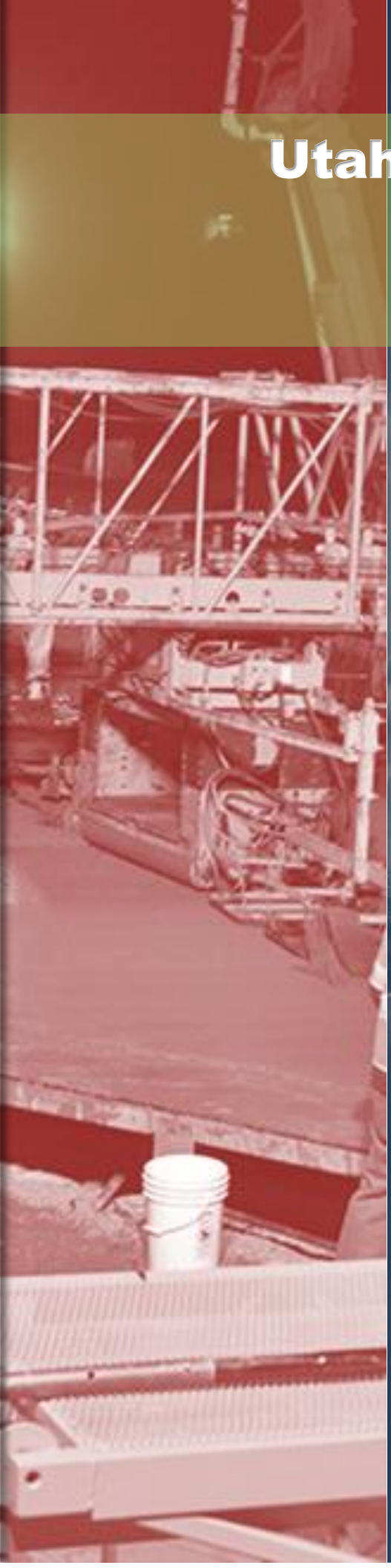
Utah Transportation Asset Management Plan

2019



UDOT

Keeping Utah Moving

State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

DEPARTMENT OF TRANSPORTATION

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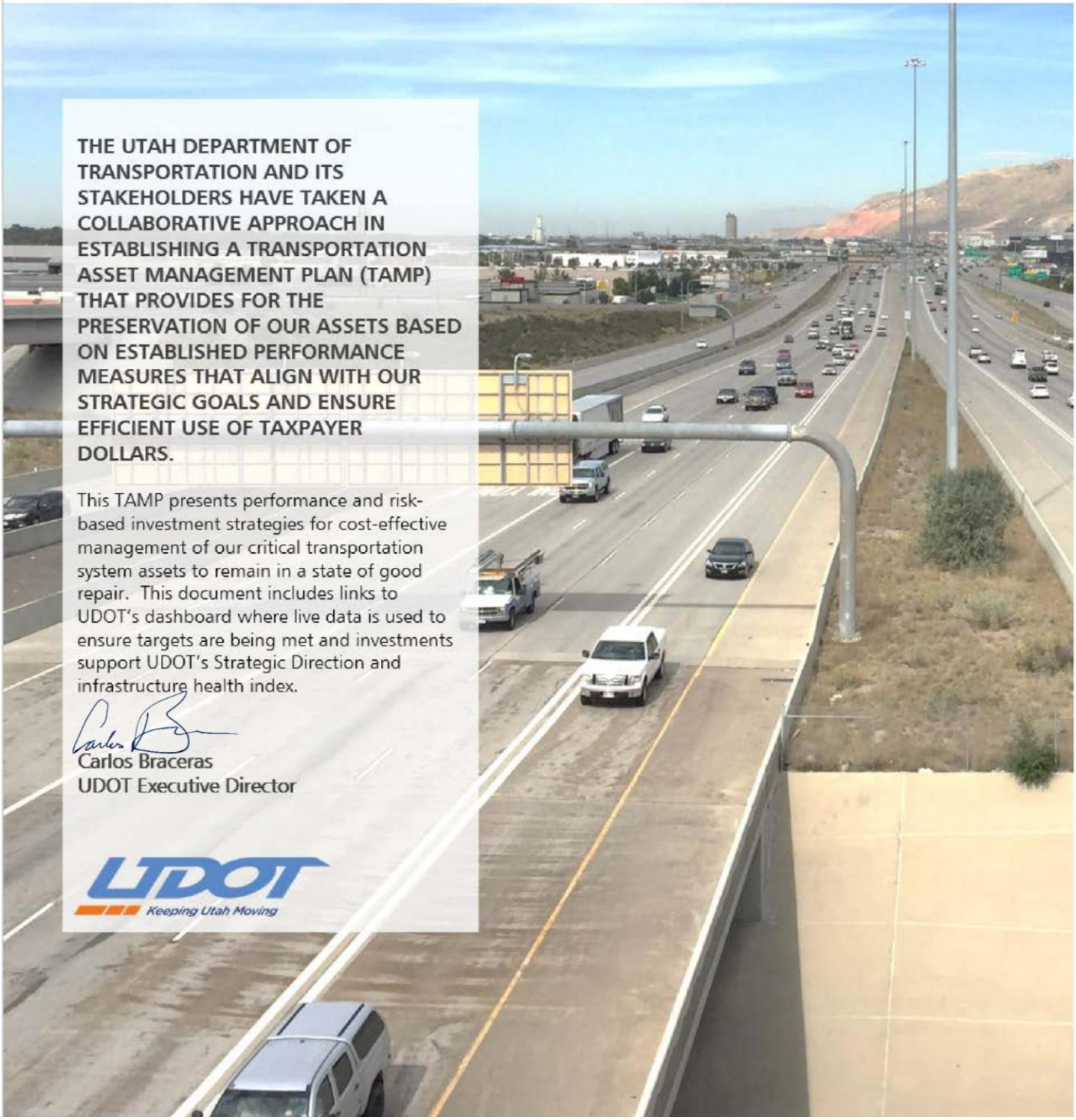
EXECUTIVE SUMMARY
Utah Transportation Asset Management Plan



THE UTAH DEPARTMENT OF TRANSPORTATION AND ITS STAKEHOLDERS HAVE TAKEN A COLLABORATIVE APPROACH IN ESTABLISHING A TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP) THAT PROVIDES FOR THE PRESERVATION OF OUR ASSETS BASED ON ESTABLISHED PERFORMANCE MEASURES THAT ALIGN WITH OUR STRATEGIC GOALS AND ENSURE EFFICIENT USE OF TAXPAYER DOLLARS.

This TAMP presents performance and risk-based investment strategies for cost-effective management of our critical transportation system assets to remain in a state of good repair. This document includes links to UDOT's dashboard where live data is used to ensure targets are being met and investments support UDOT's Strategic Direction and infrastructure health index.

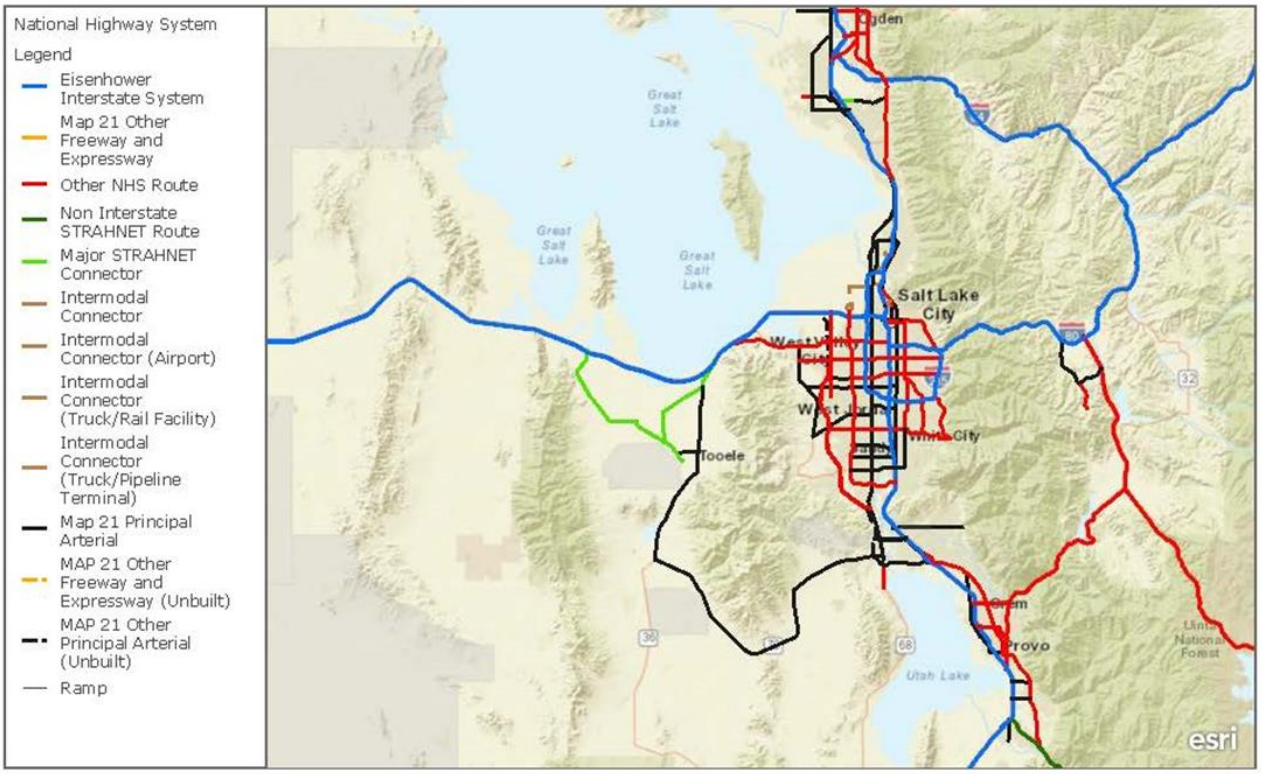
Carlos Braceras
UDOT Executive Director

UDOT
Keeping Utah Moving

UTAH NATIONAL HIGHWAY SYSTEM

The National Highway System (NHS) is a major network of roadways and bridges within the overall system. UDOT collects condition data on 100% of the NHS in Utah which consists of:

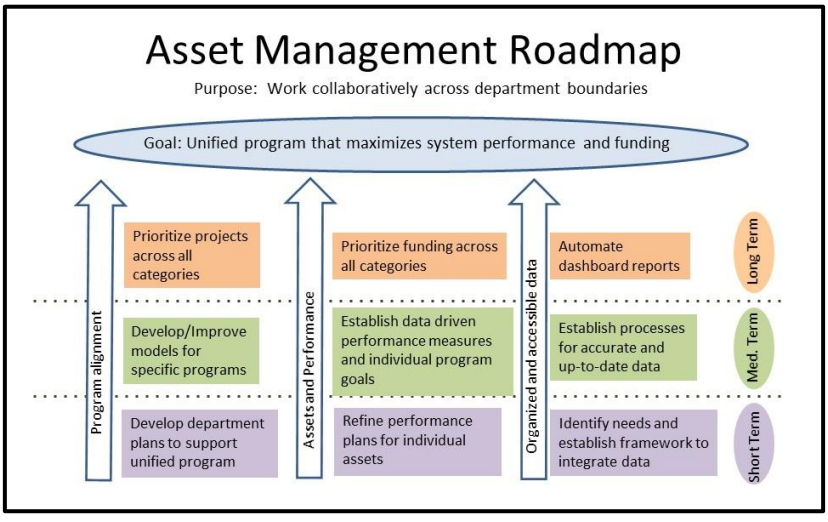
- 2,830 centerline miles of roadway
- 15,584 lane miles of roadway
- 1,353 state-owned bridges
- 6 locally owned bridges



INTRODUCTION TO THE UTAH TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

The Utah Transportation Asset Management Plan (TAMP) is the plan UDOT follows to achieve the Preserve Infrastructure strategic goal. The specific objectives of this plan which comprise the asset management roadmap are:

- Formalize a data driven performance-based approach for allocating transportation funds to manage pavements, bridges and ATMS and signal devices
- Incorporate asset management into the intermediate and long-range planning processes
- Incorporate risk management into resource allocation decisions
- Provide a valuable asset management tool with real time data



ASSET REGISTER

The UDOT Asset register depicts the quantity and value of UDOT major roadway assets. The value of each asset is the current cost to replace and construct/install the asset including costs for design, construction oversight, traffic control, and mobilization.

ASSET TYPE	QUANTITY	VALUE
Pavement & Bridge Assets		
Pavement NHS	115,694,396 SY	$20,000,000,000
Pavement Non-NHS	57,850,911 SY	$8,000,000,000
Bridges NHS	14,451,169 SF	$8,000,000,000
Bridges Non-NHS	6,258,935 SF	$3,000,000,000
Other Assets		
ATMS Devices	Lump	$479,000,000
Signal System	1255 Each	$314,000,000
Walls	71,820,494 SF	$3,400,000,000
Pipe Culverts	16,553 Each	$1,000,000,000
Barrier	7,347,574 FT	$450,000,000
Signs	96,160 Each	$300,000,000
Pavement Markings	26,000 Miles	$42,000,000
Rumble Strips	26,287,969 FT	$6,000,000
Fences	1,890 Miles	$70,000,000
Cattle Guards	895 Each	$20,000,000

ASSET MANAGEMENT TIERS

To accomplish the objective of allocating transportation funding toward the most valuable assets and those with the highest risk to system operation, the Asset Advisory/Performance Management Committees developed a tiered system of asset management. Asset Management tiers range from one to three with tier one being the most extensive management plan for the highest value assets.

Tier 1 – Performance-based management
- Accurate and sophisticated data collection
- Targets and measures set and tracked
- Predictive modeling and risk analysis
- Dedicated funding through UDOT's annual STIP process

Tier 2 – Condition based management
- Accurate data collection, less than annually
- Condition targets
- Risk assessment primarily based on asset failure

Tier 3 – Reactive management
- Risk assessment primarily based on asset failure
- General condition analysis
- Repair or replace when damaged

	Asset	*Tier*
Performance	Pavement	1
	Bridges	1
	ATMS Devices	1
	Signal Devices	1
Condition	Pipe Culverts	2
	Signs	2
	Walls	2
	Rumble Strips	2
	ADA Ramps	2
	Barrier	2
	Pavement Markings	2
Reactive	Cattle Guards	3
	Interstate Lighting	3
	Fences	3
	Rest Areas	3
	Curb and Gutter	3
	Trails	3
	Bike Lanes	3
	Surplus Land	3
	At-grade Railroad Crossing	3

PERFORMANCE-BASED MANAGEMENT

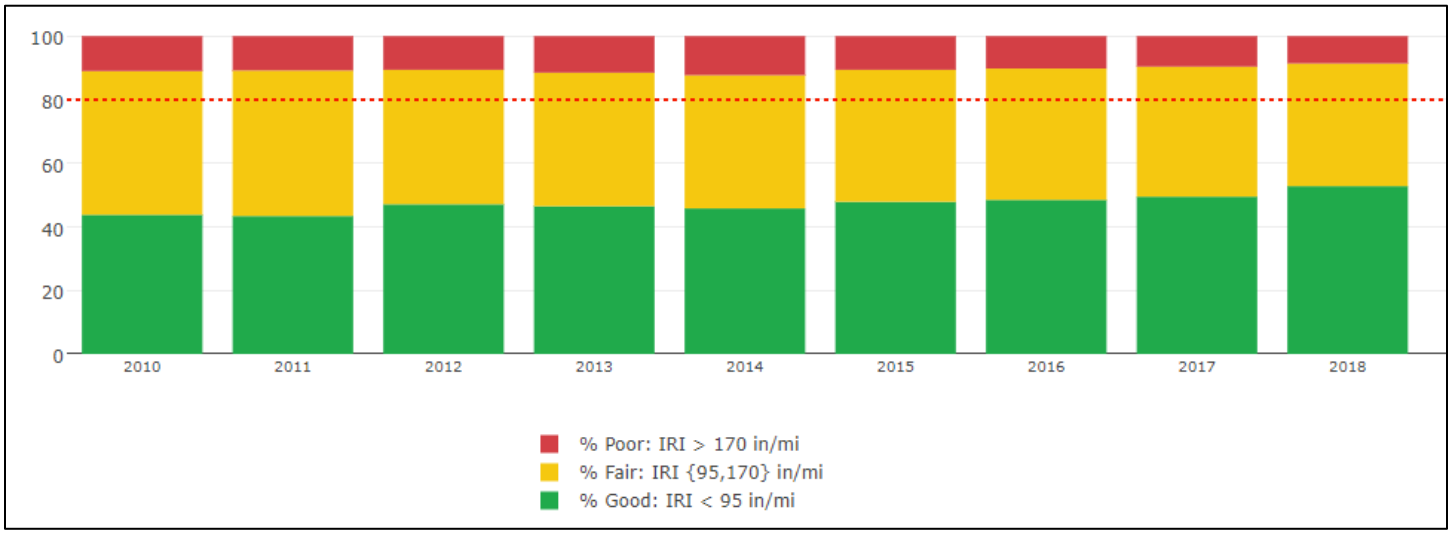
FEDERAL PERFORMANCE MEASURES AND TARGETS

Pavement Metrics	FHWA measures & UDOT targets (2020 & 2022)
Interstate Good: Percent of lane miles in good condition	2-year >60%
	4-year >60%
Interstate Poor Percent of lane miles in poor condition	2-year <5%
	4-year <5%
NHS Non-Interstate Good: Percent of lane miles in good condition	2-year >35%
	4-year >35%
NHS Non-Interstate Poor: Percent of lane miles in poor condition	2-year <5%
	4-year <5%
Bridge Metrics	**FHWA measures & UDOT targets (2020 & 2022)**
Percentage of NHS bridges in good condition	2-year >40%
	4-year >40%
Percentage of NHS bridges in poor condition	2-year <10%
	4-year <10%

