion Date: April 2012
Author: Clark County
Summary: This flyer discusses various signal operations features for the public. The devices and features mentioned include Emergency Vehicle Preemption (EVP), tattle-tail lights on some signal posts, what to do if a signal is dark, and how motorists can better understand how a signal knows vehicles are approaching. Each of these features/education topics helps increase safety and mobility along Nevada roads or helps educate motorists so they will know what to do given certain circumstances, such as a dark signal. Increasing safety and overall performance of Nevada's transportation network is one of the main goals of this flyer.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C7.2 HAZMAT Detection

Study Name: HAZMAT Response Plan – Plan Overview

Completion Date: N/A
Author: Nevada Division of Environmental Protection
Summary: This report outlines common guidelines for responding to hazardous materials incidents such that life, property, and the environment can be protected from any adverse effects of hazardous materials spills or events. The report outlines actions that should be taken by first responders and others to ensure safety and reduce injuries/exposure that could be caused by hazardous materials. By ensuring safety measures and other protocols are followed, the NDEP can help increase the safety and reliability, and overall performance of Nevada's transportation network by helping to contain and manage events involving hazardous materials quickly and safely.

- Communications Strategies: N/A
- **District Operations Strategies:** HAZMAT response should follow NIMS protocol.
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C8. Traveler Information

C8.1 Dynamic Messages

Study Name: Freeway Message Signs

Completion Date: Webpage
Author: NDOT
Summary: This website contains a public facing inventory of freeway message signs throughout Nevada, including their ID, Description, Current message, and a time stamp. DMS systems such as these increase driver awareness and decision-making capabilities, increasing safety, reliability, mobility, and overall performance of Nevada's transportation system.

- **Communications Strategies:** Data and information is quickly communicated to travelers via the DMS system. Messages typically include warnings about events or other hazards on the roadway.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Nevada agencies use AI platform to select STMS locations on high-risk corridors

Completion Date: October 2019
Author: Adam Frost, TTI
Summary: This news article outlines how three agencies in Nevada have used Waycare's AI software to help better identify high-risk areas to better deploy officer monitoring to minimize

speeding and crashes. These locations, called Strategic Traffic Management Sites (STMS) enable law enforcement to better prioritize and make "decisions related to traffic management and traffic safety." Waycare can help increase safety on Nevada's roads because of increase ability to understand data and deploy officers more effectively.

- **Communications Strategies:** Data is communicated between applications such as Waycare to law enforcement officers to help establish critical locations.
- District Operations Strategies: N/A
- **Partnership Strategies:** The website recommends the continuation of partnerships between the Nevada Highway Patrol, NDOT, and the Regional Transportation Commission of Southern Nevada.
- **Data Strategies:** NDOT should further explore the ability for AI to help increase data as data capabilities increase.
- Technology Strategies: N/A

Study Name: Dynamic Message Signs

Completion Date: Webpage
Author: NVFAST
Summary: This website shows the public locations of DMS along Nevada's transportation network. The interactive map allows users to click on each sign which then displays the current message. The information is like the table view of the NDOT run webpage but in map format. DMS helps regulate traffic by allowing drivers to make informed decisions.

- **Communications Strategies:** Travel time related information is transmitted via the DMS system.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C8.2 Highway Advisory Radio

Study Name: NDOT Highway Advisory Radio (HAR) Master Plan Update

Completion Date: March 2021
Author: NDOT (Consultant: Atkins)
Summary: The 2014 NDOT HAR Master Plan provides technical information for the HAR systems and guidance on the strategic utilization and implementation of the system. The March 2021 update contains a feasibility component to ensure the statewide efforts for the HAR system continue to align with the statewide transportation vision and mission and to promote maximum integration with emerging technology and maximum benefits to users.

Recommendations include an implementation plan with short-term (year 1 and year 2), medium-term (year 3 and year 4), and long-term (year 5 and beyond) actions, as well as a decommissioning plan for removing older devices and deploying new devices.

- **Communications Strategies:** Data can be transmitted via audio format, allowing for longer messages and minimal distraction, and it can reach more travelers in a region compared to DMS. A wider range of messages can also be transmitted and can be repeated.
- District Operations Strategies: N/A
- **Partnership Strategies:** Identified emerging technologies in use by others include the Wyoming Department of Transportation (WYDOT) Raspberry Pi, WYDOT SiriusXM partnership, Inrix Highway Emergency Link Platform (HELP), Minnesota-KBM partnership, and partnerships with navigation and smart application companies.
- Data Strategies: N/A
- **Technology Strategies:** Emerging technology includes limited edge computing, digital radio data, FEMA broadcasting, and integration into navigation tools such as smart apps or GPS devices.

C8.3 Weather Sensors

Study Name: Weather Sensors

Completion Date: Webpage
Author: NDOT
Summary: This public facing webpage shows weather sensor data, including ID, Description, Current Readings, and a timestamp.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C9. Information Management

C9.1 ATSPM

Study Name: Developing a Quality of Signal Timing Performance Measure Methodology for Arterial Operations

Completion Date: November 2020
Author: NDOT
Summary: This report outlines development of a "quality of signal timing performance measure methodology for arterial operations." The report includes the creation of two performance measures, the attainability of ideal progression (AIP) and the attainability of user satisfaction (AUS) which can be used to measure set metrics, such as operating speed, and metrics such as user interpretation of signal timing. Using these two metrics, the researchers can recommend that signal timing issues and re-timing problems can be accomplished relatively quickly. The implications of this study are increased reliability, mobility, and overall performance of Nevada's transportation network because of evaluated timing, which allows for more constant flow of traffic with fewer stops.

- **Communications Strategies:** Traffic signal coordination requires that signals be interconnected and able to communicate current phasing information with each other. Traffic progression will not be smooth without this communication. NDOT should pursue traffic signal coordination to alleviate congestion.
- **District Operations Strategies:** Signal controllers should function well at evaluated intersections. If operations are not well maintained, signal coordination should be terminated until regular operations can be achieved through maintenance efforts.
- Partnership Strategies: N/A
- **Data Strategies:** Several data analysis techniques for evaluating communicating, detecting, timing, and coordination of traffic signal systems are included in the plan. Operation event data can also be pulled from filed controllers to supplement trajectory data.
- **Technology Strategies:** Automatic data collection can be incorporated into controller functionality in the future.