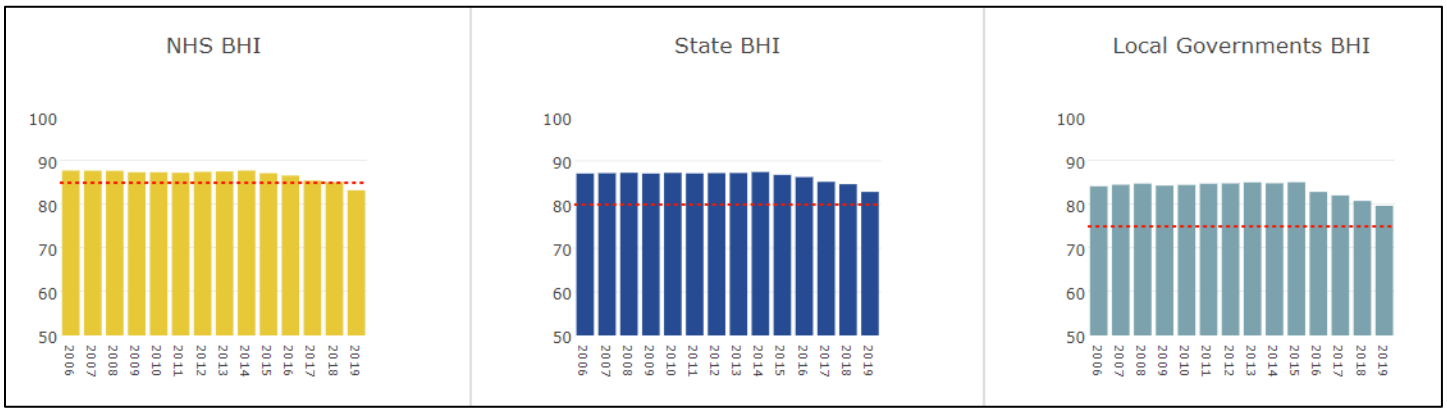
To see the results of Utah's Federal metrics click this link: Utah Federal Infrastructure Metrics

UDOT PERFORMANCE MEASURES AND TARGETS

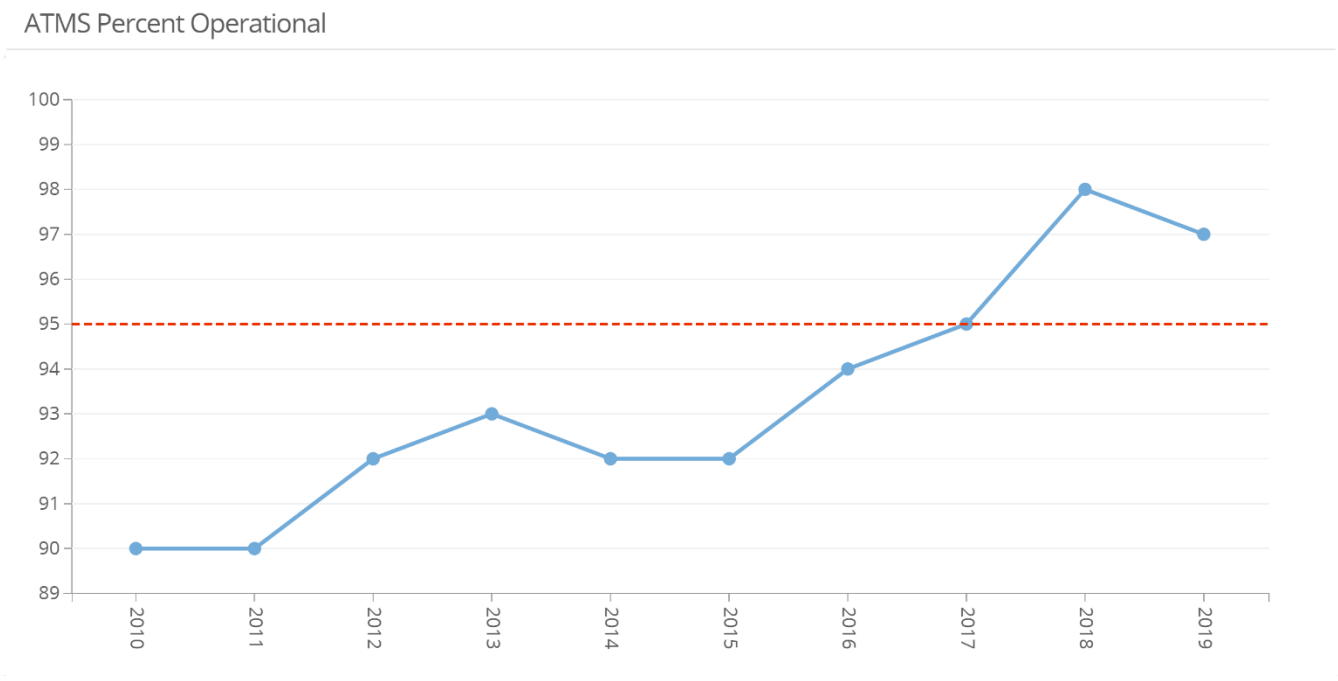
UDOT Pavement performance measures, targets and condition as of December 2018 is shown below. Utah's overall pavement condition target is 80% good or fair.



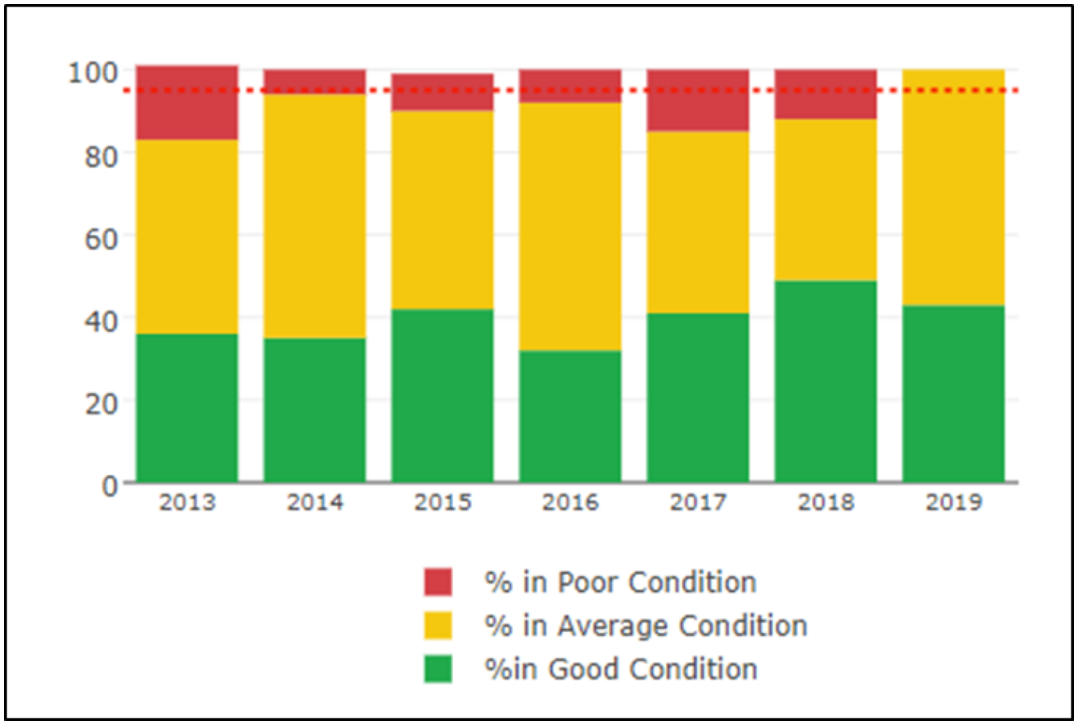
UDOT Bridge performance measures, targets and condition as of March 2019 is shown below. The target for NHS bridges is BHI of 85. The targets for state owned non-NHS bridges is BHI of 80 and for local government bridges is BHI of 75.



UDOT ATMS Devices performance measures, targets and condition as of June 2019 is shown below. The target is for 95% of ATMS devices operational.



UDOT Signal System performance measures, targets and condition as of June 2019 is shown below. The target for the signal system is 95% of signals in average and good condition.



To see live tier 1 performance metric data click this link: [UDOT Preserve Infrastructure Dashboard.]

PERFORMANCE GAP IDENTIFICATION

UDOT's Interstate pavements currently and historically have exceeded the target levels for good and poor conditions. The non-interstate NHS pavements currently and historically exceed the target levels for good and poor conditions. UDOT is also exceeding our statewide pavement condition performance target. Therefore, no pavement performance gap currently exists.

While currently well within targets, the percentage of good bridges in the state of Utah, both on and off the NHS, are consistently declining. The number of fair condition bridges continue to increase, and in time, without a proactive approach more fair condition bridges will drop from fair to poor condition than can be addressed in a given funding year. This potential performance gap is being proactively addressed through an increase in funding.

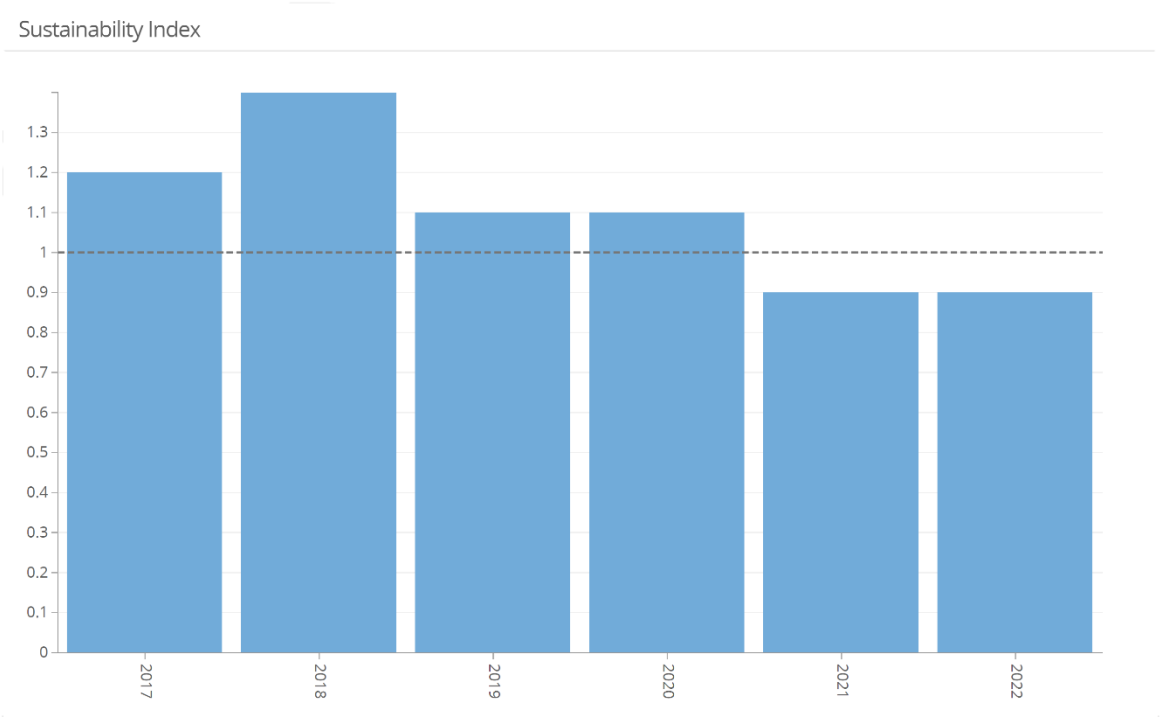
UDOT has established performance measures and targets for ATMS devices due to their importance to UDOT strategic goals. Currently UDOT has numerous devices that are beyond their expected life and are not operational or are not fully operational. Over the next few years this backlog will be eliminated, and critical devices will be replaced as they reach the end of their life and before they fail. The current level of funding will allow UDOT to reach the performance target for ATMS devices over the next few years.

UDOT has also established performance measures and targets for the Signal System as a tier 1 asset. The signal system is currently and historically below target condition. A management plan has been put in place to reach the signal system condition target.

LIFE-CYCLE PLANNING

PAVEMENT LIFE-CYCLE PLANNING

As part of the pavement life-cycle plan, UDOT has established the Sustainability Index. The Sustainability Index target goal is 1. The Index provides information that allows decision-makers to select a mix of pavement treatments that will achieve a sustainable pavement condition. Information on this measure definition, treatments with related benefits and associated targets can be found at this link: Pavement Condition Dashboard.

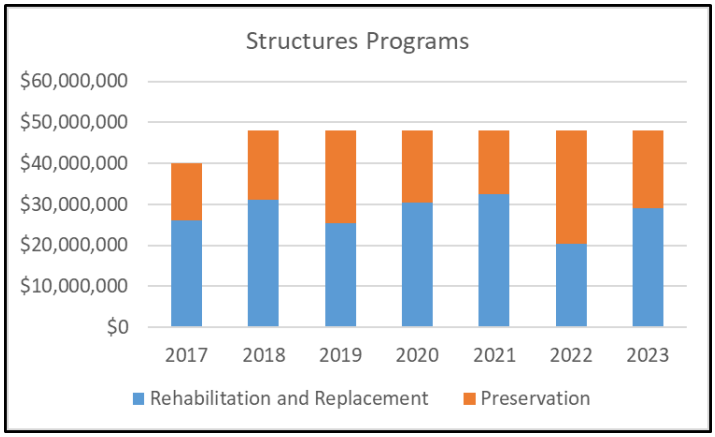


BRIDGE LIFE-CYCLE PLANNING

Bridge Management has been collecting bridge element level condition data for many years. By understanding the inventory and through the planning process, Bridge Management creates a plan for every structure to define preservation, rehabilitation and replacement options. Under the federal measure condition, the NBI component ratings for deck, superstructure, substructure, or culvert can systematically predict the type of work needed for the structure.

Treatment	Condition State (NBI)	Treatment Service Life
Preservation	≥ 7	10 Years
Rehabilitation	6 - 5	25 - 40 Years
Replacement	≤ 4	75 Years

The current plan for structures by treatment type based on the Utah Bridge Health Index is:



ATMS DEVICE LIFE-CYCLE PLANNING

The UDOT asset inventory and maintenance system manages component types, failure types, projects, manufacturers and vendors. Applying this system to the life cycle process, UDOT will replace each device at the end of its life prior to failure thereby supporting the safety, preservation and mobility strategic goals.

SIGNAL SYSTEM LIFE-CYCLE PLANNING

Life-cycle planning for the signal system is under development. At this time signal electronics and infrastructure is replaced on a priority basis as funding is available.

RISK MANAGEMENT ANALYSIS

Risk is incorporated into asset management at the program and system level. Program level risk is evaluated in four areas for each asset in tiers 1 and 2.

Asset	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Average Risk	Value	Tier
Pavements	6	3	8	7	6	$28B	1
Bridges	6	3	8	8	6	$11B	1
ATMS/Signals	6	6	5	5	5.5	$793M	1
Pipe Culverts	6	7	5	3	5	$1B	2
Signs	7	5	3	3	4.5	$300M	2
Walls	3	3	5	3	3.5	$3.4B	2
Rumble Strips	3	4	2	5	3.5	$6M	2
ADA Ramps	2	2	1	5	2.5	$20M	2
Barrier	3	1	4	2	2.5	$450M	2
Pvt. Markings	2	1	2	5	2.5	$42M	2

System level risk is analyzed at the intermediate planning process level and is being implemented based on the results of "The I-15 Corridor Risk and Resilience (R&R) Pilot Project". Risk mitigation investments will become a part of projects developed through this corridor level planning process.

SUMMARY OF TRANSPORTATION ASSETS REPEATEDLY DAMAGED BY EMERGENCY EVENTS

To date no assets in Utah have been twice damaged due to an emergency event as defined by FHWA. UDOT does have procedures in place for communication and rapid response during states of emergency as well as more targeted emergencies, such as bridge hits or small area flooding. A map layer in UDOT's interactive mapping center (UPLAN) has been created to display the location and project information for all projects that use Emergency Funds (ER projects). A process is under development that will automatically alert appropriate people when projects are added to the map. This will allow UDOT staff to track areas that are prone to damage during emergency events and develop plans to mitigate or avoid future damage.

FINANCIAL PLAN

UDOT relies on the federal funding process, state annual budget process, and distribution decisions by the Transportation Commission for transportation funding. Funding available varies each year depending on the national and state economies and priorities of decision-makers and historically comes primarily from three specific funds: the state Transportation Investment Fund, The state Transportation Fund, and Federal funds. Within the overall funding stream UDOT's pavement, bridges, and ATMS devices have dedicated funding as Tier 1 assets. Funding for each has been established based on projected needs to meet performance targets.