C9.2 Drones

Study Name: Drone Laws in Nevada (2022)

Completion Date: Webpage
Author: UAV Coach
Summary: This website outlines both federal and state laws regarding drones.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C10. Commercial Vehicle Operations (Freight)

C10.1 General

Study Name: Nevada State Freight Plan

Completion Date: September 2016
Author: NDOT
Summary: The Nevada State Freight Plan is a comprehensive multimodal plan that provides a strategic framework for freight mobility and establishes the following goals: economic competitiveness, safety; advanced innovative technology; sustainable funding, mobility & reliability; infrastructure preservation; environmental sustainability and livability; and collaboration, land use, and community values. The plan identifies specific recommendations that will improve the freight transportation network statewide including actions/strategies such as multi-use planning for I-11, deploy technologies that enhance commercial vehicle fuel efficiency, and pursue research related to freight.

- Communications Strategies: N/A

- District Operations Strategies: N/A
- **Partnership Strategies:** Plan recommends private and public stakeholder partnerships to develop truck parking ITS. Multistate partnerships should also be explored.
- **Data Strategies:** Re-evaluate NDOTS role in state rail planning and investment. (Inference from text).
- **Technology Strategies:** Incorporate CAV tech, adapt to allow UAV delivery, use advanced inspection tech, integrate advanced tech at inspection stations. Advanced tech to reduce emissions, including electrification of truck stops to reduce idling.

Study Name: Nevada State Rail Plan

Completion Date: March 2012
Author: NDOT (Consultant: Jacobs)
Summary: The Nevada State Rail Plan identifies proposed rail improvements for passenger and freight rail service and offers an implementation plan that identifies potential federal, state, and local funding sources. Identified projects for a 5-year timeline include DesertXpress high speed rail service between Las Vegas and southern California and NDOT rail-highway grade crossing improvements. Identified projects for a 6- to 20-year timeline include a rail-highway grade crossing improvement in Las Vegas, and consolidated multimodal terminals in Elko, Winnemucca, Sparks, Reno, Las Vegas, and Laughlin. Identified long-term projects beyond the 20-year horizon include high speed rail across norther Nevada and Las Vegas and high-speed rail passenger terminals in Las Vegas.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** California-Nevada Interstate Maglev, American Magline Group, Pullman Palace Car Company, and further exploration of public-private partnerships should be continued or considered.
- **Data Strategies:** NDOT should work to enhance coordination for rail-related opportunities.
- **Technology Strategies:** Investment in transportation tech can help realize community goals. Tech to help improve air quality through travel demand management, reduced idling time, and intermodal freight. Positive Train Control (PTC) and LED signals should be used. Passenger trains should adopt tilt technology (which is used in Europe, not included in article), or maglev technology. Signal preemption.

Study Name: I-15 Freight Mobility Enhancement Plan (MEP)

Completion Date: September 2020
Author: NDOT and Caltrans (Consultant: Parametrix)
Summary: The I-15 Freight MEP was developed to achieve the following: address the lack of truck parking along the I-15 corridor in urban areas, enhance the performance of the transportation system, and develop resources that can ultimately be applied to improve other freight corridors. The plan provides strategy recommendations accompanied by recommended policies to support these strategies, as well as an implementation framework.

- **Communications Strategies:** Plan supports collection, sharing, and use of data. Further tech that supports data communication is encouraged.
- District Operations Strategies: N/A
- **Partnership Strategies:** Multistate partnerships are suggested to help develop comprehensive plan.
- **Data Strategies:** GPS truck probe data should be utilized to find where additional parking is needed.
- **Technology Strategies:** Mobile applications for truck parking availability should be explored, as well as further development of DMS systems to display parking availability. Lot based truck parking availability systems were also suggested. Agency operated infrastructure and sensors to display availability at locations along highway are suggested. Static signs displaying upcoming parking, or even smart urban parking zones with apps capable of coordinating locations, parking security, and payment are suggested.

Study Name: I-15 Corridor System Master Plan Update

Completion Date: March 2017
Author: NDOT (Consultant: CH2M)
Summary: The I-15 Corridor System Master Plan was developed to evaluate the I-15 corridor; maintain partnerships with California, Nevada, Arizona, and Utah to ensure that public and private interests are satisfied; identify and prioritize projects to enhance the I-15 corridor with respect to all modes of transportation and provide an implementation framework. Immediate identified ITS/ATMS project in Nevada include I-15 from Las Vegas Valley to Mesquite (FAST Package H) and the I-15 Dynamic Mobility Project: Multi-State ITS Architecture.

- **Communications Strategies:** Plan recommends increasing communications capabilities along the corridor. Suggests smart roadways could communicate with CAV vehicles about upcoming obstacles. Multistate DMS to obtain, exchange, and disseminate real-time data on all segments of I-15 for seamless ITS.
- District Operations Strategies: N/A
- **Partnership Strategies:** Multistate partnerships.
- Data Strategies: N/A
- **Technology Strategies:** Solar highway, hyperloop, EVs.

Study Name: Nevada Freight Projects

Completion Date: Webpage
Author: NDOT
Summary: This interactive map provides the locations of completed, programmed, and proposed freight and rail projects in Nevada. These improvement projects will help increase safety along Nevada's transportation network.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A

- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Nevada Highway Freight Network

Completion Date: Webpage
Author: NDOT
Summary: This interactive map provides information about Nevada's Highway Freight Network. Information specifically included consist of key intermodal facilities and a breakdown of priority corridors, including primary, critical urban, critical rural, and other interstate freight systems.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** Priority corridors include each of the interstate facilities in Nevada, US 95 and 395, SR 445, SR 659, Greg Street in Reno, parts of US 50 near Carson City. In Las Vegas, CC-215, SR 593, 612, Craig Road, lamb Boulevard, and parts of Sunset Road and Koval Lane were identified.