Asset Funding	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Pavement NHS	$108.0	$155.6	$156.1	$156.7	$157.2	$157.7	$158.2	$158.7	$159.3	$159.8
Pavement Non-NHS	$84.0	$94.4	$94.6	$94.8	$95.0	$95.2	$95.5	$95.7	$95.9	$96.1
Bridges NHS	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0
Bridges Non-NHS	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0
ATMS Devices NHS	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5
ATMS Non-NHS	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2
Signal Systems NHS	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5
Signals Non-NHS	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1
Amounts shown for each fiscal year is in Millions $										

INVESTMENT STRATEGIES

- Pavement Strategy 1: Maintain current condition of Interstate, NHS and other routes with over 1,000 AADT (high volume) so that greater than 60% of pavements are in good condition and less than 5% are in poor condition.
- Pavement Strategy 2: Improve non-NHS and other roads with less than 1,000 AADT (low volume) so that greater than 30% of the pavements are in good condition and less than 20% are in poor condition.
- Pavement Strategy 3: Apply maintenance, preservation, rehabilitation, and reconstruction treatments that when combined with new construction replace one year of life to the statewide pavement system each year.
- Bridge Strategy 1: Proactively provide preservation and rehabilitation treatments to bridges on NHS routes to maintain them at the target level of 85 % bridge health index.
- Bridge Strategy 2: Apply a balance of proactive preservation and condition-based rehabilitation or replacement treatments on non-NHS State owned bridges to maintain a bridge health index of 80 % or greater.
- Bridge Strategy 3: Coordinate with local owners of bridges to develop an appropriate treatment plan when local funding is available to achieve the target level of 75% Bridge Health Index.
- ATMS Strategy 1: Replace highest value devices prior to their end of expected life and failure in support of the UDOT Strategic Goals.
- ATMS Strategy 2: Maximize funding by replacing devices within projects developed for other assets.
- Traffic Signal Strategy 1: Conduct preventative maintenance regularly on existing signal equipment to meet target of 95% of system in average or better condition.
- Traffic Signal Strategy 2: Implement the emergency maintenance response plan when emergencies occur.
- Traffic Signal Strategy 3: Apply the established maintenance management process to minimize equipment downtime and unexpected failures.
- Final investment strategy is the STIP approved annually by the Transportation Commission and FHWA.

NEXT STEPS

The next steps proposed in the continual maturation and improvement of asset management include:

- Develop a more formalized management process for some tier 2 assets
- Re-evaluate the contribution to decision-making of the current state performance measures to determine if they are the right measures to support UDOT Strategic Goals
- Finish the documentation of the signal system condition and analyze funding needs
- Imbed risk management into the intermediate planning process
- Mature and broaden the risk management process beyond the I-15 urban corridor
- Continue collaboration across UDOT department boundaries to develop a program of construction projects that optimize funding and move UDOT toward meeting the Strategic Goals.

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1. INTRODUCTION

UTAH NATIONAL HIGHWAY SYSTEM

The National Highway System (NHS) is a major network of roadways and bridges within the overall system. UDOT collects condition data on 100% of the NHS in Utah which consists of:

- 2,830 centerline miles of roadway
- 15, 584 lane miles of roadway
- 1,353 state-owned bridges
- 6 locally owned bridges

The Interstate and non-Interstate NHS routes cover the entire state and can be found on a map at this link: Utah National Highway System.

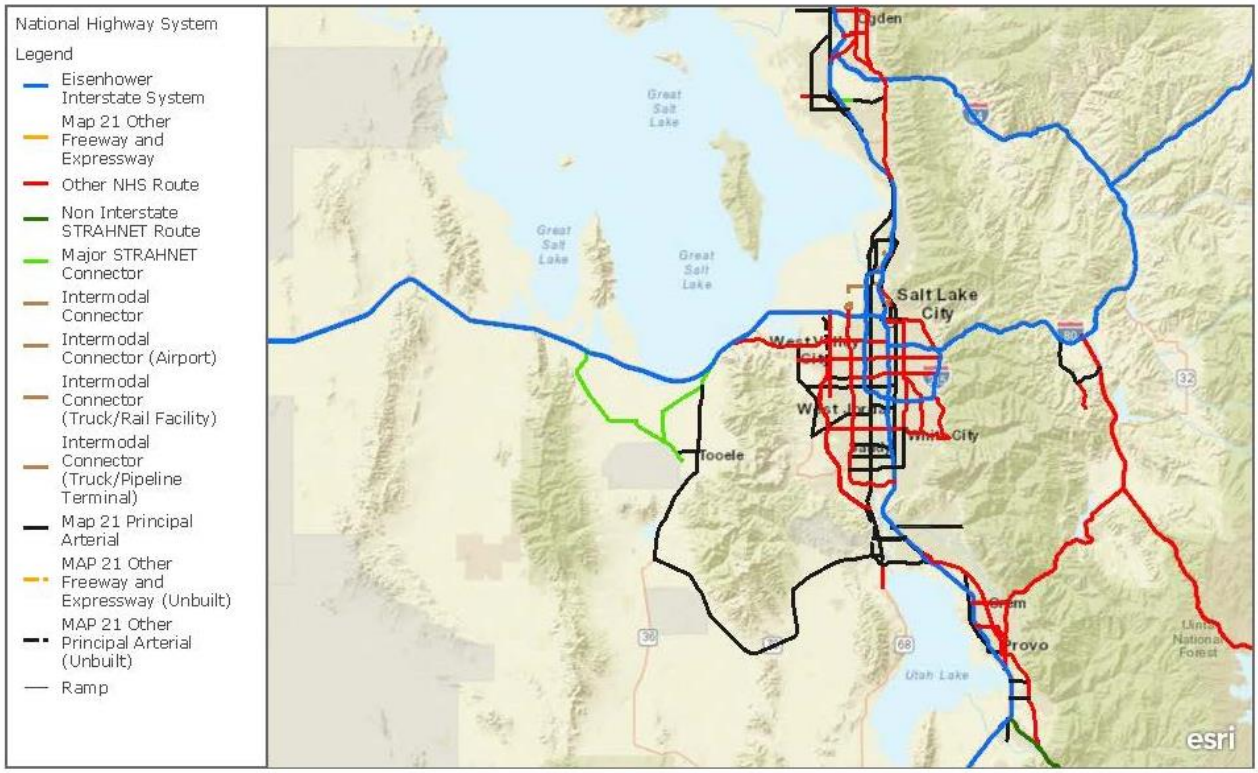

Figure 1. National Highway System Map.

OBJECTIVES OF THE UTAH TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

UDOT has established three strategic goals that guide and direct everything we do for the NHS and the statewide system. These goals are the foundation for reporting to our customers—the taxpayers of the state of Utah—how we are investing resources allocated to us by the state legislature. Progress toward these goals and updates to the associated strategies are reported in the annual Strategic Direction.

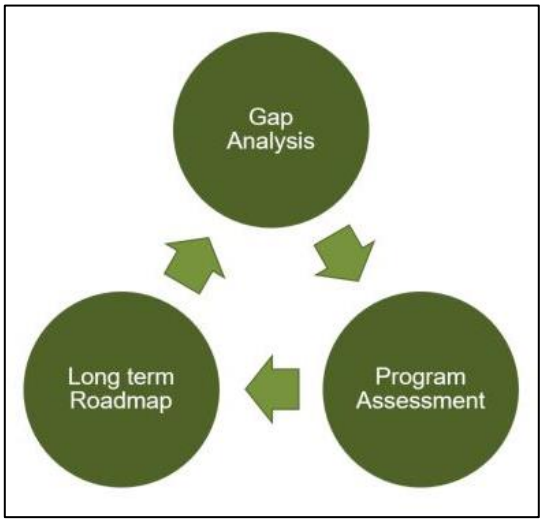

Figure 2. Program Assessment Flowchart.

The Utah Transportation Asset Management Plan (TAMP) is the plan UDOT follows to achieve the Preserve Infrastructure strategic goal. The specific objectives of this plan are:

- Formalize a data driven performance-based approach for allocating transportation funds to manage pavements, bridges and ATMS and signal devices
- Incorporate asset management into the intermediate and long-range planning processes
- Incorporate risk management into resource allocation decisions
- Provide a valuable asset management tool with dynamic data connections.

ROADMAP TO A COMPREHENSIVE PLAN FOR ASSET MANAGEMENT

To prepare for MAP21/FAST Act requirements and to move forward as a performance-based organization, the asset management oversight committee structure was revised, and a self-assessment gap analysis was completed (Figure 2). The reorganization of the oversight committee is included in Appendix A. The organizational gap analysis process and results are in Appendix B. Committee member comments from the self-assessment are included in Appendix C. The result of the organizational gap analysis and program assessment formed a roadmap for UDOT asset management that embraces MAP-21/FAST Act and UDOT goals of preserving infrastructure with a transparent, performance and risk-based approach.

Categorization of the program assessment comments resulted in the identification of three areas of focus:

- Program alignment
- Assets and performance
- Organized and accessible data

These focus areas create the framework for the Utah TAMP and the organizational structure. Objectives for each of the three areas of focus within the roadmap are shown in Figure 3.

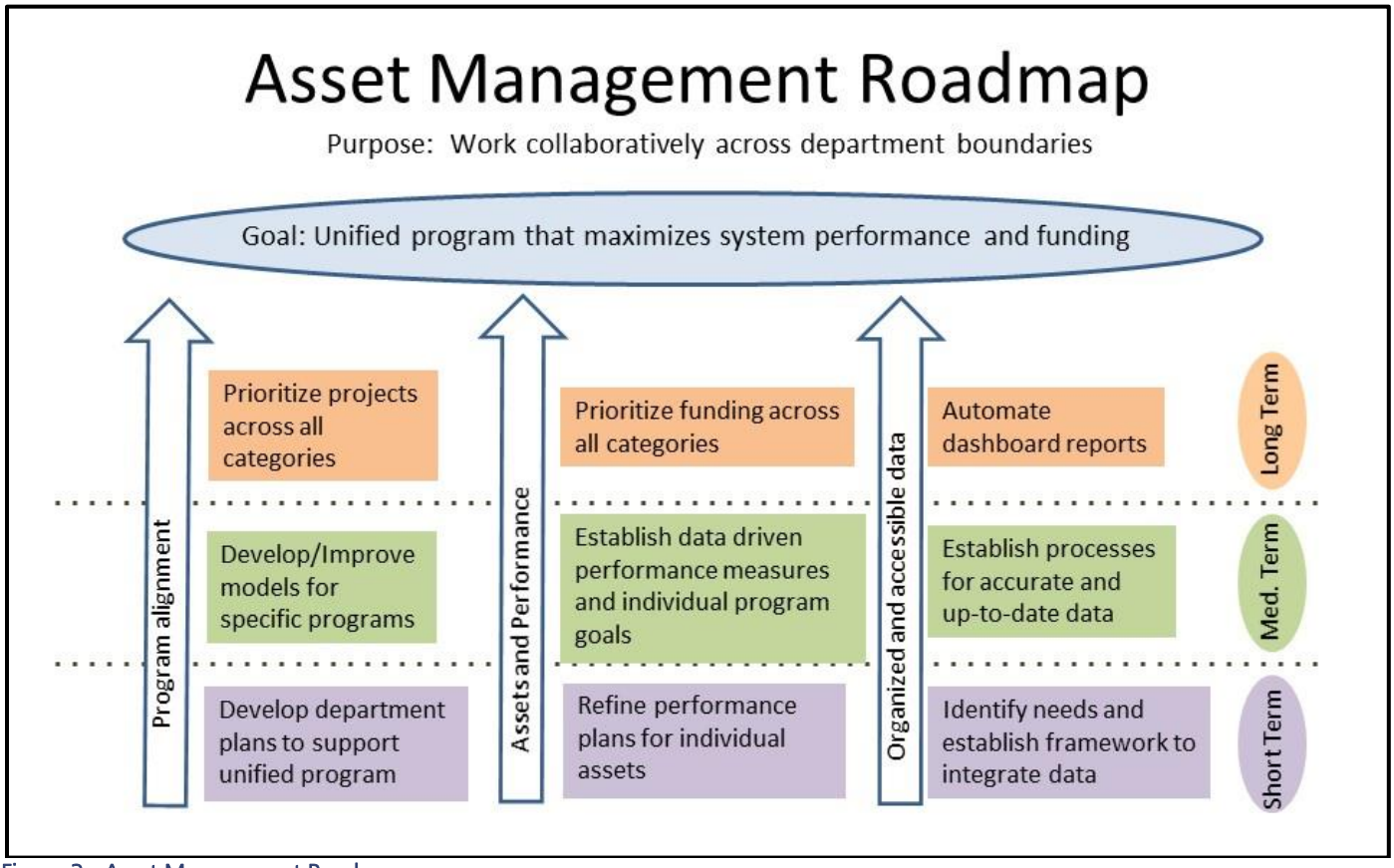

Figure 3. Asset Management Roadmap.

The UDOT goal for Asset Management is to work collaboratively across Divisions to develop a unified program that maximizes system performance and funding and put in place a process to quantify risks to assets in the UDOT system. The initial oversight committees identified and approved objectives for the purpose of continuous improvement of asset management within UDOT.

With roadmap efforts well underway, it became clear that asset management is a subset of performance management. Therefore, the committee structure was again revised to form the Performance Management Committee (PMC). Members of this committee are the managers of every UDOT Division and are key to UDOT transitioning to a performance-based organization. A subcommittee remains focused on asset management (AAC) and regularly reports key decisions and developments to the PMC. Membership of the AAC is depicted in Appendix A.

ROADMAP IMPLEMENTATION

Each UDOT division and the Committees are working separately and collectively to fulfill the objectives and needed tasks to accomplish the roadmap goal of maximizing available funding. The short and medium-term objectives are well underway and steps to accomplish the long-term objectives have been defined and initiated. Following is a summary of work associated with each category of the roadmap.

PROGRAM ALIGNMENT

Consolidating data collection of several individual UDOT divisions into a single contract was the kick-off to program alignment. Collaboration between UDOT divisions continues toward developing the ability to prioritize projects irrespective of specific funding categories. The replacement value of each asset has been calculated and a financial model defined based on life cycle costs for the highest value/risk assets. Work continues to complete an information loop of project planning, design, construction and maintenance. Developing this consistent loop of communication will improve the accuracy and efficiency of each separate process and thereby the overall UDOT program. It will also tie the Long-Range Plan process and results to the STIP process (Figure 4).

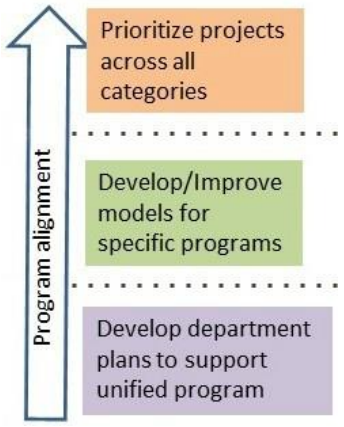

Figure 4. Program alignment.

ASSETS AND PERFORMANCE

The wealth of data now available due to a unified and automated collection process allows UDOT to evaluate conditions and develop a performance-based plan that includes all assets to the level appropriate to the value and risk associated with each. Following the roadmap, UDOT will continue to identify risks, performance measures and life cycle costs for numerous assets in a joint effort to better prioritize funding across all funding categories (Figure 4).

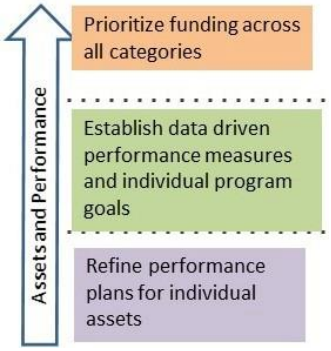

Figure 5. Assets and Performance

ORGANIZED AND ACCESSIBLE DATA

The influx of data and information provides an opportunity and urgency for UDOT to develop a more systematic approach and structure for data storage and access. The ability to import and export data to all existing and future business systems has provided the opportunity to create interactive dashboards. Dashboards are used by decision-makers at multiple levels to maximize system performance and funding. The structured and organized details associated with each data set allows groups to reference any related data to make better decisions (Figure 6).

The organization and structuring of the data have also led to the ability to create live data sets to documents such as this TAMP. The charts and graphs automatically update in real time as data is received and analyzed by each Division staff. The "intelligent" TAMP is a management tool for all UDOT leaders. All links within this document provide access to the most current data.

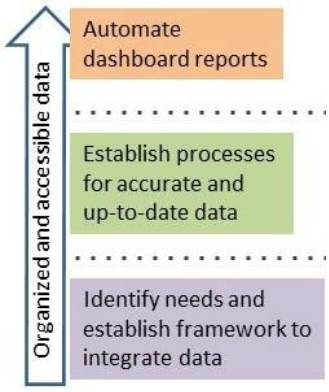

Figure 6. Organized and Accessible Data.