C10.2 Truck Parking

Study Name: Nevada Truck Parking Implementation Plan

Completion Date: August 2019
Author: NDOT (Consultant: Cambridge Systematics)
Summary: NDOT has developed the Nevada Truck parking Implementation Plan, which will expand, improve, and integrate a system of truck parking communications. Due to rising demand, changing of hours of service, and other safety standards, it has become more needful to have an established method for distributing parking information for truck drivers in Nevada. This will increase road safety for all road users and help increase reliability and mobility for truck drivers in Nevada.

- Communications Strategies: N/A
- **District Operations Strategies:** NDOT should consider converting closed facilities into truck parking areas.
- **Partnership Strategies:** Public-private partnerships, local municipalities, counties, multistate.
- **Data Strategies:** ATRI truck GPS database is mentioned several times. Mobile applications for data collection are also discussed as ideal ways to collect data.
- **Technology Strategies:** NDOT should consider spacing truck parking based on typical starting and stopping points based on legal truck driving hours and typical distances travelled (inferred suggestion).

Study Name: Urban Truck Parking Technology Exploration

Completion Date: July 2020

Author: NDOT and Caltrans (Consultant: Parametrix)
Summary: Truck parking is becoming a more urgent need in urbanized areas. Land use policies, zoning, and other active input from agencies and landowners will be required to increase and maximize available parking areas for trucks. Areas suitable to allow trucks to park for multiple reasons will be needed. Some areas will need to be near truck deliver or pick up destinations, near areas often visited by trucks while in transit, or areas where trucks typically stop for longer periods of time, such as when drivers sleep or take longer breaks will be needed. Having these spaces dedicated and easily identifiable to truck drivers will be another difficult aspect. Technology can play a major role in implementing truck parking systems in Southern Nevada. Achieving a well-designed truck parking system will help increase road safety, reliability, mobility, and overall performance of the transportation system in Nevada because truck will be more safely parked off the road.

- **Communications Strategies:** Communication between devices, mobile phones, and physical locations will be needed.
- **District Operations Strategies:** Funds to operate both physical and digital systems in perpetuity are needed.
- **Partnership Strategies:** Public-private, municipal, multistate, and federal partnerships are suggested.
- **Data Strategies:** Data analysis to determine popular locations for future expansion should be considered (inferred).
- **Technology Strategies:** Technology must be supported by policies, processes, and partnerships. Tech includes magnetometers, side-fired microwave radar, video detection, ground-based micro radar.

C10.3 Over Height Warning

Study Name: Devices and early warning methods used to reduce hits on low-clearance structures

Completion Date:
Author: Work Zone Safety.org
Summary: This webpage provides a brief description of warning devices which are designed to signal to vehicles of low clearances, often under falsework on ongoing projects. The increased safety benefits from these devices also allow for increased reliability and mobility due to avoided incidents.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C10.4 Port of Entry

Study Name: Virtual Weigh-In Motion Brochure

Completion Date: October 2008
Author: American Association of State Highway and Transportation Officials (AASHTO)
Summary: This brochure provides information about the advantages of Virtual Weigh-in-Motion (VWIM) technology at truck port of entries/weigh-stations. VWIM is ideal because it supplements permanent weigh stations and can incorporate 3D imaging to identify over size vehicles and is able to communicate data to officers. VWIM can help reduce congestion around weigh-stations, increasing road safety and mobility on Nevada's road network.

- **Communications Strategies:** Uses wireless methods to communicate data.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- **Data Strategies:** WIM has played a traditional role in data collection and vehicle classification. Can check weight data against national databases.
- **Technology Strategies:** Camera, virtual, VWIM, LPR, OCR.

C10.5 Truck Escape Ramps

Study Name: Truck Escape Ramp Brochure

Completion Date: 2012
Author: NDOT
Summary: This brochure provides educational material about truck escape ramps. Dos and Don'ts are listed, along with reasons to use a truck ramp are given. This educational material increases safety of Nevada's transportation network.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C10.6 Mobility Hubs

Study Name: Lake Tahoe Mobility Hub

Completion Date: Webpage
Author: Tahoe Regional Planning Agency
Summary: This webpage provides information about the proposed Tahoe Mobility Hub (TMH). The TMH will likely address many of the region's transportation needs, including acting as a transit hub, rideshare location, or bicycle storage facility. The TMH will connect with other hubs in the region to provide access to all types of transit, helping to alleviate transportation congestion. The TMH will help increase safety, reliability, and mobility of the Tahoe Region.

- **Communications Strategies:** Communication connection to any mobility hub would be desired to support the connection to other hubs.
- District Operations Strategies: N/A

- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C11. Work Zone Management

C11.1 Smart Work Zones

Study Name: NOCoE Smart Work Zones (SWZ) – Peer Exchange Proceeding Report

Completion Date: August 2019
Author: National Operations Center of Excellence (NOCoE)
Summary: The report provides a summary of the topics discussed at the NOCoE SWZ Exchange in March 2019 including traveler information in work zones, lane closure management, and technology in work zones. The document notes that staff and resource limitation should be considered when designing projects with a significant ITS maintenance component. The report also notes outsourcing the ITS device installation and maintenance portion of a project allows for a quicker timeline.

- **Communications Strategies:** Communicating information across jurisdictional boundaries is a priority. FHWA Work Zone Data Initiative creates consistent language for communicating information.
- **District Operations Strategies:** Consider vendor penalties if a device or system goes down and isn't brought back up within a specified amount of time.
- Partnership Strategies: N/A
- **Data Strategies:** Public facing data and engineering data for both external and internal coordination.
- **Technology Strategies:** iCone Traffic Beacons, emphasis on collecting quality data to secure future funding.

Study Name: NDOT SWZ Presentation

Completion Date: N/A
Author: NDOT
Summary: The presentation outlines the components and specifications of NDOT's first and second SWZ project: SR-160/Blue Diamond Road from Red Rock to Mountain Springs and I-15/Starr Avenue Interchange. SWZ components included a solar battery charging system and a queue warning and dynamic travel time system, operated using a self-contained operating system. The advance warning system was designed to automatically change messages if certain speed conditions within the work zone were met. Additionally, if communication between the device and operator is lost, a "Work Zone Ahead" message was programmed to override any existing message. Lessons learned include the following: device placement is crucial, inclement weather can result in issues with equipment, construction crews need more education on devices and requirements.