ASSET REGISTER

The first step to organizing the influx of data from the unified data collection process resulted in a register of all major UDOT assets. The second step was to add the current value of each of the assets to the register.
In addition to pavements and bridges, UDOT maintains registers of many roadway assets through routine high-tech LiDAR scanning and maintenance inventories of the state highways. These registers are used to track the quantity and some condition information of each UDOT asset. UDOT also maintains an extensive database of current unit bid item costs compiled from the advertisement of new construction projects. This database is used to establish the replacement value of the quantified assets. Additional sources of information, such as R.S. Means, are referenced to establish a value for specialty items that are not in the database. A contingency amount is included in the replacement value of each asset to account for design, construction oversight, traffic control, and mobilization costs.

The current quantified assets and their value are shown in Table 1 and Figure 6. The values shown for tier 1 assets reflect costs to completely replace the asset including mobilization, traffic control, design and construction engineering, etc.

Table 1. Asset Register.

ASSET TYPE	QUANTITY	VALUE
Pavement & Bridge Assets		
Pavement NHS	115,694,396 SY	$20,000,000,000
Pavement Non-NHS	57,850,911 SY	$8,000,000,000
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Fences	1,890 Miles	$70,000,000
Cattle Guards	895 Each	$20,000,000

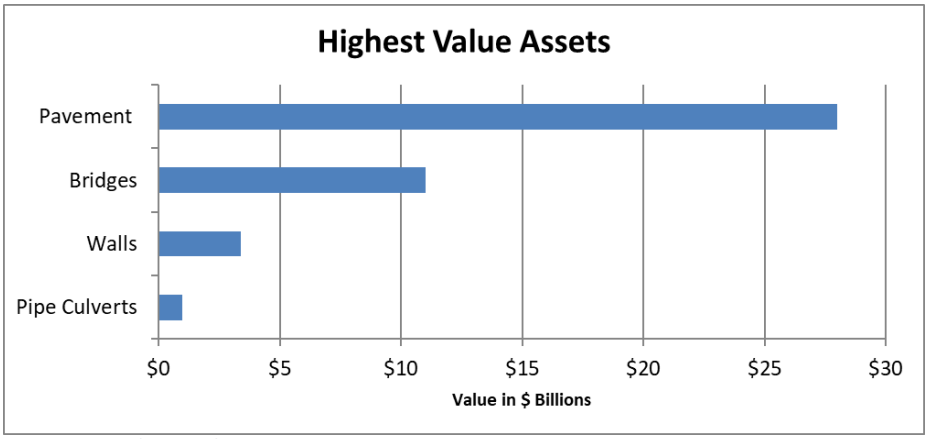


Figure 7. Highest Value Assets.

ASSET MANAGEMENT TIERS

To accomplish the objective of allocating transportation funding toward the most valuable assets and those with the highest risk to system operation, the Asset Advisory/Performance Management Committees developed a tiered system of asset management. Asset Management tiers range from one to three with tier one being the most extensive management plan for the highest value assets (Table 2).

Tier 1 – Performance-Based Management

Assets in the tier 1 management level are highest value combined with highest risk of negative financial impact for poor management. These are assets that are very important to the UDOT performance plan success and are recommended for a significant separate funding source. Management plans for tier 1 assets include elements such as:

- Accurate and sophisticated data collection
- Targets and measures set and tracked
- Predictive modeling and risk analysis
- Dedicated funding through UDOT's annual STIP workshop process

Tier 2 – Condition-Based Management

Assets in the tier 2 management level are moderate value and substantial importance to transportation system operation. These assets have a moderate risk of negative impact for poor management or asset failure. They may have a separate funding source. Management plans for tier 2 assets include elements such as:

- Accurate data collection, less than annually
- Risk assessment primarily based on asset failure
- Condition targets
- Management strategy based on condition

Tier 3 – Reactive Management

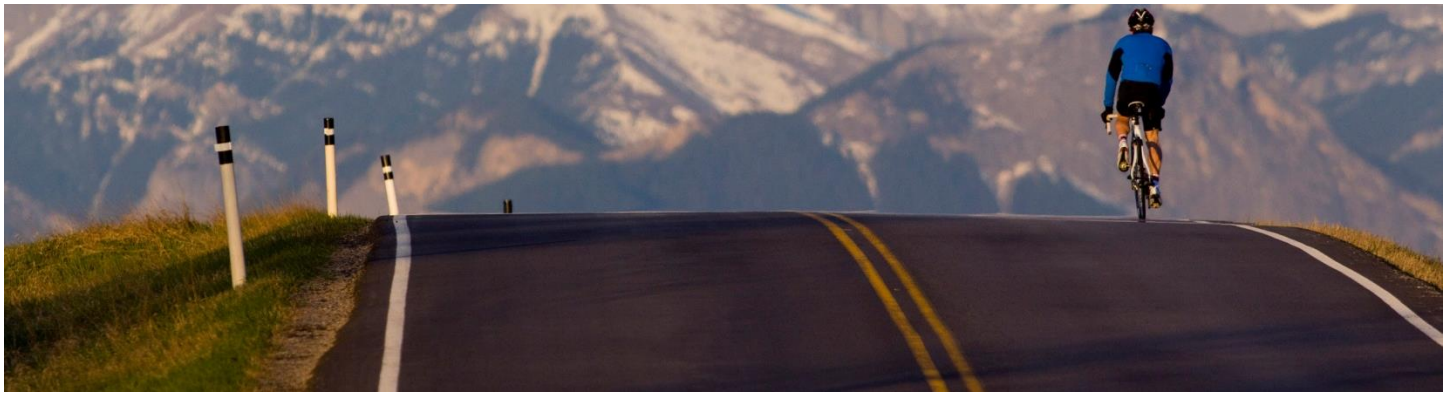
Assets in the tier 3 management level are generally the lowest value assets with the lowest risk of negative impact for poor management or asset failure. Management plans for tier 3 assets include elements such as:

- Risk assessment based on asset failure
- General condition analysis
- Reactive management involving repair or replacement when damaged

Table 2. Asset Tiers.

	Asset	*Tier*
Performance	Pavement	1
	Bridges	1
	ATMS Devices	1
	Signal Devices	1
Condition	Pipe Culverts	2
	Signs	2
	Walls	2
	Rumble Strips	2
	ADA Ramps	2
	Barrier	2
	Pavement Markings	2
Reactive	Cattle Guards	3
	Interstate Lighting	3
	Fences	3
	Rest Areas	3
	Curb and Gutter	3
	Trails	3
	Bike Lanes	3
	Surplus Land	3
	At-grade Railroad Crossing	3

Tier 1 assets are managed with performance measures and targets as detailed in this TAMP. Tier 2 assets are managed with condition and risk focus by the responsible UDOT Division. Tier 3 assets are managed reactively within funding availability and assessed risk.



2. PERFORMANCE-BASED MANAGEMENT

UDOT uses a performance-based approach to maintain the National Highway System (NHS) in a state of good repair and manage the assets identified as Tier 1. This approach is an extension of and in support of the Unified Plan compiled in collaboration with the state's Metropolitan Planning Organizations and Utah Transit Authority. Projects to maintain or improve NHS and asset condition become part of the STIP through the process described in chapter 7. Through data driven performance-based management UDOT developed targets for state primary and secondary performance measures as well as the required federal performance measures. While UDOT understands and embraces the need for the federal performance measures our state measures provide the foundation to drive daily decisions for managing asset condition in a cost-effective manner to accomplish UDOT's strategic goals. Additionally, our state measures meet federal measures for the NHS.

FEDERAL PERFORMANCE MEASURES

The National Highway System (NHS) in Utah consists of 2,830 miles and 1,356 bridges. UDOT owns all but 6 of the bridges and all but 49 miles of pavement which is owned by several Cities, Counties and the National Park Service. UDOT collects condition data on 100% of the NHS. Through collaborative discussions with the Metropolitan Planning Organizations and other local owners it was determined to be most cost effective for UDOT to collect all condition data for pavements and bridges since less than 1% of the NHS is locally owned. A Memorandum of Understanding was executed on April 16, 2018 between the Metropolitan Planning Organizations and UDOT. This MOU includes the agreement that UDOT will collect bridge and pavement condition data for the State asset management plan on all NHS routes irrespective of ownership and is found in Appendix F.

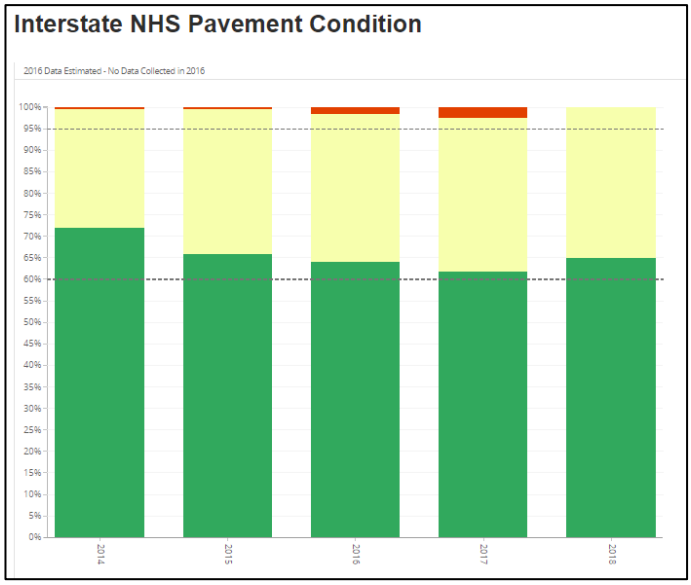
Through a data driven process, historic condition data and projected condition, targets have been established for the pavement and bridge performance measures established by FHWA for the National Highway System. Four metrics make up the pavement performance measure and are calculated based on data from the Highway Performance Monitoring System (HPMS). The four metrics are:

- Pavement roughness measured using the International Roughness Index (IRI).
- Rutting quantified for asphalt pavements by measuring the depth of ruts along the wheel path.
- Cracking measured in terms of the percentage of cracked pavement surface.
- Faulting quantified and averaged for jointed concrete pavements.

The federal pavement condition targets have been established to be consistent with the UDOT strategy to maintain the NHS in a state of good repair.

Pavement Metrics	FHWA measures & UDOT targets (2020 & 2022)
Interstate Good: Percent of lane miles in good condition	2-year >60%
	4-year >60%
Interstate Poor Percent of lane miles in poor condition	2-year <5%
	4-year <5%
NHS Non-Interstate Good: Percent of lane miles in good condition	2-year >35%
	4-year >35%
NHS Non-Interstate Poor: Percent of lane miles in poor condition	2-year <5%
	4-year <5%

Figure 8. Federal Pavement Metrics.



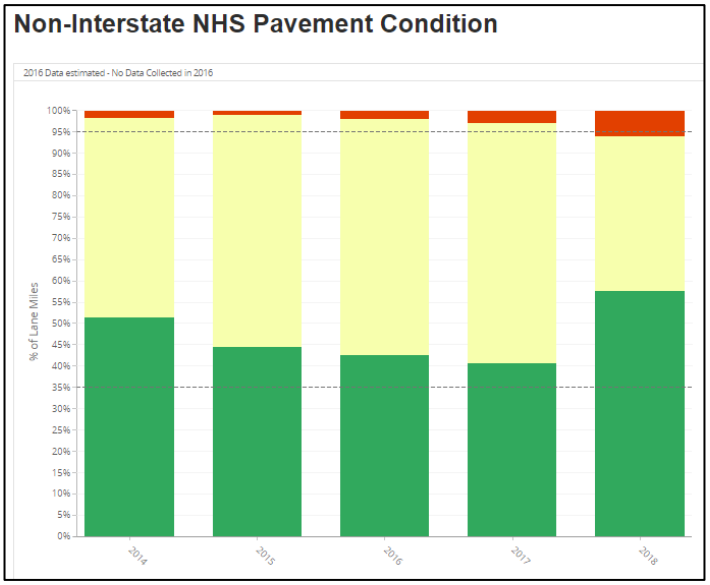


Figure 9. Pavement Targets and Condition.

The federal bridge performance measure is based on component ratings from the National Bridge Inventory (NBI). The bridge measure is determined by the lowest rating of deck, superstructure, substructure, or culvert, and evaluates the systemwide percentage of deck area in good, fair, and poor condition. A component rating of 7 – 9 is good condition, 5 – 6 is fair condition, and 4 or less is poor condition.

Bridge Metrics	FHWA measures & UDOT targets (2020 & 2022)
Percentage of NHS bridges in good condition	2-year >40%
	4-year >40%
Percentage of NHS bridges in poor condition	2-year <10%
	4-year <10%

Figure 10. Federal Bridge Metrics.

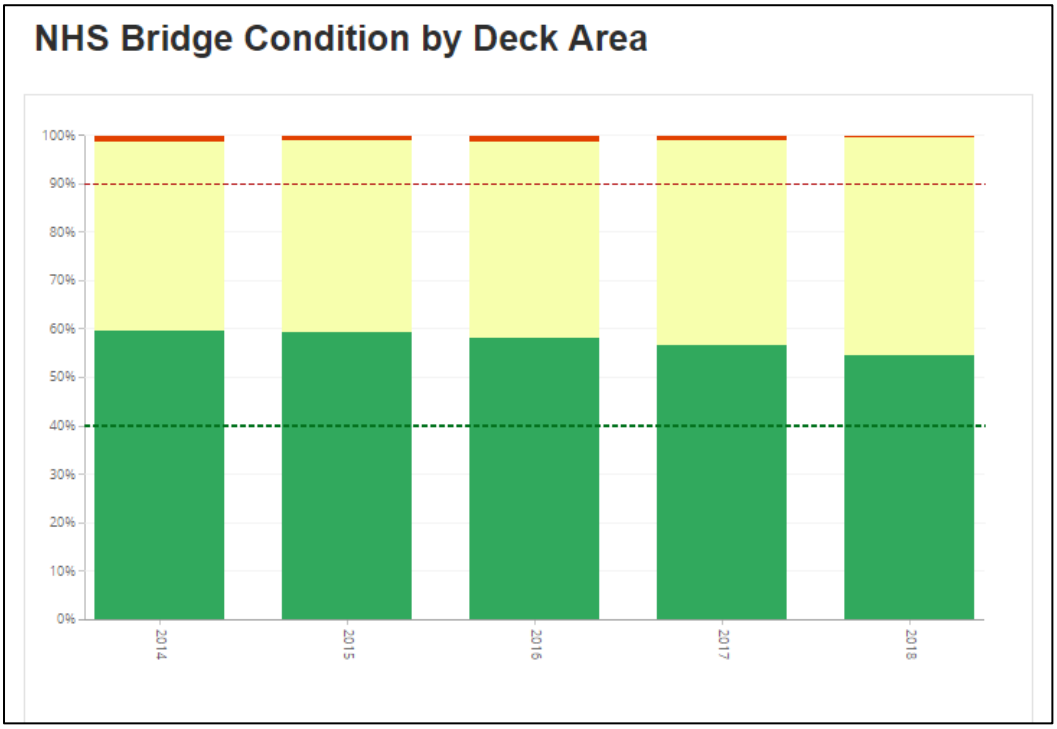


Figure 11. Bridge Targets and Condition.

Current condition data and information on Federal Infrastructure measures can be found at this link: [Utah Federal Infrastructure Metrics.]

STATE PERFORMANCE MEASURES

In support of the federal performance measures, UDOT Strategic Goals, and the asset management plan, UDOT has established state performance measures and targets for pavement, bridges, ATMS devices and signal systems. Transportation funds and work effort are allocated to these tier 1 assets based on systematic improvement or maintenance of asset condition and value.

UDOT PAVEMENT PERFORMANCE MEASURES AND TARGETS

UDOT reports percent of mileage in Good, Fair and Poor condition using the collected 0.1-mile IRI data. These ranges are; Good: with IRI $<$ 95 in/mi, Fair: with IRI between 95 and 170 in/mi and Poor: with IRI $>$ 170 in/mi.

To assure the system is adequately funded and not at any financial risk to be maintained per the Preserve Infrastructure strategic goal, the statewide condition target is to have 80% of the mileage rated Fair or better condition.

The Sustainability Index is a forward-looking performance measure developed to upgrade the Good Roads Cost Less philosophy that has been in place since early 1978. This index is based on each surfacing project providing a benefit to the pavement life. Assuming all pavements lose 1 year of life each year our projects should replace an equivalent amount of pavement life. This index supports UDOT's long term vision and pavement management strategy to maintain pavements in a continuous state of good repair.

Additional pavement condition data can be found at: [Pavement Condition Dashboard.]

UDOT BRIDGE PERFORMANCE MEASURES AND TARGETS

The UDOT performance measure for bridges is based on the Bridge Health Index (BHI), a measure to describe the overall structural condition of each bridge calculated from AASHTO Element Level ratings. This index is used as a tool for planning and tracking UDOT's bridge system condition. The BHI is calculated at the element level as a ratio of the value of the bridge in the bridge's current condition to the value of the bridge in the best possible condition. This tool supports decisions focused on maintaining each bridge in a state of good repair.

A BHI of 80 – 100 is classified as good condition, while a BHI of 60 – 80 is classified as fair condition, and a BHI less than 60 is classified as poor condition.