- **Communications Strategies:** Devices can communicate and change messages displayed automatically.

- **District Operations Strategies:** Develop operational procedures to support smart work zones.
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** Changeable message signs, cellular connectivity, smart cones, solar power, beacon lights.

Study Name: RTC of Southern Nevada Smart Work Zones

Completion Date: June 2019
Author: RTC (Consultant: Kimley-Horn)
Summary: Road construction projects often occur simultaneously, and it can be difficult for entities to coordinate, monitor, and communicate relevant safety information to road users. This report presents information about the deployment of existing Smart Work Zone (SWZ) technology to begin coordination of Temporary Traffic Control Devices between different agencies. Information covering currently existing technology and implementation methods are presented, followed by an overview of desirable future technology. The report also outlines technology and programs that support SWZ currently in use in Nevada:

- GPS arrow boards: devices which direct road users to merge into another lane of travel
- Seeing Orange: provides information to the public about road construction and road closures
- Cone Management Working Group: facilitates monthly meetings among work zone stakeholders to discuss standards, procedures, and policies that affect transportation facilities
- Project NEON: utilized construction cameras to monitory traffic in construction zones
- NDOT Work Zone Technology Implementation: provided queue warning in construction zones, real-time traveler information, automated enforcement, entering/exiting construction are vehicle notifications, dynamic merge, zipper merge
- Nevada 511: provides real-time information by phone or internet
- Waze: publicly updated GPS map and route finder. NDOT and RTC can input construction, incident, and closure data directly into the Waze app.
- Waycare: Waycare is a predictive AI program that analyzes live data to predict where incidents are predicted to occur based on real-time data.
- City of Las Vegas Street Disruption Report: The city publishes via email and online a report which outlines locations where roadways may be disrupted by approved barricades, cones, or other approved devices for construction purposes.

SR 160 Blue Diamond Road from Red Rock to Mountain Springs implemented a queue warning and dynamic travel time system. Changeable message signs (CMS) were portable and fully compliant with MUTCD. The CMS incorporated 2 flashing beacons on the top corners. Smart Traffic Monitoring Systems were operated in real time, which consists of a central processing system, 3 portable traffic sensors, 1 CMS, complete communication system, hardware, software, and support necessary to make an operating system which could provide advance traffic information to motorists if traffic slows, or congestion is present. System had basic field security

protection and could store ad-hoc messages with an automatically generated log to incorporate decision making detection or error detection. Remote message changes took no longer than 15 seconds, and the system was password protected. STMS was constantly collecting data. System had a self-contained operating system capable of monitoring travel speeds of traffic through the work zone. If a speed threshold is reached within the traffic zone, the CMS automatically updates with a pre-programmed message. System runs on solar power, with ability to view live traffic with Waze implementation. Some weaknesses in system were present, including solar charging issues, easily moveable cones, or irregular data collection if vehicles were not moving, however the system works if properly maintained. If the system errored, or lost communication, a pre-set message was scheduled to override any other message. System may require per NOCoE requirements, cellular service, satellite service, internet connection or other requirements to operate the system continuously.

- **Communications Strategies:** The system communicates real-time information to drivers based on measured conditions.
- **District Operations Strategies:** It is unclear who would operate the system or has full responsibility for the system. FHWA has released guidelines outlining operations and minimum technical requirements.
- **Partnership Strategies:** Partnerships may need to exist between project owner and the company carrying out the construction work to ensure the system functions as intended.
- **Data Strategies:** Data is continuously gathered by the system; data is primarily speed data. Logs of decisions and CMS message changes are produced.
- **Technology Strategies:** Variety of SWZ technology options.

Study Name: Innovations: Data Driven Insights

Completion Date: Webpage
Author: RTC
Summary: Real-time reporting of incidents and other dangerous driving conditions helps improve safety and efficiency on Nevada's freeways. Southern Nevada has seen increased safety since adopting use of Waycare's technology. Another AI software, GeoTab, provides open platform fleet management solutions. AI and other innovative technology can help improve safety, reliability, mobility, and overall performance of Nevada's transportation networks.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C11.2 Contractor Requirements in Procurement Process

Study Name: Nevada Department of Transportation Standard Plans for Road and Bridge Construction

Completion Date: 2020
Author: NDOT
Summary: This document provides NDOT's standard plans for road and bridge construction. The ITS details cover cabinet labeling, communication cabinets, solar poles, steel posts, ITS poles, communication poles, RWIS sites, HAR cabinets and installation, and CCTV mounting and lowering.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** Defines standards and specifications for ITS devices. These standards are updated regularly as required by safety improvements, cost efficiencies, or updated technology vendor requirements.

C12. Connected/Autonomous Vehicles

C12,1 General

Study Name: Automated and Connected Vehicles

Completion Date: Webpage
Author: NDOT
Summary: This website provides information about automated vehicles (AVs), connected vehicles (CVs), and CAVs, summarizes the benefits of CAV technology, and details smart and connected NDOT projects (Waycare, Audi Countdown to Green, Nexar, and WAZE). Benefits of CAV technology includes enhanced safety, reduced need for capacity, reliable travel time, improved mobility, reduced energy consumption, opportunities for vehicle sharing, and economic development.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** NDOT has been partnering with the Nevada GOED, DMV, RTC Washoe, and RTC of Southern Nevada to promote CAV initiatives.
- **Data Strategies:** Consideration for CAV technology such as Waycare, Audi Countdown to Green, Nexar, and WAZE is being pursued by NDOT for benefits in safety, mobility, and efficiency.
- Technology Strategies: N/A

Study Name: Nevada Continues to Embrace an Autonomous Vehicle Future
Completion Date: April 2021
Author: Scott King, Sierra Nevada Ally
Summary: This article illustrates how Nevada has been on the forefront of autonomous vehicle legislation and describes the associated impacts on autonomous vehicle companies. In 2011, Nevada became the first state to allow the operation of autonomous vehicles with Assembly Bill 511. With Assembly Bill 69 in 2017, fully autonomous vehicles were allowed to be tested or

operated on state highways. Assembly Bill AB412, passed in 2021, contains provisions for neighborhood occupant less vehicles. With this legislation, companies like Nuro–which designs, tests, and manufactures autonomous delivery vehicles–may be able to bring its technology to Nevada.

- Communications Strategies: N/A
- **District Operations Strategies:** Legislation has opened the door to autonomous vehicle testing and corridor implementation. Monitoring of these corridors will be valuable to district operations as AV is implemented more statewide.
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Connected Vehicle Data to Improve Driving in Nevada

Completion Date: September 2019
Author: Adam Frost, TTI
Summary: This article details the parentship between Wejo and Waycare. Wejo is a technology company that is using CV data to develop global mobility services. Waycare is a smart mobility cloud-based traffic management firm. As a result of the partnership, Waycare will utilize Wejo's CV data to increase the accuracy of its traffic management solutions. Waycare is currently used by RTC of Southern Nevada, FAST, NHP, and NDOT to identify and respond to incidents more quickly and to inform decisions.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Keeping Nevada's Drivers Safe and Connected

Completion Date: February 2021
Author: Government Technology
Summary: This article details the State's award-winning ITS system and provides insight on NDOT's vision for the system moving forward. The ITS platform allows Waycare, NOAA, and other private partners to forecast weather, analyze traffic conditions, provide roadside assistance, and respond to incidents. NDOT is working towards a future ITS system complete with 5G, vehicle-to-vehicle, and vehicle-to-infrastructure communication to support emerging technologies like CAVs.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Chapter 482A – Autonomous Vehicles

Completion Date: N/A
Author: State of Nevada
Summary: This section of the NRS outlines rules and regulations regarding autonomous vehicle technology, testing, operation, and manufacturing.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** Enables autonomous vehicles to drive Nevada roadways.
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Nevada Legislative Counsel Bureau – Research Brief on Autonomous Vehicles

Completion Date: November 2017
Author: Nevada Legislative Counsel Bureau
Summary: The Research Brief on Autonomous Vehicles summarizes autonomous vehicle legislation in the State of Nevada, in other states, and relevant federal guidelines.

The briefing explains that Assembly Bill 511, passed in Nevada in 2011, mandates that Nevada's Department of Motor Vehicles (DMV) adopt regulations and driver's license endorsement for the operation of autonomous vehicles. Assembly Bill 69, passed in Nevada in 2017, allows fully autonomous vehicles to be tested or operated on a Nevada highway so long as certain safety requirements are satisfied. The bill also authorizes the use and testing of driver-assistive platooning technology, which allows two (2) or more vehicles to travel at synchronized speeds at a lesser distance than would be acceptable without technology. Furthermore, the briefing also summarizes the National Highway and Transportation Safety Administration (NHTSA) autonomous vehicle guidelines, Automated Driving Systems 2.0: A Vision for Safety (2017). The voluntary guidelines provide technical assistance to states and best practices. The United State House of representatives passed H.R. 3388 in 2017, the Safely Ensuring Lives Future Development and Research in Vehicle Evolution (SELF DRIVE) Act, while the Senate introduced S. 1885, the American Vision for Safer Transportation through Advancement of Revolutionary Technologies Act (AV START) Act. These bills prevent states from regulating autonomous vehicles to a certain extent and would a create technical committee and begin the process of updating federal safety standards for vehicles.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** NDOT should monitor legislation and federal guidelines related to autonomous vehicles to prepare for the emergence of the technology.

C12.2 Vehicle Conditions

Study Name: High-Resolution Micro Traffic Data from Roadside LiDAR Sensors for Connected-Vehicles and New Traffic Applications

Completion Date: October 2018
Author: NDOT
Summary: This report outlines the procedure and algorithms to obtain high-accuracy and high-resolution trajectory data from LiDAR sensors and summarizes the potential for LiDAR to be used to predict pedestrian and animal behaviors as well as near-crash events. LiDAR technology is intended to provide a foundation for autonomous/connected vehicle infrastructure while accounting for unconnected multimodal traffic. Expanding NDOT's ITS infrastructure to include LiDAR has the potential to significantly enhance the multimodal safety of the transportation network.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** NDOT should consider installing LiDAR sensors as part of roadway projects, when possible, and in locations where the data applications would be useful.

Study Name: Expansion in the Works for Nevada Smart Roadway Project

Completion Date: October 2020
Author: AASHTO Journal
Summary: This article describes the expansion of a University of Nevada-Reno LiDAR sensor project and summarizes the applications of data collected by the sensors. The project is part of an Intelligent Mobility research initiative funded by RTC of Southern Nevada, NDOT, USDOT, and others. LiDAR technology can collect data on near-crashes to identify unsafe intersections or roadway segments that are not detected using traditional crash data. Adoption of LiDAR technology will ultimately support the deployment of autonomous vehicles by transmitting data to those vehicles in real-time to improve traffic operations. Furthermore, LiDAR data in conjunction with artificial intelligence could help to predict driver, pedestrian, bicyclist, and animal behavior on roadways.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** NDOT should consider installing LiDAR sensors as part of roadway projects, when possible, and in locations where the data applications would be useful.

C13. Communications

C13.1 Fiber

Study Name: Nevada State Broadband Connectivity Strategy

Completion Date: N/A
Author: Nevada Governor's Office of Science, Innovation, and Technology (OSIT)
Summary: This report explains the increasing importance of access to broadband and knowledge of how to use it for employment, commerce, education, healthcare, transportation, etc. As a result of significant federal funding for broadband infrastructure, Nevada is aiming to move towards universal broadband access through a coordinated effort. Improving Nevada's broadband network can also improve NDOT's ITS capabilities through enhanced network coverage to support safety, reliability, mobility, and overall performance of Nevada's transportation network. Key corridor fiber paths are identified as major state highways.