The performance measure targets are as follows:

- State Owned NHS Bridges: Systemwide average BHI of 85 or greater
- State Owned Non-NHS Bridges: Systemwide average BHI of 80 or greater
- Locally Owned Bridges: Systemwide average BHI of 75 or greater

The measures and targets for the three categories of bridges and the historical and current condition of each is found at the following link: Structures Dashboard.

UDOT ATMS DEVICE PERFORMANCE MEASURE AND TARGET

The UDOT performance measure for ATMS devices is the percent of devices in operational condition. The ATMS system is made up of several different types of devices and the measure and target are tracked separately and reported monthly for each type of device and averaged into a composite score. The condition target is 95% of the system in operational condition. The current condition information is found at the following link by scrolling down to the ATMS section: UDOT Preserve Infrastructure Dashboard.

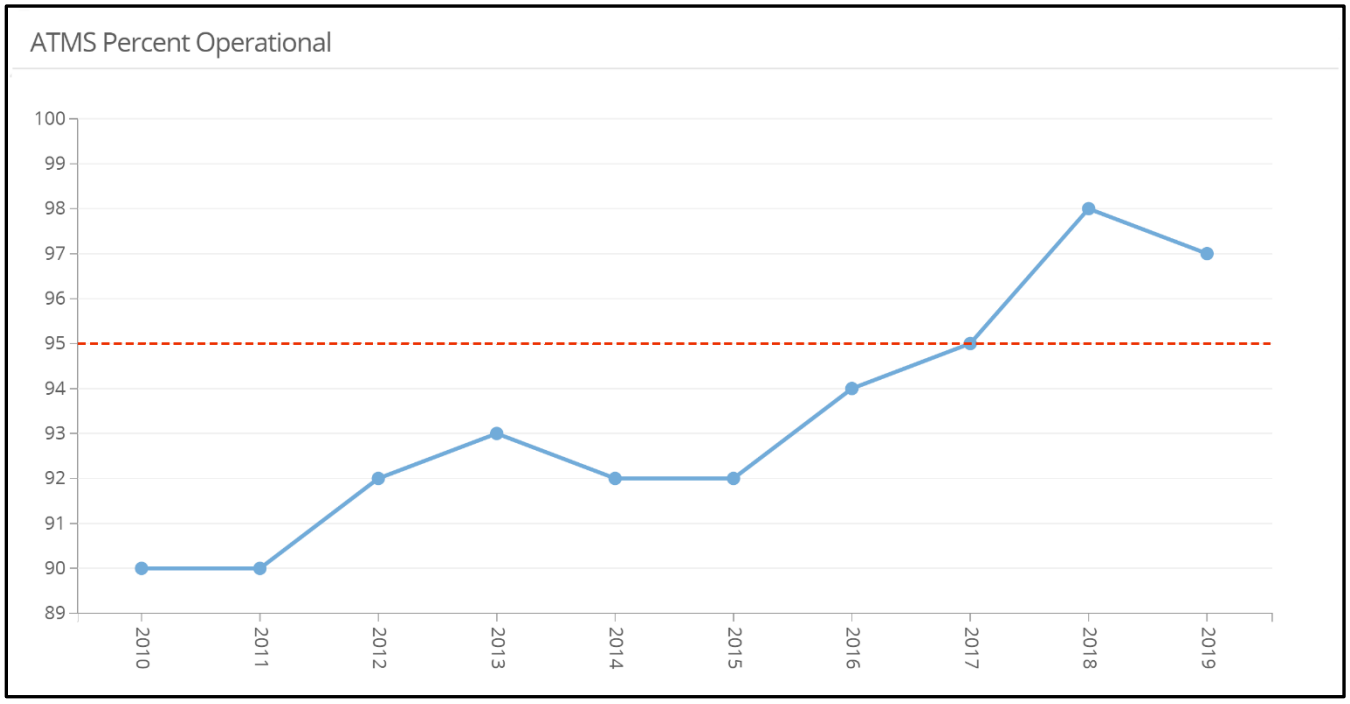


Figure 12. ATMS performance target and historic condition.

UDOT SIGNAL SYSTEM PERFORMANCE MEASURE AND TARGET

The performance measure for the UDOT Signal system is the percent of signals that are in good or fair condition based on annual inspection of all electronics and physical infrastructure associated with signal systems. The target is 95% of the statewide system in good or fair condition.

Historical and current condition data and information on the signal system and all UDOT Preserve Infrastructure performance measures and targets can be found at the following link: [UDOT Preserve Infrastructure Dashboard.]

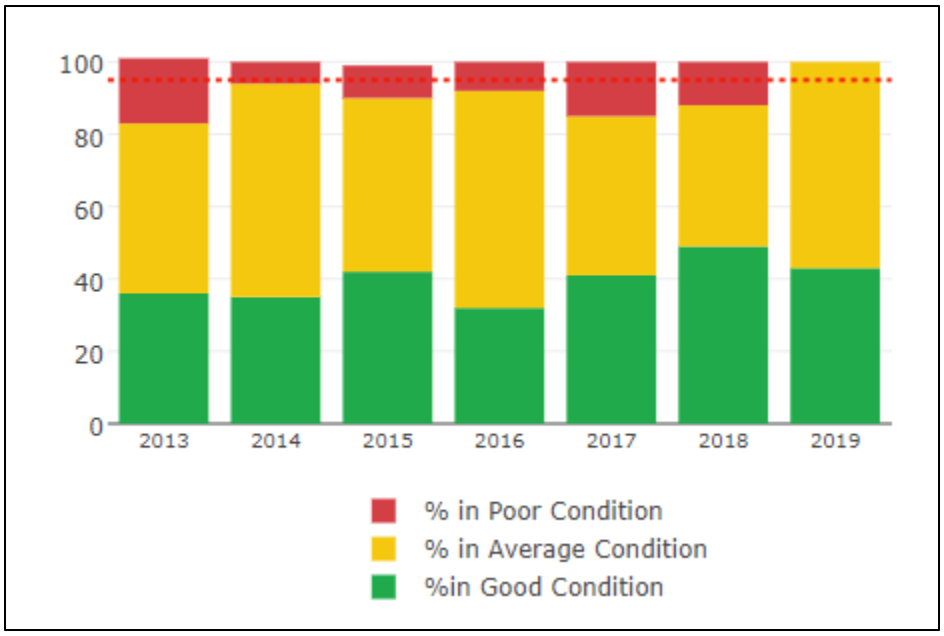


Figure 13. Signal performance target and historic condition.

3. PERFORMANCE GAP IDENTIFICATION

UDOT has numerous years of pavement and bridge condition data. Based on this historical data, targets have been set for the percentage of pavements and bridges in good and poor condition per Federal requirements. These targets focus UDOT activities and decisions to maintain the NHS and all pavements and bridges in a continuous state of good repair. UDOT has created a dashboard to track and report the federal infrastructure measures. The most current data for these measures can be found at this link: Utah Federal Infrastructure Metrics.

PAVEMENT PERFORMANCE GAP

As shown in Utah Federal Infrastructure Metrics, the Interstate pavements currently and historically have exceeded the target levels for good and poor conditions. Also shown is that the non-interstate NHS pavements historically exceed the target levels for good and poor conditions. The 2018 pavements in poor condition do not meet the target of less than 5%. The FHWA measures only look at the NHS pavements. UDOT is also exceeding our statewide pavement condition performance target. The pavement performance gap exists only for non-interstate NHS pavements. Analysis of projections from the pavement model and other metrics indicate that the programmed projects will result in a decrease of poor pavements.

New lane miles are continually added to the roadway system with New Construction projects. These projects create an annual gap in maintenance resources. To close this gap, UDOT dedicates a portion of the Utah Transportation Investment Fund (TIF) to the pavement, bridge and maintenance budgets to cover this annual increase of need. The gap is covered by calculating each year the amount of new surface area added to the system. The new surface area is multiplied by the average cost of maintaining roadways in Utah using a 3-year average and the result is added to the maintenance budget from the TIF program. Based on the surface type the new area is evaluated for future pavement and bridge treatments and their associated costs with inflation. The amount calculated for pavement treatment needs is added to the pavement budget. The remaining TIF funds go to support bridge maintenance and new construction.

BRIDGES PERFORMANCE GAP

UDOT is currently meeting both good and poor targets for federal performance measures and have continuously met these targets over the last 10 years.

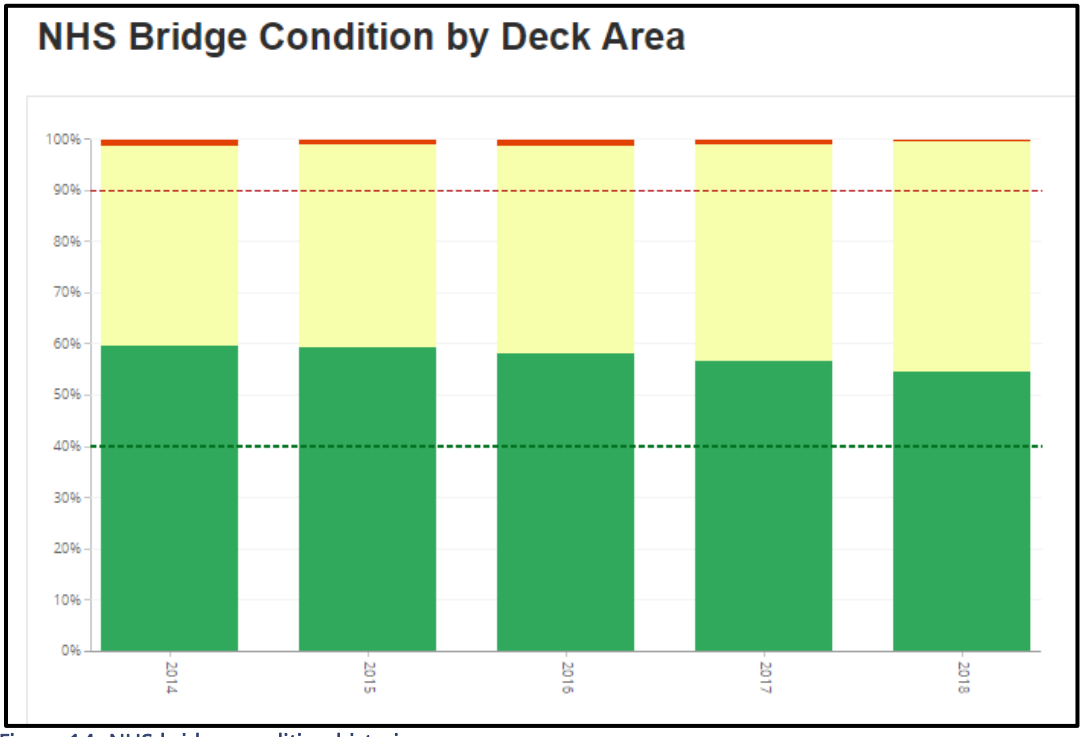


Figure 14. NHS bridge condition historic.

The Federal performance measures only look at NHS bridges. Non-NHS bridges also meet both targets at this time. As shown in Utah Federal Infrastructure Metrics, that while currently well within targets, the percentage of good bridges in the state of Utah, both on and off the NHS, are consistently declining. The number of fair condition bridges continue to increase, and in time, without a proactive approach more fair condition bridges will drop from fair to poor condition than can be addressed in a given funding year. This potential performance gap is being proactively addressed through an increase in funding discussed in the Financial Plan chapter of this document.

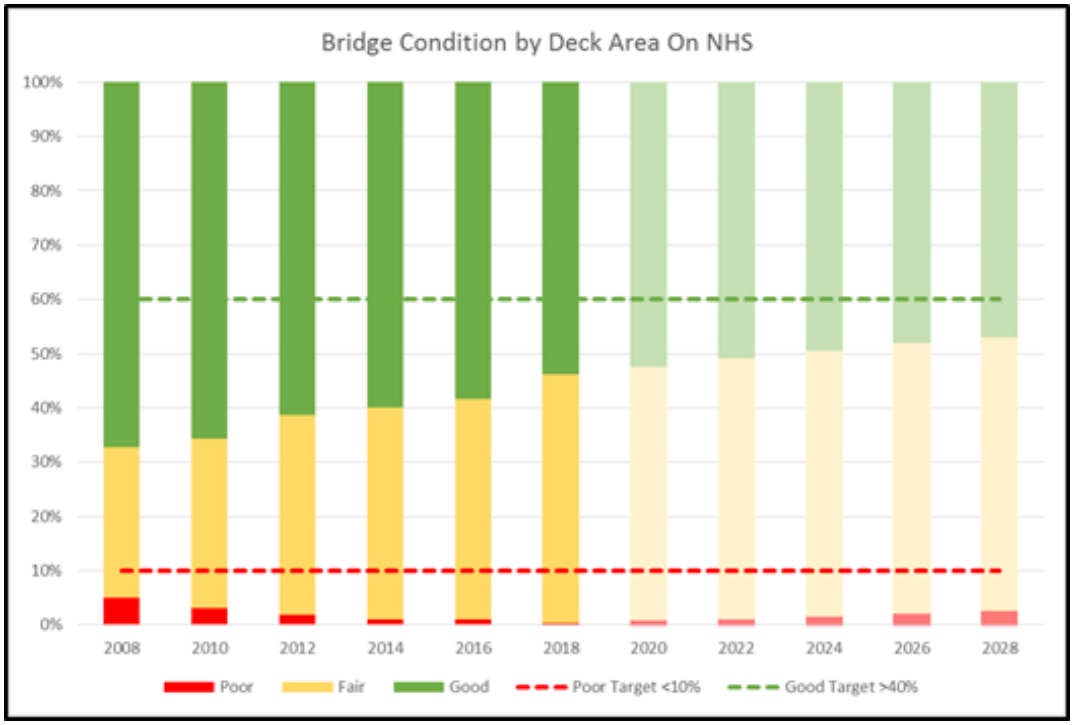


Figure 15. NHS bridge condition projections.

The increase in funding required to maintain the NHS and UDOT system in a state of good repair was based on a high-level evaluation of the system as a whole. Each bridge was given a good, fair, and poor condition classification based upon the lowest NBI component rating, consistent with the Federal Performance Measures. Bridges in good condition were assigned preservation treatments and treatment costs associated with such. Bridges in fair condition were assigned rehabilitation treatments. Bridges in poor condition were assigned replacement treatments. The total cost of these treatments was evenly distributed annually over 20 years.

Existing structures specific funding, new construction projects in the Long-Range Plan and redistribution of Federal Funding left a shortfall that was closed with the 2015 State Gas Tax Increase. The combined sources of funding result in a projection for both NHS and non-NHS bridge systems to remain within current performance targets.

New bridges are continually added to the system with New Construction projects. These projects create an annual gap in bridge maintenance resources. To close this gap, UDOT dedicates a portion of the Utah Transportation Investment Fund (TIF) to the bridge, pavement, and maintenance budgets to cover this annual increase of need. The gap is covered by calculating each year the amount of new bridge deck area added to the system. Based on the bridge type the new bridges are evaluated for future treatments and their associated costs with inflation. The amount calculated for treatment needs is added to the bridge budget. The remaining TIF funds go to support pavement maintenance and new construction.

ATMS PERFORMANCE GAP

ATMS devices must be functioning and reliable for UDOT to achieve the Safety and Mobility strategic goals. Therefore, UDOT has included these devices in the highest tier for asset management. Although federal requirements do not exist for ATMS device performance UDOT has set performance measures and targets for all ATMS devices as part of the Preserve Infrastructure strategic goal.

The UDOT state performance measure for ATMS devices is the percentage of devices operational as reported monthly by the Traffic Management Division. The historic and current percentage data can be found at this link: UDOT Preserve Infrastructure Dashboard.

Currently UDOT has numerous devices that are beyond their expected life and are not operational or are not fully operational. These devices are listed in the Backlog column in Table 3. The remaining columns detail the number of each device to be replaced in future years to close the performance gap.

Table 3. ATMS Device Replacement Schedule.

DEVICE TYPE	ADDRESSED IN CONST.	BACKLOG (<2017)	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
VMS	4	21	34	8	6	18	31
TMS Freeway Operations	17	0	19	90	43	79	27
CCTV	14	0	1	154	1	113	198
Express Lanes Freeway Operations	18	105	24	0	18	37	0
RWIS	0	0	53	26	58	117	90
Communication switches	33	18	1	541	0	246	0
Misc.	6	1000	0	0	321	0	0

Recognizing the importance of these devices to UDOT success, the Utah Legislature allocated $3.9M dollars each year for device replacement and upgrades. Over the next few years the backlog will be eliminated, and critical devices will be replaced as they reach the end of their life and before they fail. This funding is also supplemented by devices that are replaced within projects each year. The combination of funding will allow UDOT to reach the performance target for ATMS devices in the next few years. Funding needs will be tracked and adjusted as the system grows and life expectancy can be modified based on accumulated historical data and technology improvements.

SIGNAL SYSTEM PERFORMANCE GAP

The UDOT Signal system is included in the highest tier for management. Signalized intersections and related infrastructure manage traffic, and provide a safe, and reliable movement of goods, services and people. Based on an annual assessment of all signal electronics and physical infrastructure associated with signals the target has been set as 95% or more of the system in better than poor condition. The historic and current signal condition data can be found at this link: UDOT Preserve Infrastructure Dashboard.