- **Communications Strategies:** Add broadband infrastructure to other infrastructures being constructed, when possible.
- District Operations Strategies: N/A
- **Partnership Strategies:** NDOT should partner with GOED, OSIT, Regional Economic Development Agencies, County and Local governments, the Nevada Treasurer, and the Nevada State Broadband Task Force to make access to broadband infrastructure and access to workforce skilled in broadband infrastructure construction and economic development a competitive advantage for the State. NDOT should partner with OSIT, the Nevada Hospital Association, the State Office of Rural Health, Nevada Rural Hospital Partners, Nevada Health Centers, the Nevada Rural Hospital Association, For Profit Hospitals, the Nevada Indian Commission, Tribal governments, the Nevada Department of Corrections, and NevadaNet to develop and implement a plan to provide broadband infrastructure to hospitals, clinics, tribal clinics, and prison systems in Nevada.
- **Data Strategies:** Develop a map of Broadband Ready Communities and recent and planned state infrastructure projects to incentivize companies looking to enter the Nevada market.
- Technology Strategies: N/A

Study Name: Public Safety Communications Revolution – Our Broadband Future Presentation

Completion Date: N/A
Author: Nevada Division of Emergency Management
Summary: The presentation explains the concept of interoperability as the ability for agencies to effectively communicate in real time. FirstNet, or the Nationwide Public Safety Network, is a federal not-for-profit agency that was mandated by congress to build a nationwide, interoperable, digital data network available for any public safety use (public works, schools, transportation, first responders, etc.). FirstNet will allow public entities to better coordinate and respond to public safety events.

- **Communications Strategies:** Complete and extend the core network of infrastructure.

- District Operations Strategies: N/A
- **Partnership Strategies:** Partner with local agencies and public safety uses to understand the needs of the system and build on the applications.
- Data Strategies: N/A
- Technology Strategies: N/A

C13.2 Wireless

Study Name: Nevada Shared Radio System (NSRS) Existing System Analysis and P25 System Requirements Report

Completion Date: May 2016
Author: NDOT, NV Energy, and Washoe County (Consultant: Federal Engineering)
Summary: This report outlines the user requirements for the NSRS partners (NDOT, NV Energy, and Washoe County) and forms the foundation for the preliminary conceptual design of the replacement system. The replacement system is needed as the manufacturer of the key system components of the NSRS advised that the components are approaching the end of their lifecycle and support for the technology will cease. Implementation of the replacement system will enhance the safety, mobility, reliability, and operability of Nevada's road network.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: Nevada Shared Radio System Replacement

Completion Date: N/A
Author: NDOT
Summary: Per the presentation, the NSRS contains 114 sites statewide, with 66 sites owned by NDOT. The presentation summarizes the NSRS Replacement project phasing, selection process, vendor negotiation process, and next steps. Harris Communications was selected to deploy the next generation radio system. Next steps included finalizing funding/agreements.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** The shared radio system will continue to be invested in and maintained overtime as it serves to support NSRS partners as either primary or redundant communications.

Study Name: System Site Location Data Report for: Nevada Shared Radio System

Completion Date: Webpage

Author: RadioReference.com
Summary: This webpage provides location information for the NSRS sites. Per this source, there are 103 sites.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

Study Name: NDOT Land Mobile Radio (LMR) Services

Completion Date: August 2019
Author: NDOT
Summary: This document outlines the operational, consulting, and support services that NDOT provides to users of its LMR system.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- Data Strategies: N/A
- Technology Strategies: N/A

C14. Other Studies

Study Name: NDOT Statewide Transportation Systems Management and Operations (TSMO) Program Plan

Completion Date: January 2020
Author: NDOT (Consultant: Atkins)
Summary: The NDOT Statewide TSMO Program Plan describes the justification and the need for a statewide TSMO Program, outlines the strategic approach to enhance mobility across all modes of transportation with the incorporation of TSMO, and defines an approach with actionable items and timeframes to implement the NDOT TSMO program.

The identified TSMO goals include to enhance safety, preserve infrastructure, enhance reliability, optimize mobility, optimize customer service, enhance collaboration, foster sustainability, and strengthen TSMO integration. Identified tactical elements for NDOT for the next 5 years include real-time traveler information, connected and automated vehicles, active traffic management (ATM), traffic incident management, transportation asset management, transportation performance management, and ITS database and communications.

NDOT's current and future actions to support the ITS database and communications tactical element reference NDOT's ITS SDP and include the timely implementation of the prioritized ITS SDP projects as well as the annual Investment Prioritization Tool (IPT) to prioritize projects in alignment with TSMO objectives. NDOT's current and future actions to support the ATM tactical element include the implementation and refinement of ATMS along I-15 and other major NDOT roadways.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- **Partnership Strategies:** Coordinate with NHP to enhance Traffic Incident Management. Coordinate between the NV2X Office and newly requested TSMO staff to enhance connected and autonomous vehicle efforts.
- **Data Strategies:** Complete the comprehensive ITS database.
- **Technology Strategies:** Develop connected and autonomous vehicle implementations policies and guidelines.

Study Name: NDOT TSMO Business Case

Completion Date: N/A
Author: NDOT (Consultant: Atkins)
Summary: This document outlines the role of NDOT's Planning Division in shaping the state's transportation system. Examples of TSMO strategies integrated into Planning Division activities include: NDOT Strategic Plan (2020) goals related to safety, efficient operation and maintenance of the Nevada transportation system, and consistent and effective data management; the NV2X Office of Innovation which is planning for a transportation system that can accommodate connected vehicle (CV) technology; benefit-cost analysis conducted by NDOT's Performance Analysis section that can be used to support TSMO strategies in long-term planning efforts; and performance measurement and system monitoring which provides an understanding of the transportation system's needs.

- Communications Strategies: N/A
- **District Operations Strategies:** Coordinate among stakeholders through regular construction updates as part of TIM Coalition meetings as a strategy to improve work zone safety.
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** The NV2X Office of Innovation is preparing a transportation that accommodates emerging CV technologies. Work-zone specific ITS technology should be implemented to manage traffic during construction. Continue to implement TPAS along high-priority corridors.