The signal system is currently and historically below target condition. Minor repairs are made throughout the year with maintenance money. Replacement and installation of new signals is funded through projects on the STIP. The management plan to reach the signal system condition target is:

- Update signal assessment process to make it more objective and consistent across the state.
- Map signal condition in UDOT's interactive mapping platform (UPLAN).
- Communicate signal replacement and upgrade needs to the Regions so they can incorporate the costs into the project scoping and construction estimates for STIP projects.
- Replace highest priority locations first with money available.

4. LIFE-CYCLE PLANNING

For over 40 years UDOT has used the pavement management strategy of "Good Roads Cost Less" to maintain pavements. Based on a wealth of historical pavement condition information that supports this life-cycle planning strategy it is now being expanded to cover other roadway assets. Life cycle plans covered in this document in addition to pavement are bridges, signals and ATMS devices. UDOT incorporates life-cycle planning into the performance-based management for each of these assets through the definition of secondary performance measures. These secondary measures focus efforts on minimizing long-term costs and maximizing length of life for each asset.

PAVEMENT LIFE-CYCLE PLANNING

UDOT has used the same pavement management deterioration model since the early 1990's. The model uses the most current information including the current traffic volumes, pavement condition, project costs, and pavement management strategy to recommend projects for the STIP. The model is configured to accommodate different strategies for each pavement type such as interstate, high-volume asphalt, low volume asphalt, etc. Configuration also includes deterioration rates, different treatment types, current construction costs, etc. The model evaluates all possible treatment strategies for every pavement section. Each of the treatments have a unit cost and associated benefit.

The model output is a suggested set of treatments at a specified funding level. Treatments fall into the broad categories of preservation, rehabilitation, and reconstruction.

- Preservation treatments correct surface defects improve ride quality and improve safety characteristics and extend life of the pavement without increasing structural capacity.
- Rehabilitation treatments prolong the service life and enhance safety.
- Reconstruction projects are identified where the existing pavement section life expectancy has been met or is approaching. Additionally, reconstruction is identified where all preservation and rehabilitation treatment options have been exercised and/or evaluated and will not yield a good return on investment.

The model suggests a set of projects over a five-year time frame based on the highest benefit to the overall system condition/cost. The resulting list of projects is sent to each UDOT Region for consideration and final recommendation to be included in the current year STIP.

Table 4. Pavement treatment benefits.

Preservation Treatments	Benefit Years
Chip Seal	7
Micro Surface	7
Concrete Repair	8
1" Treatment (BWC & OGSC)	10
Preservation-unspecified	10
1 1/2" Treatment (HMA & SMA)	10
Rehabilitation Treatments	
2" Treatments (HMA & SMA)	12
3" Treatments (HMA)	15
Rehabilitation-unspecified	15
Concrete Repair with Grind	15
4" Treatments (HMA)	18
> 4' Treatments (HMA)	20
Major Rehabilitation-unspecified	20
Reconstruction Treatments	
Reconstruct	25
New PCC	40

As part of the pavement life-cycle plan, UDOT has established the Sustainability Index. The Index provides information that allows decision-makers to select a mix of pavement treatments that will achieve a sustainable pavement condition for the whole system. The Sustainability Index is defined as:

- Considering that all pavements age 1 year, each year, a loss of pavement life can be measured in units of Surface Area Years.
- The different surfacing projects replace different amounts of pavement life, which can be added up in units of Surface Area Years.
- The Sustainability Index is the ratio of the work done (planned) to the work required – measured in units of Surface Area Years.
- Sustainability Index (SI) = SA Years replaced / SA Years lost

The SI associates a benefit to each project in terms of years of added/replaced pavement life. Using this data, the SI provides an indication of future pavement condition. Values less than 100% would forecast a decline in condition, while values greater than 100% would forecast an improvement in condition.

Major reconstruction projects on I-15 in 2017-2018 resulted in an index of well over 1.0. As shown on the graph below planned work in future years will result in less pavement benefit years and an overall average sustainability index of just over 1 for the period shown. The SI is calculated and reviewed annually for the statewide system and by Region to ensure adequate funding to maintain the NHS and the whole system in good condition. Further information about this index can be found at this link: [Pavement Condition Dashboard.]

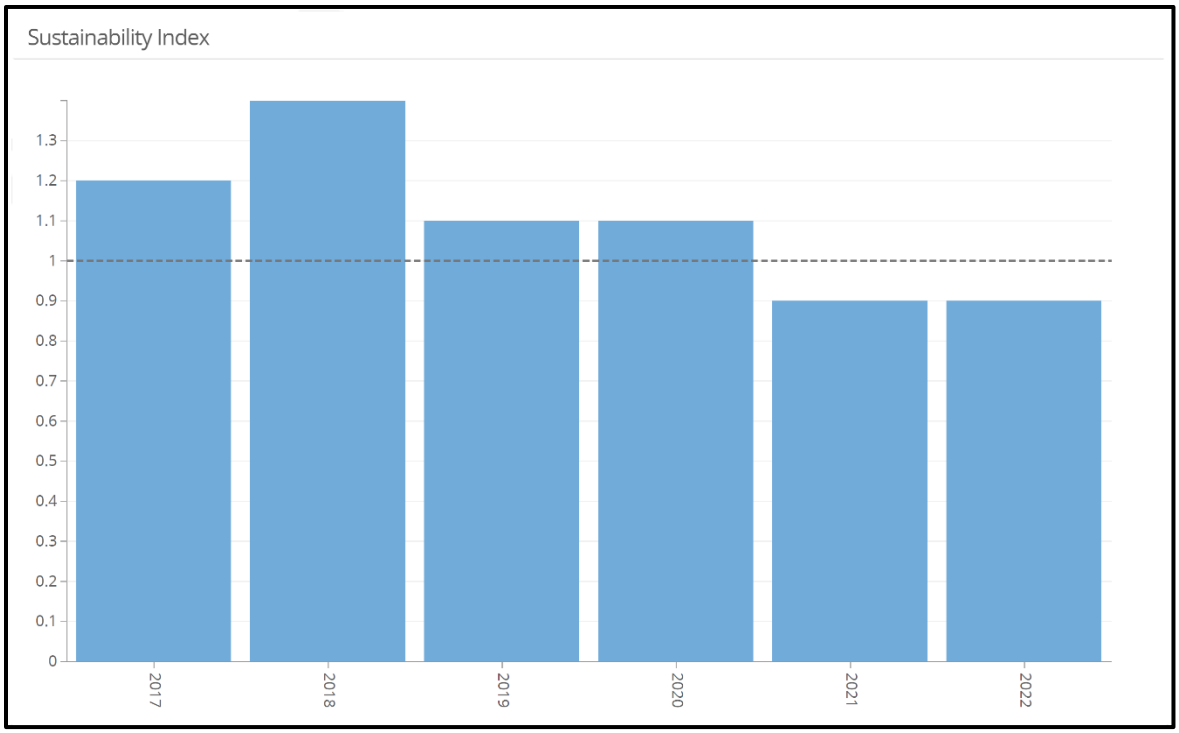


Figure 16. Sustainability Index.

BRIDGE LIFE-CYCLE PLANNING

Bridge Management has been collecting bridge element level condition data for many years. By understanding the inventory and through the planning process, Bridge Management creates a plan for every structure to define preservation, rehabilitation and replacement options. Under the federal measure condition, the NBI component ratings for deck, superstructure, substructure, or culvert can systematically predict the type of work needed for the structure (Table 5).

Table 5. Bridge Treatment Service Life.

TREATMENT	CONDITION STATE (NBI)	TREATMENT SERVICE LIFE
Preservation	≥ 7	10 Years
Rehabilitation	6–5	25–40 Years
Replacement	≤ 4	75 Years

The deck is the component that protects the structure. Detailed preservation treatments have been implemented depending on the work needed as seen in Table 6.

Table 6. Bridge Preservation Treatment Service Life.

PRESERVATION DECK TREATMENT TYPE	CONDITION STATE (NBI)	TREATMENT SERVICE LIFE
THIN BONDED POLYMER OVERLAY	≥ 7	10 YEARS
POLYESTER CONCRETE OVERLAY	6	25 YEARS
HYDRODEMOLITION	6–5	30 YEARS
DECK REPLACEMENT	≤ 4	40 YEARS

Bridge Management developed the Bridge Health Index (BHI), a measure to describe the overall condition of each bridge that is used as a structural performance measure and for work effort prioritization. The BHI is made up of three separate scores, deck, superstructure, and substructure, that are weighted to underscore the importance of each category in overall bridge health. The weighting of these categories is as follows:

$$\text{BHI} = (\text{Deck Score} \times 0.40) + (\text{Superstructure Score} \times 0.35) + (\text{Substructure Score} \times 0.25)$$

The health of deck elements is weighted higher because the elements contribute to preserving many other areas of the structure. Culverts have a different BHI scoring system and are rated out of a score of 100, based on inert culvert elements.

A health index score is calculated for each element as a ratio of the value of the element in the element's current condition to the value of the element in the best possible condition. Each of the three category scores are then calculated as a weighted average of the health indices of the bridge category elements, where elements are weighted by the total quantity of the element and relative importance. The category score is calculated for the deck, superstructure, and substructure before combining the resulting scores, as described above, into a final BHI.

The BHI is used to prioritize bridges statewide for replacement and rehabilitation projects. Health indices for individual elements, such as the deck overlay, are used to identify projects for preservation treatments or for targeted projects. This condition analysis combined with risk assessment and performance projections results in a program of projects that is refreshed each year following the annual bridge inspection. The program of projects maintains the NHS and non-NHS bridges in good repair at the lowest cost. The following graph shows the current program of projects by treatment types.

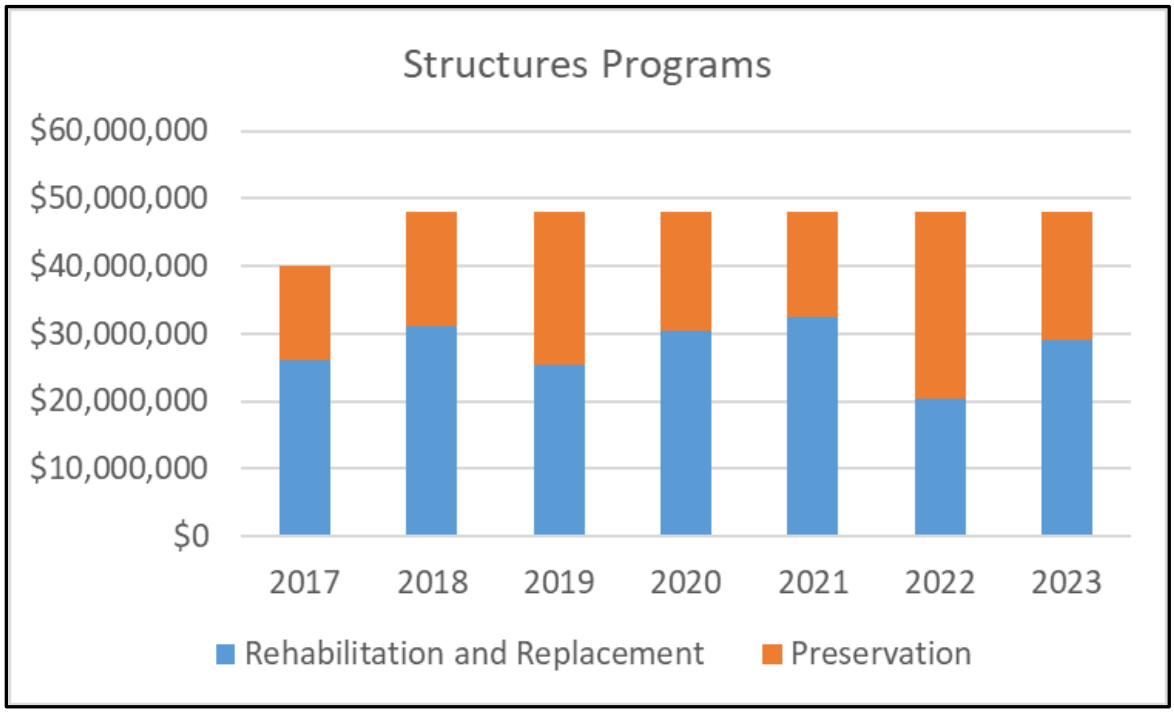


Figure 17. Bridge program by treatment type.

ATMS DEVICE LIFE-CYCLE PLANNING

UDOT has determined that the most effective ATMS management strategy is to consider the entire life-cycle of each device type. Like the strategy used for pavement and bridges, a "plan for every ATMS device" is necessary that addresses the device from cradle to grave. As part of the plan development, UDOT Traffic Operation and Region staff participated in a workshop to determine the perceived relative value of the ATMS devices. The Decision Lens tool was used in this workshop which resulted in a prioritization of devices and determination of which should be replaced on schedule and which should be allowed to fail before replacement.

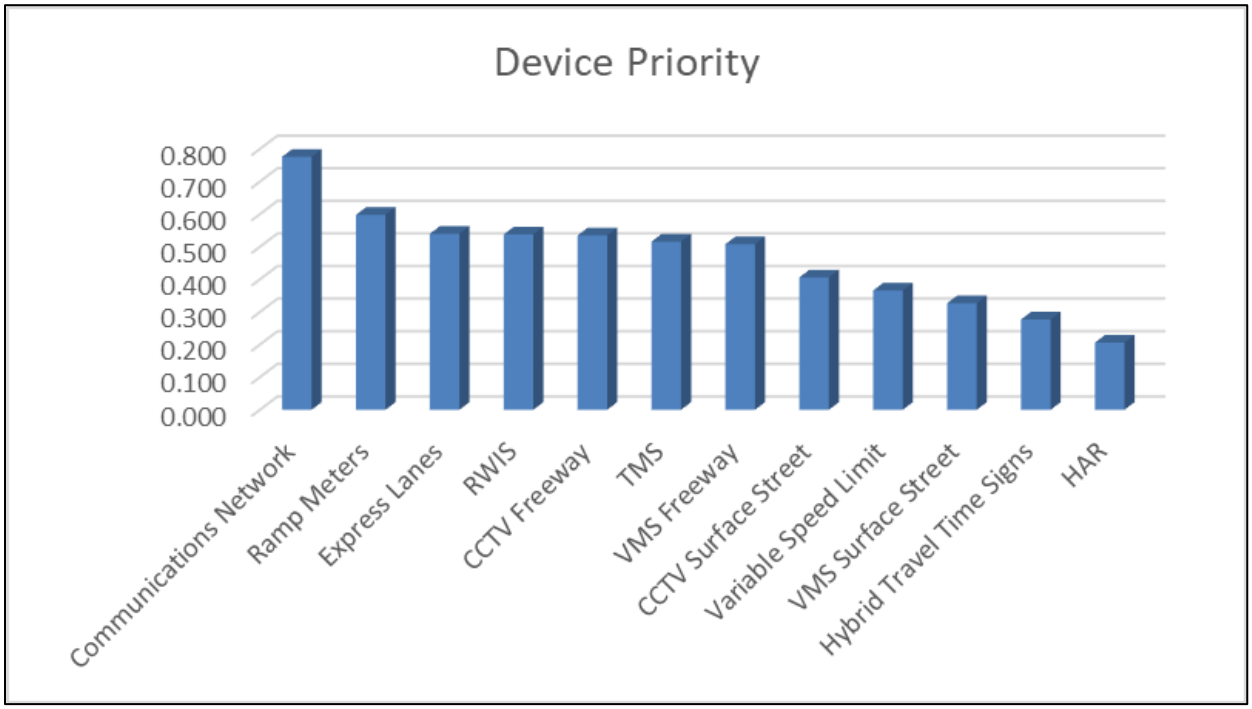


Figure 18. ATMS Device Priority

The plan for each device is defined using the following general steps:

1. Estimate the year that each device will fail by projecting the expected service life from the installation date.
2. Assign the replacement year based on the estimate and the relative importance of the device as determined in the workshop and shown in the table below.
3. Determine which devices will fall within a construction project and include them in the project scope and funding.
4. Replace highest priority devices first in each funding year.

The UDOT asset inventory and work order system is a web-based application tailored to the needs of the UDOT ITS operations. The software includes a work order management system, inventory control management system, staff management system, work group management system and other sections for configuring privileges and locations and an administration management system for managing component types, failure types, projects, manufacturers and vendors. Applying this system to the life cycle process, UDOT will replace each device at the end of its life prior to failure thereby supporting the UDOT safety, preservation and mobility strategic goals.

SIGNAL SYSTEM LIFE-CYCLE PLANNING

Life-cycle planning for the signal system is under development. At this time signal electronics and infrastructure is replaced on a priority basis as funding is available.

- Top priority are system critical elements, those that would shut down the system if they failed.
- Second priority are electronics that are at or near the end of an estimated 10-year life.
- Further priority consideration is a shift in technology that creates benefits to capacity, preservation or safety that are greater than the cost.

Signals are installed or replaced within project scopes based on funding availability and the expected contribution to system operations.

5. RISK MANAGEMENT ANALYSIS

Risk is incorporated into asset management at two levels. Programmatic risks were identified and analyzed based on the expert opinion, experience, and professional judgment of over 20 senior leaders. This analysis contributed to the allocation of UDOT assets into three management tiers. This approach allows resources to be allocated to highest risk assets and programmatic risk areas. To complement programmatic risk, a process for system level, data driven risk analysis is being developed as described in the next section.

PROGRAMMATIC RISK IDENTIFICATION AND ASSESSMENT

Risk to the UDOT program is evaluated by asset in four programmatic risk areas that were developed by a committee of UDOT Division leaders, currently called the Performance Management Committee. The four risk areas are:

- Financial – analysis of sustainable funding for performance goals
- Information – availability and quality of data needed for long term management
- Operational – analysis of probability of asset failure and impact to the operation of the transportation system
- Safety – analysis of impact to public safety in the event of asset failure or poor condition.

		Consequences		
		L	M	H
Probability	H	4	7	9
	M	2	5	8
	L	1	3	6

Programmatic risk was assessed for each asset in each of the four risk areas based on the probability of the risk happening and on the estimated consequences. Probability and consequence were assessed separately as high, medium, or low and a risk number assigned based on the risk matrix depicted at right.

All four risk numbers are averaged for each asset with all four areas of risk being equally weighted. The management tier was assigned based on the average risk factor, the monetary value of the asset, and an assessment of the importance of the asset to UDOT's performance plan and strategic goals.

Table 6 depicts the current value and risk numbers for each tier 1 and 2 assets. The numbers are based on the risk matrix. Additional details regarding the initial risk assessment completed in 2014 for each asset can be found in Appendix E.

PROGRAMMATIC RISK MITIGATION PLAN

As shown in Table 7, tier 1 assets have the highest operation risk and average risks. Performance-based management plans are well defined for these assets. History has proven these management plans minimize management costs and emergency repairs. All four categories of risk are monitored with regularly scheduled, detailed inspection and data collection for these tier 1 assets.

Table 7. Risk Analysis of Tier 1 and 2 Assets.

Asset	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Average Risk	Value	Tier
Pavements	6	3	8	7	6	$28B	1
Bridges	6	3	8	8	6	$11B	1
ATMS/Signals	6	6	5	5	5.5	$793M	1
Pipe Culverts	6	7	5	3	5	$1B	2
Signs	7	5	3	3	4.5	$300M	2
Walls	3	3	5	3	3.5	$3.4B	2
Rumble Strips	3	4	2	5	3.5	$6M	2
ADA Ramps	2	2	1	5	2.5	$20M	2
Barrier	3	1	4	2	2.5	$450M	2
Pvt. Markings	2	1	2	5	2.5	$42M	2

UDOT also has strategies and policies to mitigate each category of risks for all assets.

- Financial risk is mitigated first by focusing resource allocation toward accomplishment of UDOT Strategic Goals. Short term financial risk is mitigated by maintaining tier one assets in good condition so that potential years of reduced funding do not create critical conditions for these assets. Financial risk is also mitigated by transparent and data driven spending which builds trust with state leaders and taxpayers.

- Information risk is being mitigated by using advances in technology to collect data more regularly, accurately and completely at reasonable costs. This data is stored and mined to create information trends and history for roadway assets. Technology advances are continually monitored and implemented to improve data collection efficiency and accuracy.

- The plan for mitigating Operational risk is to institute an intermediate level planning process across the state. The sections on system risk below further detail this plan.

- Safety risk mitigation is the focus of the Zero Fatalities, Crashes and Injuries strategic goal. This goal focuses project planning and funding of design and construction elements that will increase safety within project limits.

SYSTEM RISK IDENTIFICATION AND ASSESSMENT

To augment this experiential based approach to programmatic risk, UDOT completed a data driven system risk analysis of portions of I-15 and has initiated a second pilot project to refine the process and establish a standard workflow that can be implemented system wide. This approach is not intended to replace years of professional experience but to complement experience and institutional knowledge while taking into consideration FHWA's recommendations for evaluating Resilience & Durability to Extreme Weather events. The correct data can be hard to identify, gather, validate, and use appropriately. It is therefore not our intent to throw out hard won experience but to blend it with relevant data.

This data driven approach initially focused on system level risk for a portion of I-15. The I-15 Corridor Risk and Resilience (R&R) Pilot project demonstrated the benefits of examining a highway transportation network in terms of both its capacity to serve demand and its ability to withstand environmental threats. The R&R for Highways process provides a framework for accommodating uncertainty, incorporating a probabilistic approach to assessing risk, and

making ensuing investment decisions to increase system resilience and reduce annual risk from environmental threats. It is a strategic approach, explicitly trading off the risk of asset failure against the cost of greater system resilience. The R&R for Highways Framework will assist UDOT in understanding how its system will perform under a range of potential environmental events. The framework will also provide information on risk reducing investments and actions for maintenance decisions, operational procedures, project delivery and the design process.

SYSTEM RISK IMPLEMENTATION PLAN

The current plan is to expand the data driven risk analysis to other corridors and over time the entire National Highway System. The results of this analysis will be captured on GIS maps and made available to all UDOT functions. With this knowledge we can more thoroughly address risk in project planning and construction.

We are only beginning to understand the value of this analysis but initially it appears that we can save construction time and cost by pre-planning how to mitigate risks discovered in our risk analysis. Currently we wait for a project to be initiated before considering what risks exist within the project boundaries. This limits the time we have available to perform trade off analysis and choose the best risk mitigation approach. A pre-project analysis will provide an opportunity for better cost savings without impact to project delivery time. We have already seen this potential cost savings because of the analysis completed in our I-15 Corridor Pilot project.

To incorporate risk into our business processes we plan on including risk data into our intermediate planning process. This corridor level planning is done with our partners that include MPO's, Cities, Counties, Regions, State and Federal Resource Agencies, Tribes, Transit Agency, etc. The corridor plans are designed with a focus on our UDOT Strategic Goals and Performance Measures. Specific projects are developed from corridor plans and incorporated into the STIP for each funding year. Risk mitigation investments will become a part of developed projects. We have experienced the cost saving benefits of Risk Management at the project level and expect similar or better savings at the corridor and system level.

SUMMARY OF TRANSPORTATION ASSETS REPEATEDLY DAMAGED BY EMERGENCY EVENTS

Risk management includes collecting and analyzing data on assets damaged during emergency events. To meet FHWA requirements, manage risk and reduce the need for emergency repair and reconstruction funding UDOT initiated a process to track and evaluate assets damaged during emergency events.

A map layer in UDOT's mapping center (UPLAN) has been created to display the location and project information for all projects that use Emergency Funds (ER projects). The map is shown below and can be accessed at this link: ER Fund Map. The map is updated daily through a connection to the ePM system.

To date no assets in Utah have been twice damaged due to an emergency event as defined by FHWA. UDOT does have procedures in place for communication and rapid response during states of emergency as well as more targeted emergencies, such as bridge hits or small area flooding. A process is under development that will automatically alert appropriate people when projects are added to the ER project map. This will allow UDOT staff to track areas that are prone to damage during emergency events and develop plans to mitigate or avoid future damage.

A bridge scour program is also in place for mitigation of potential bridge damage. This program identifies scour critical bridges through the regular inspection process and provides recommendations for counter measures and monitoring. Details of this program are in the Bridge Management Manual, Chapter 2. The Manual can be found at this link: Bridge Management Manual.

Programs are in place to track and mitigate other environmental events such as rockfall, flooding, debris flows, landslides, and earthquakes. A pilot study on US 40 was completed to evaluate the risk of environmental events and level of resilience in the corridor. The risk of each type of event occurring and the total risk has been mapped as shown below. This process will be refined and incorporated into the corridor planning process.

Figure 19. Risk Map.

Senior leaders have contingency funds available to respond to this type of unplanned environmental events. If the cost is greater than these programmed funds a request is made to the legislature for special funds to cover the event. If appropriate, federal funds are requested through FHWA to assist in covering the costs of the largest events.

Next steps for this area of focus include adding a map layer for projects that are funded by UDOT emergency dollars. This will allow tracking of areas that experience localized damage and potentially highlight mitigation opportunities.

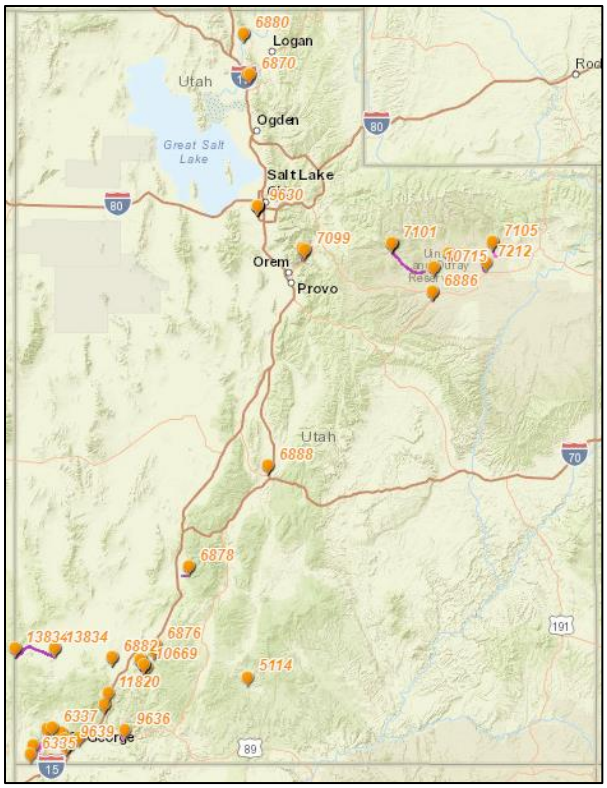


Figure 20. ER fund map.

6. FINANCIAL PLAN

UDOT relies on the federal funding process, state annual budget process, and distribution decisions by the Transportation Commission for transportation funding. Funding available varies each year depending on the national and state economies and priorities of decision-makers and historically comes primarily from three specific funds: the state Transportation Investment Fund, The state Transportation Fund, and Federal funds (Figure 21). Aeronautics also provides a very small percentage of funding which does not contribute to asset management and therefore is not addressed in this plan.

FUNDING SOURCES

The state Transportation Investment Fund (TIF) is derived from sales taxes on auto related services and makes up approximately 45% of UDOT funding. Half of this fund pays the bond for previously constructed projects and half is used to fund current capacity and mobility projects. A percentage of these funds is also designated to preserve existing infrastructure. The state Transportation Fund comes from the state portion of gas taxes paid by individuals at the gas pump. This fund makes up approximately 32% of UDOT funding and is primarily used to fund UDOT operations, management and maintenance as well as other agencies. These funds also provide the match amount required for federal funds. The Federal portion of gas taxes makes up approximately 22% of UDOT funding and is used primarily for current pavement projects. Further details of funding sources can be found at this link: UDOT Funding.

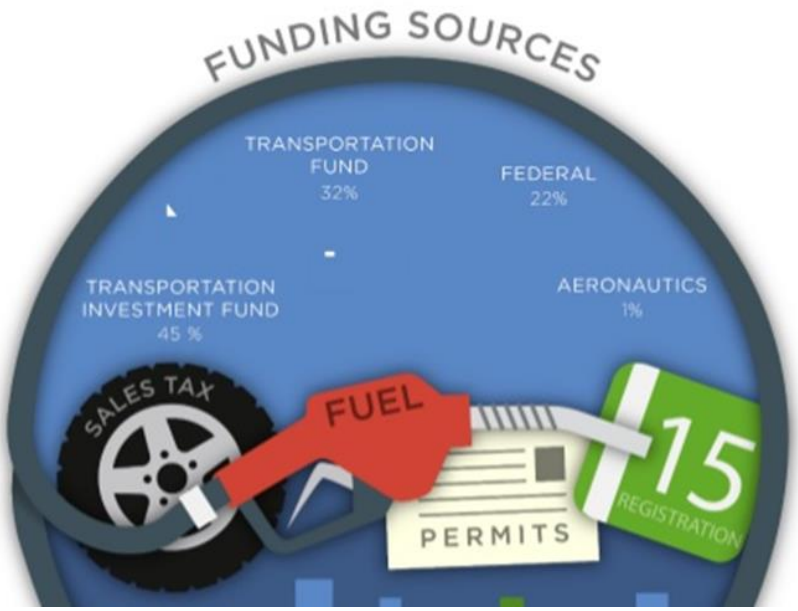


Figure 21. UDOT Funding Sources.

FUNDING NEED PROJECTIONS

All of Utah's transportation agencies and Metropolitan Planning Organizations have worked together to develop the Unified Transportation Plan. Each agency used shared growth projections, time horizons and financial assumptions to assemble complementary regional plans that integrate seamlessly into the Unified Transportation Plan. These agencies have worked together to develop robust financial planning based on sound technical analysis for the current and future projected revenue that can reasonably be assumed to pay for transportation needs (Figure 21).

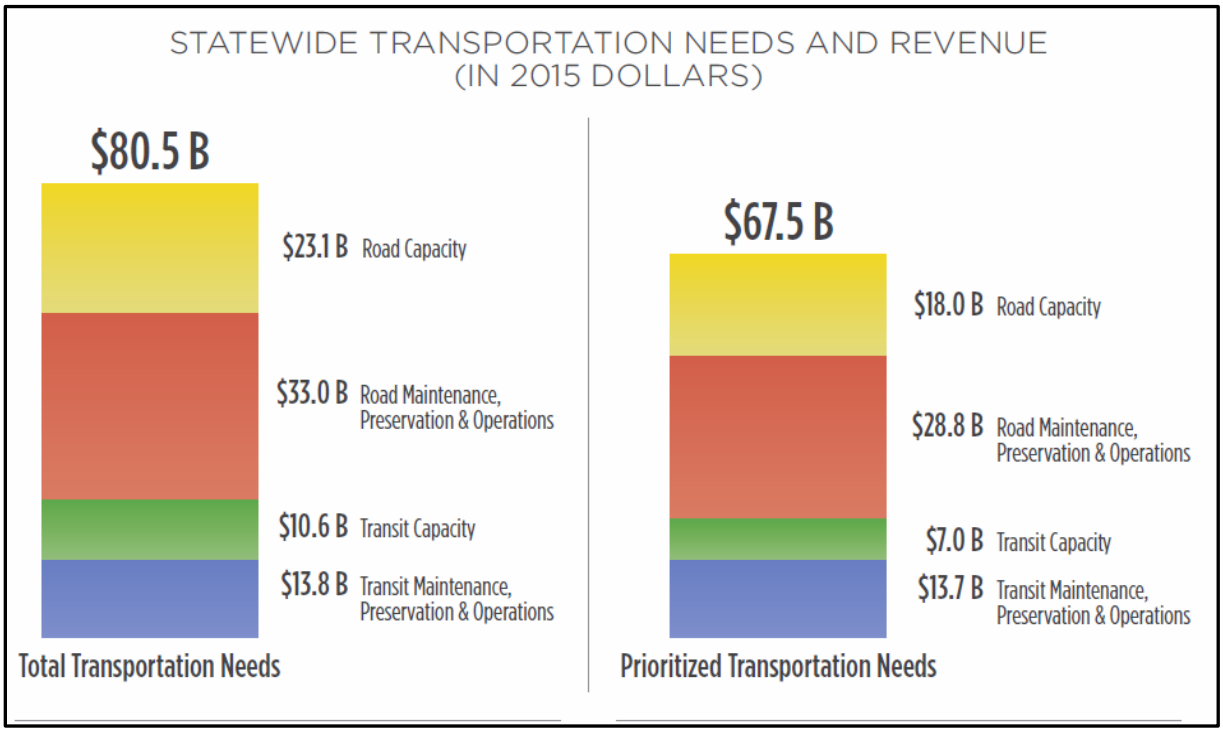


Figure 22. Utah Transportation Needs and Revenue Projection.

During the 2015 Legislative Session, Utah lawmakers passed House Bill 362 (HB 362), Transportation Infrastructure Funding. This historic transportation funding package was the first law in Utah to comprehensively fund all modes of transportation, including roads, transit and active transportation. It represents a reform to the state fuel tax and equips local communities with the tools to more adequately address their needs.

HB 362 was an important step forward in addressing the transportation funding shortfall identified in the Unified Transportation Plan, providing much-needed funding for critical, priority transportation needs. The law significantly reduced the funding shortfall identified in the Unified Plan, but future revenue increases will still be needed to maintain, preserve and expand state and local road, transit and active transportation systems.

Using increasingly sophisticated accounting mechanisms, Utah's Unified Transportation Plan provides a robust, technical analysis of growth rates in forecasting the future revenue available for transportation needs in the state. This analysis assumes the increase of revenue from vehicles (registration fees), fuel consumption (fuel taxes) and general purchases (sales taxes).

These calculations for the growth rates are conservative and based on historical trends from each region of the state. Calculations were coordinated closely with projections from the Governor's Office of Management and Budget and the Utah Tax Commission and with assistance from private sector financial advisors.

For planning purposes, the Unified Transportation Plan assumes future revenue sources, although specific mechanisms will depend on decisions by state and local elected officials. Revenue sources include statewide vehicle registration fees, local option tax (varies by MPO and county and includes additional local option fuel taxes, local option sales taxes and vehicle registration fees) and private sector funding.