Study Name: Case Study – NDOT TSMO Investment Prioritization Tool

Completion Date: N/A
Author: National Operations Center of Excellence (NOCoE)
Summary: The case study outlines the development, incorporation, and application of an Investment Prioritization Tool (IPT) in NDOT's TSMO plan. The tool incorporates prioritization criteria such as alignment with TSMO strategic goals and objectives, cost, and implementation timeframe, resulting in a higher score for projects with a low cost and short-term implementation timeframe that are aligned with TSMO strategic goals and objectives. The NDOT ITS Strategic Deployment Plan (SDP) identifies and prioritizes short-term, mid-term, and long-term projects, services, and activities. After the list of prioritized projects is updated, the IPT can prioritize the projects based on the specified scoring criteria.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- **Data Strategies:** NDOT should continue building upon the IPT tool to support the decision-making process.
- Technology Strategies: N/A

Study Name: One Nevada Transportation Plan

Completion Date: November 2018 (Revised February 2020)
Author: NDOT
Summary: The One Nevada Transportation Plan provides guidance to NDOT and its partner agencies to plan, develop, operate, and maintain Nevada's transportation system and transportation investments. The Plan indicates that technology is expected to have a highly important role within Nevada's future transportation network. Specifically, current infrastructure will need to be updated to include fiber-optics and advanced communication systems to accommodate connected and autonomous vehicles.

- **Communications Strategies:** Plan suggests updating and modernizing current infrastructure with fiber-optics and advanced communications systems. Recommends development of strategy to enable traveling public and planning partners to engage in planning and performance efforts.
- District Operations Strategies: N/A
- **Partnership Strategies:** Plan suggests expanding partnerships with safety advocates and identification of safety improvement strategies and future investments.
- **Data Strategies:** Plan recommends that massive "big data" storage and analytical capabilities will require new definition of roles as an agency.
- **Technology Strategies:** Plan suggests continued development and adoption of new technologies as they become available.

Study Name: One Nevada Transportation Plan – I-15 Critical Corridor Plan

Completion Date: October 2018
Author: NDOT (Consultant: Jacobs)
Summary: The main goal of the I-15 Critical Corridor Plan is to assess the performance of I-15 and identify projects that will enhance the operation of the corridor. The document evaluates previous planning studies and current relevant data to identify transportation needs of the corridor in alignment with goals and objectives established by the One Nevada Transportation Plan.

The Plan identifies two (2) immediate-term ITS improvement projects: the I-15 ITS FAST Package H3 and I-5 ITS FAST Package H2, which are either currently under construction or programmed to begin construction with two (2) years. The document also identifies the I-15 Dynamic Mobility Project: Multi-State ITS Architecture as a project that has been identified in previous planning studies but has not been programmed in any improvement plan.

- **Communications Strategies:** Plan identifies wireless communications as an important capability that will be built into the roadway system.
- District Operations Strategies: N/A
- **Partnership Strategies:** Plan identifies a Nevada policy which is open to attracting innovative partners, such as Tesla in addition to DOT partnerships.
- **Data Strategies:** Plan used data deficiencies to identify future needs of projects.
- **Technology Strategies:** Plan identifies Nevada's quick embrace of new technologies and encourages future adoption of new technology.

Study Name: One Nevada Transportation Plan – US-93 Critical Corridor Plan

Completion Date: December 2018
Author: NDOT (Consultant: Wood Rodgers)
Summary: The main goal of the US-93 Critical Corridor Plan is to assess the performance of US-93 and identify projects that will enhance the operation of the corridor. The document evaluates previous planning studies and current relevant data to identify transportation needs of the corridor in alignment with goals and objectives established by the One Nevada Transportation Plan. The Plan identifies the near-term US-93/US-95 ITS FAST Package project which is undergoing the design and review process and could begin construction in the next five (5) years.

- **Communications Strategies:** Plan identifies wireless communications as an important capability that will be built into the roadway system.
- District Operations Strategies: N/A
- **Partnership Strategies:** Plan identifies a Nevada policy which is open to attracting innovative partners, such as Tesla in addition to DOT partnerships.
- **Data Strategies:** Plan used data deficiencies to identify future needs of projects.
- **Technology Strategies:** Plan identifies Nevada's quick embrace of new technologies and encourages future adoption of new technology.

Study Name: NDOT Rural Intelligent Transportation Systems (ITS) Strategic Deployment Plan (SDP)

Completion Date: April 2018
Author: NDOT (Consultant: Kimley-Horn)
Summary: The NDOT Rural ITS SDP was developed in 2018 to provide guidance for ITS planning, implementation, and integration of technologies and systems to better manage the statewide transportation system.

The document explains that the state has a significant amount of ITS infrastructure already in place from in urbanized areas of the state. For rural areas, however, short-term, and long-term ITS planning is needed. The Plan includes the following components: identification of operational and infrastructure needs and gaps, inventory assessment, deployment strategies, ITS toolbox, and implementation priorities. It is noted that to successfully manage all technologies recommended in the Plan, the ATMS software may require improvements, though specific costs or activities to do so are not identified.

The Plan identifies specific requested and programmed ITS projects/packages (CCTV Pan/Tilt/Zoom (PTZ), Road Weather Information System (RWIS), Dynamic Message Sign (DMS), etc.) and locations.

- **Communications Strategies:** The SB 53 Bill implemented several policies to improve the state's fiber infrastructure. As relevant to NDOT ITS planning, these policies include a "dig once" policy which requires the installation of excess conduit in road projects and allows telecommunications providers to access the excess conduits in exchange for compensation to NDOT.
- District Operations Strategies: N/A
- **Partnership Strategies:** The SB 53 Bill implemented several policies to improve the state's fiber infrastructure. As relevant to NDOT ITS planning, these policies include a "dig once" policy which requires the installation of excess conduit in road projects and allows telecommunications providers to access the excess conduits in exchange for compensation to NDOT. NDOT should establish agreements with other Departments for the viewing or control of CCTV cameras.
- Data Strategies: N/A
- **Technology Strategies:** NDOT should implement the identified ITS projects/packages.

Study Name: Statewide ITS SDP (Addendum 1 to NDOT Rural ITS SDP)

Completion Date: January 2020
Author: NDOT (Consultant: Atkins)
Summary: The 2020 Addendum to the NDOT Rural ITS SDP achieves the following objectives: modify the Rural ITS SDP to the Statewide ITS SDP and update project lists accordingly; focus on ITS needs and alignment with TSMO goals and objectives; and develop a GIS tool using available data and input from key stakeholders, which is intended to keep track of projects and deployments in an efficient manner for the Signals, Lighting, and ITS (SLI) design section and the NDOT Districts to support the decision-making process.

The Statewide ITS SDP identifies specific projects/locations for the implementation of ITS technologies (CCTV Pan/Tilt/Zoom (PTZ), RWIS, DMS, etc.), Road Weather Information System (RWIS), Dynamic Message Sign (DMS), etc.) and associated communications infrastructure needs (primarily cellular coverage). The projects were prioritized based on input from District representatives and the IPT.

- **Communications Strategies:** NDOT should install the required communications infrastructure associated with the identified and prioritized projects.
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- **Data Strategies:** NDOT should continue building upon the IPT tool to support the decision-making process.
- **Technology Strategies:** NDOT should work to implement the identified and prioritized projects.

Study Name: NDOT Signal, Lighting, and ITS Design Guide

Completion Date: 2019
Author: NDOT (Consultant: Atkins)
Summary: The NDOT Signal, Lighting, and ITS Design Guide was developed to achieve the following objectives: establish uniform design criteria; provide a summary of applicable traffic signal, lighting, and ITS components; and supplement the Manual on Uniform Traffic Control Devices (MUTCD) and other relevant manuals. The ITS design criteria set forth in this document is important to consider in the implementation of the NDOT ITS & ATM Master Plan.

- **Communications Strategies:** Design and specifications related to communications are noted in this guide.
- District Operations Strategies: N/A
- **Partnership Strategies:** The guide outlines the process for project scoping, including which partners to get involved during the development of traffic signal systems, ITS, and other types of systems.
- Data Strategies: N/A
- **Technology Strategies:** Design and specifications related to most ITS technologies utilized in Nevada are noted in this guide. Conduit, pull boxes, poles, fiber, wireless, DMS, CCTV, vehicle detection, RWIS, HAR, WWD, and RRFB design guidelines including procurement, installation methods, and testing procedures are included in the guide. No connected vehicle infrastructure or in-vehicle equipment is specified in these guidelines.

Study Name: NDOT Smart Mobility Plan

Completion Date: 2020
Author: NDOT (Consultant: Gartner)
Summary: This Smart Mobility Plan identifies initiatives for the following smart mobility components: financial/RFP, KPIs, data, devices/edge, infrastructure cloud, staffing resources, training, regulatory, roadway network, safety, communications, small cell/5G, ITS asset management, and security risk. There are opportunities to incorporate ITS and ATM elements to support the identified initiatives.

- Communications Strategies: N/A
- **District Operations Strategies:** Fulfill required skills and resource through staff, positions, and retaining TSMO staff. Provide training for staff. Emerging technologies training such as CAV.
- **Partnership Strategies:** Collaborate within NDOT and with partnering agencies to require multi-factor authentication for ITS users and review ITS user account access and rights.
- **Data Strategies:** ITS device performance measure data should be more available to all Department staff/personnel. ITS asset health reports, and performance measurements should be developed. Data-based decisions that improve system operations, ROI and business case should be used. Develop ITS asset health reports and performance measurement based on accurate inventory for all ITS assets.

- **Technology Strategies:** ITS edge devices should be using modern protocols in the future. Cloud migration strategy where possible. Training desired for arterial management, ATM, congestion pricing, and emergency transportation operations. Fiber optics deployed to the fullest extent possible. Achieve 95% coverage for portable radio communications statewide.

Study Name: NDOT Fully Compliant Transportation Asset Management Plan (TAMP)

Completion Date: 2022
Author: NDOT
Summary: This document was prepared to summarize the condition of pavement, bridge, and ITS assets, to describe NDOT's plan to manage these assets, and to guide investments in NDOT's transportation assets. Of note, from 2017 to 2027, NDOT is expected to put $1.15 billion towards the maintenance and management of its pavement, bridge, and ITS assets.

ITS assets have a current replacement value of $42.2 million utilizing a replacement cost per device of:

- CCTV: $11,500/device
- DMS: $95,000/device
- Flow Detector: $9,500/device
- HAR: $25,000/device
- Ramp Meter: $52,500/device
- RWIS: $75,000/device

ITS assets that are maintained and managed by NDOT's Traffic Operations Division and addressed in the TAMP include: Closed Circuit Television Camera (CCTV) devices, Dynamic Message Signs (DMS), Flow Detectors, Highway Activity Radios (HAR), Ramp Meters, and Road Weather Information Systems (RWIS). Investment strategies developed for these assets include to determine initial device conditions as related to level of risk, define general procedures and protocols for maintenance and replacement activities, identify appropriate activities for device maintenance and management, and determine maintenance and repair activities to maintain current levels of service.

- Communications Strategies: N/A
- District Operations Strategies: N/A
- Partnership Strategies: N/A
- **Data Strategies:** Condition categories are outlined in the TAMP as Good, Low Risk, Medium Risk, or High Risk based on the age of the device. This should be considered when developing an asset management system for reporting on ITS assets.
- Technology Strategies: N/A

Study Name: Regional Transportation Commission of Southern Nevada (RTC SNV) Access 2050 Plan

Completion Date: January 2021
Author: RTC

Summary: The Regional Transportation Plan outlines visions, goals, and strategies for the transportation system of Southern Nevada and establishes an investment program. Primary strategies identified include to improve safety, manage congestion, enhance multimodal connectivity, maintain current infrastructure, and promote economic development.

The City of Las Vegas Citywide ITS Master Plan Upgrades project is included as an example congestion project with an estimated cost of $24 million. Investments for local agency led projects at a regional scale that are not specific to any one identified focus area such as citywide ITS projects and electric vehicle programs are included in the category of revenue not allocated to a focus area, which has a total amount of $18.2 billion.

- Communications Strategies: N/A
- **District Operations Strategies:** People spend more than 32% of their driving time and drive 47% of their miles on highways, including Interstates and other limited-access roads such as US-95 and Summerlin Parkway.
- Partnership Strategies: N/A
- Data Strategies: N/A
- **Technology Strategies:** 59% of survey respondents desire to incorporate new transportation technologies in Southern Nevada. US-95 and Summerlin Parkway were cited as taking most of the traffic in the region. Promoting use of mass transit and HOV lanes is a strategy being implemented to reduce traffic delays. Improvements to freight corridors (I-15, I-515/US-93, CC-215/I-215, and US-95) have the potential to benefit both commuters and trucking.