Between 2015 and 2040, the total transportation needs for the state are $80.5 billion. This includes funding needed to operate the current transportation system and keep the infrastructure in good condition (roadway and

transit maintenance, preservation and operations). It also includes the funding needed to build new roads and transit lines, as well as widen existing roads and extend transit lines (roadway and transit capacity).

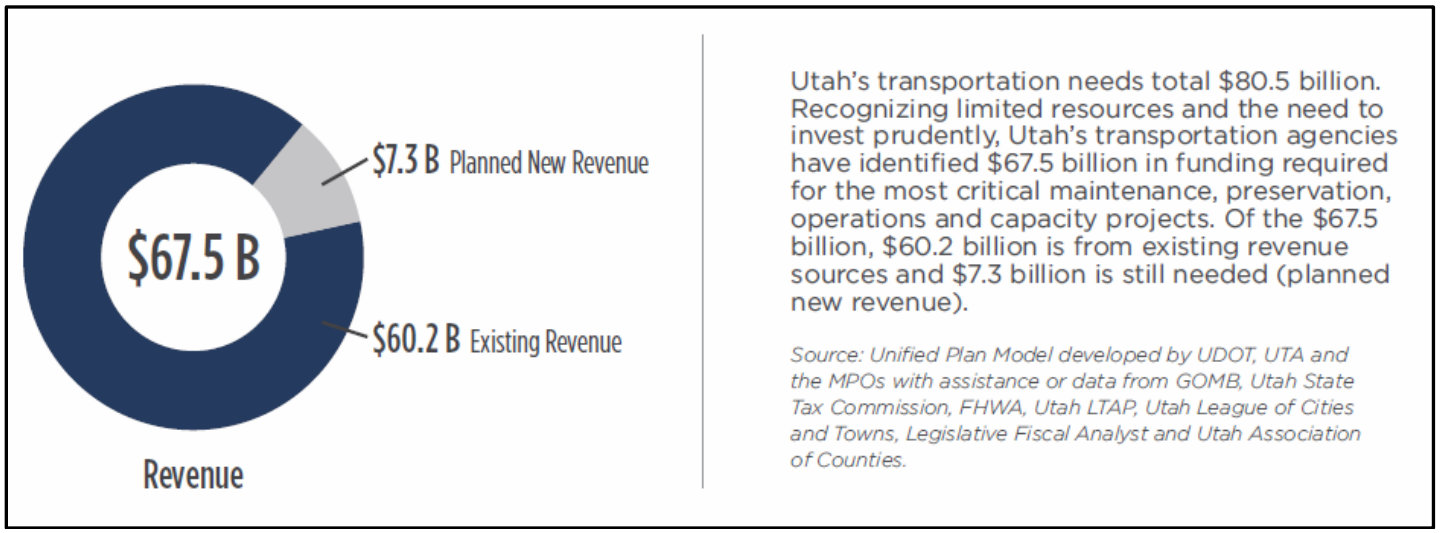


Figure 23. Utah Transportation Funding Gap.

Utah's transportation agencies understand that it is not reasonable to assume funding will be available for all the transportation needs in the state. Instead, the agencies have identified a prioritized set of the most critical needs at $67.5 billion (Figure 22).

Existing revenue sources currently in place to fund the Unified Plan between 2015 and 2040 are projected to generate $60.2 billion. That leaves $7.3 billion as the amount needed to fund Utah's most critical priority projects.

The Utah Unified Transportation Plan 2015-2040 can be found on the UDOT website at this link: Utah Unified Transportation Plan.

ASSET MANAGEMENT FUNDING

Within the overall funding stream described above, UDOT's pavement, bridges and ATMS devices have dedicated funding as Tier 1 assets. Funding for each has been established based on projected needs to meet performance targets. At this time these assets are fully funded, and 10-year revenue projections are shown in Table 7.

Table 8. Projected Tier 1 Asset Funding by Year.

Asset Funding	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Pavement NHS	$108.0	$155.6	$156.1	$156.7	$157.2	$157.7	$158.2	$158.7	$159.3	$159.8
Pavement Non-NHS	$84.0	$94.4	$94.6	$94.8	$95.0	$95.2	$95.5	$95.7	$95.9	$96.1
Bridges NHS	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0	$38.0
Bridges Non-NHS	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0	$10.0
ATMS Devices NHS	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5
ATMS Non-NHS	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2
Signal Systems NHS	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5	$3.5
Signals Non-NHS	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1	$2.1
Amounts shown for each fiscal year is in Millions $										

PAVEMENT FUNDING

Historical tracking of pavement condition shows UDOT has been maintaining a status quo condition level for our High-Volume system, and a declining then improving condition for the Low Volume system.

The High-Volume roads have a consistent stream of funding that continues to maintain the current condition level. The legislature approved a new stream of funding starting in 2018 to provide for preservation of the growing amount of pavement across the state. This is reflected in the small annual increase in dollars from 2018-2028.

In December of 2016 UDOT's Pavement Working Group (PWG) developed recommendations for including a Reconstruction program into their pavement management responsibilities to compliment the Preservation and Rehabilitation programs. A Draft 7 Year Program (2019-2025) has been developed with funding approved to average $50M per year. The story map at the following link covers the projects, funding and programming recommendations that the group developed: Pavement Management Website.

At the same time the state legislature approved a gas tax increase that is being used to fund projects on our Low Volume system. Together this funding maintains the state of good repair of the Interstate, NHS and High Volume roads and improves the condition of the Low Volume roads as shown on the condition project charts below. Distribution by Region for pavement funding can be found in the Funding tab at this link: Pavement Management Website.

Pavement Program Recommendations

2-22-2018

				Estimated 2019	Estimated 2020	Estimated 2021
Funding			Federal Amount	$ 204,000,000	$ 204,000,000	$ 204,000,000
			State Pavement LVR & Statewide Pvmt. Mgmt.	$ 42,000,000	$ 42,000,000	$ 42,000,000
			TIF Preservation	$ 6,000,000	$ 6,700,000	$ 7,500,000
			Total State & Federal	**$ 252,000,000**	**$ 252,700,000**	**$ 253,500,000**
dTIMS Model & TIF Preservation Increase Recommendation for Pavements			LVR & HVR combined	**$ 250,000,000**	**$ 250,700,000**	**$ 251,500,000**
Statewide Pavment Mgmt.				**$ 2,000,000**	**$ 2,000,000**	**$ 2,000,000**
LVR Program				**$ 40,000,000**	**$ 40,000,000**	**$ 40,000,000**
HVR Program			Reconstruction Program	**$ 50,000,000**	**$ 50,000,000**	**$ 50,000,000**
			Distributed to Regions	**$ 160,000,000**	**$ 160,700,000**	**$ 161,500,000**

Figure 24. Pavement program recommendations.

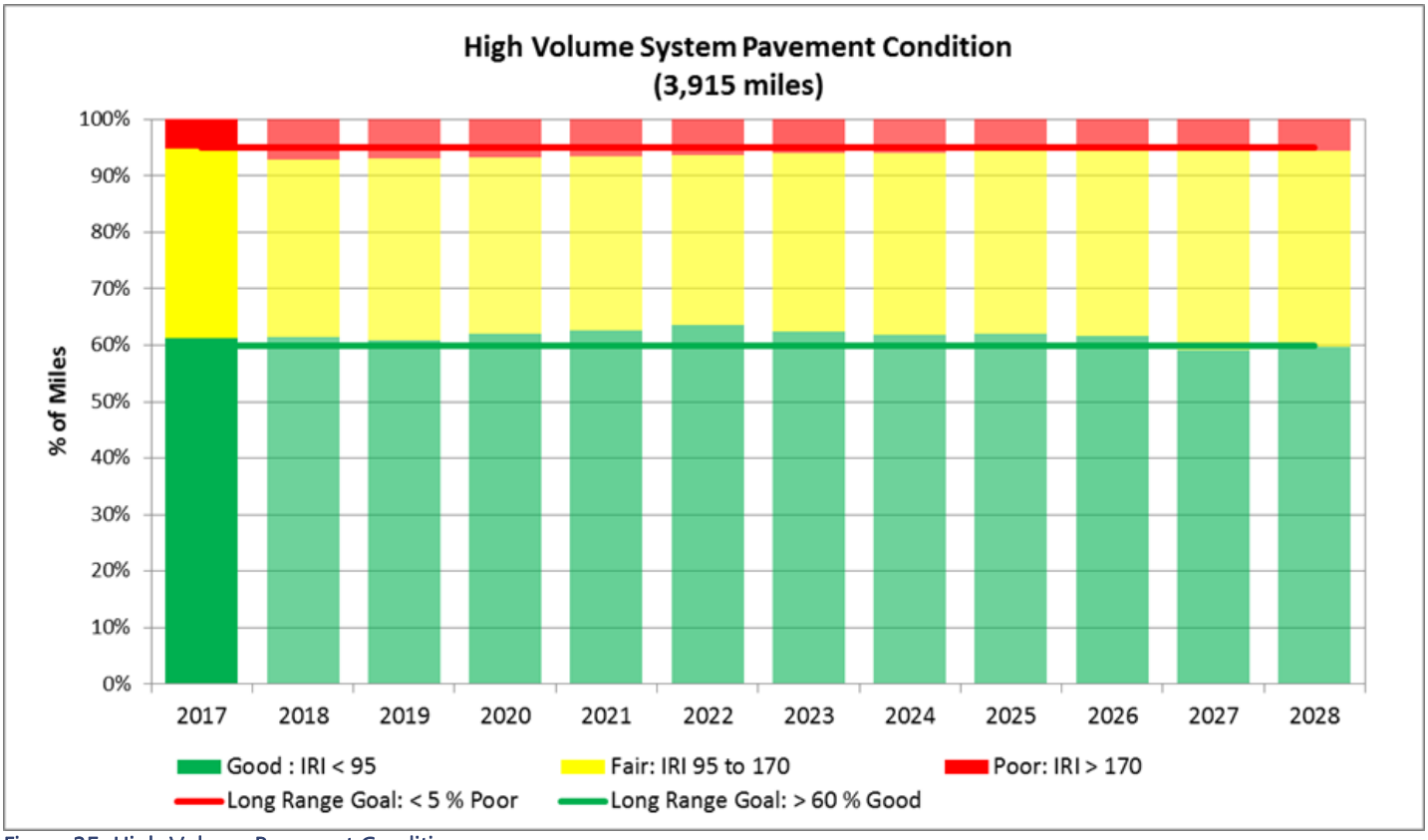


Figure 25. High-Volume Pavement Condition.

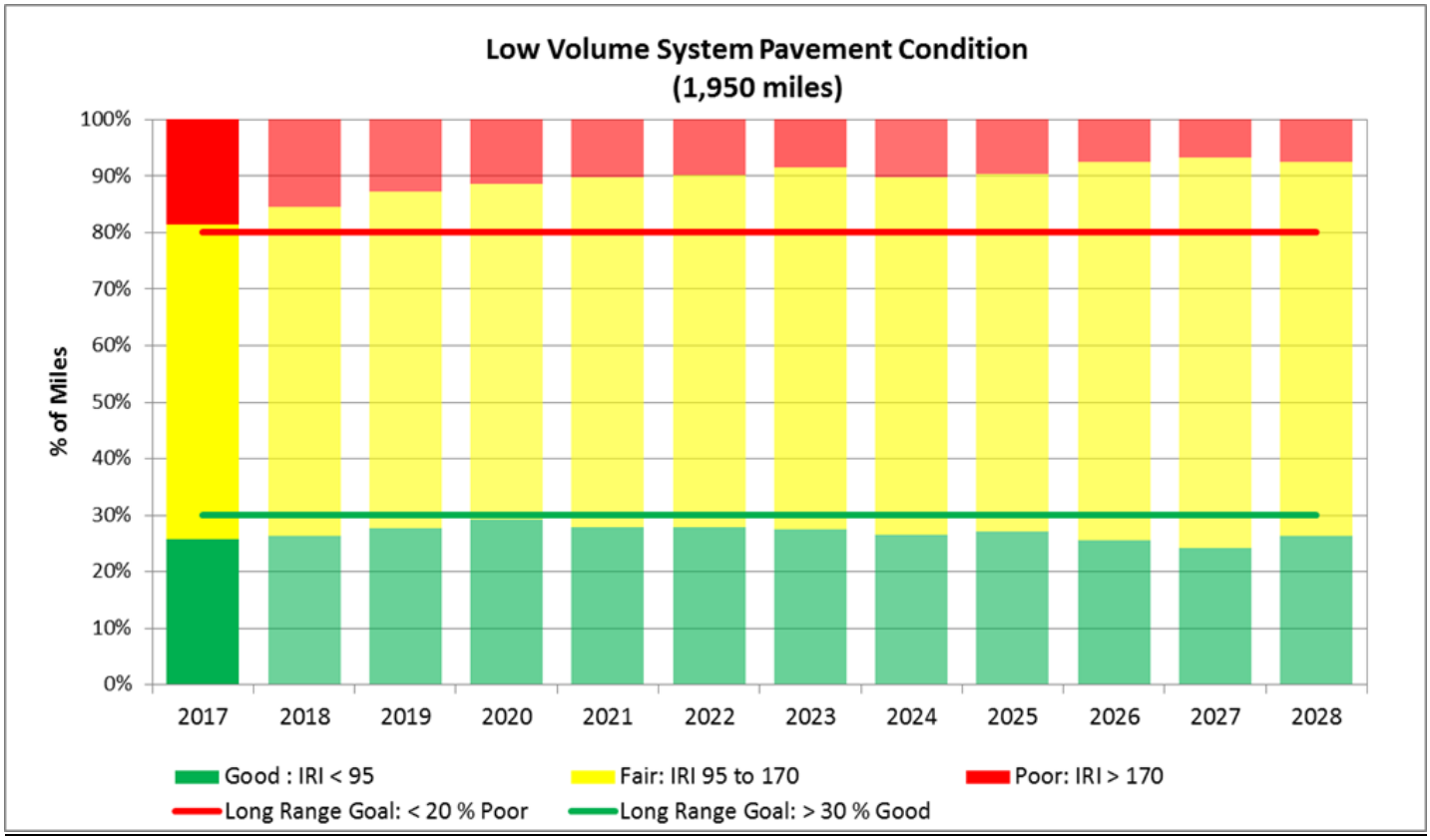


Figure 26. Low-Volume Pavement Condition.

BRIDGE FUNDING

Historical tracking of bridge condition (based upon component condition data) shows an overall decline in the number of poor condition bridges. The number of fair condition bridges continues to increase, and in time, without a proactive approach, more fair condition bridges will drop into poor condition than can be addressed in a given funding year. Currently 27% of the state bridge inventory exceeds the 50-year original design life.

In order to address the impending increase in poor condition bridges as the state system ages, UDOT made a high-level condition-based evaluation of the system as a whole. Each bridge was classified as good, fair, and poor condition based upon the lowest NBI component rating, as is consistent with the Federal Performance Measures. The analysis looked at a 20-year time span to treat each bridge. Bridges in good condition were assigned preservation treatments and treatment costs associated with such. Bridges in fair condition were assigned rehabilitation treatments. Bridges in poor condition were assigned replacement treatments. The total cost of these treatments was evenly distributed annually over 20 years.

UDOT evaluated funding from all sources, including structures specific funding, and larger capacity projects to establish the shortfall. Based upon the identified shortfall, UDOT increased bridge funding from $18.7 million to $48 million between 2015 and 2018 (Table 8). This was accomplished through redistribution of Federal Funding and the addition of the 2015 State Gas Tax Increase.

Based upon the current $48 million bridge budget, Utah bridges will remain in a state of good repair. Both NHS and non-NHS bridge systems will see an increase in poor condition bridges and a decrease of good condition bridges, but both systems will stay within current performance targets (Figures 14 and 15).

Table 9. Bridge funding projection.

		Estimated 2019	Estimated 2020	Estimated 2021	Estimated 2022
Funding	Federal Amount	$ 33,000,000	$ 33,000,000	$ 33,000,000	$ 33,000,000
	State Amount	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000
Total Program Recommendations		**$ 48,000,000**	**$ 48,000,000**	**$ 48,000,000**	**$ 48,000,000**

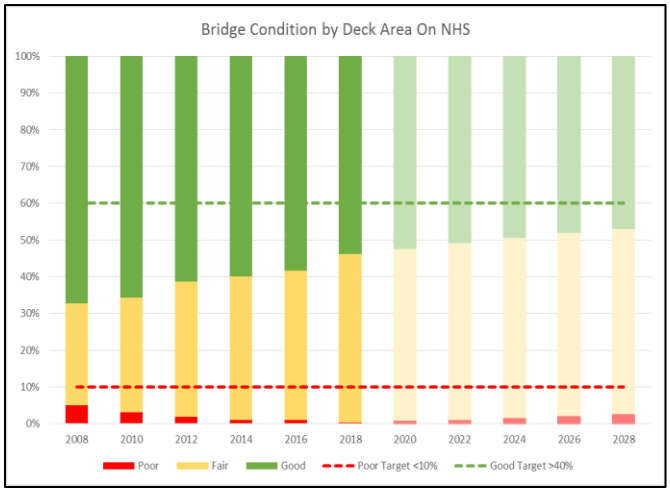


Figure 27. NHS Bridge condition.

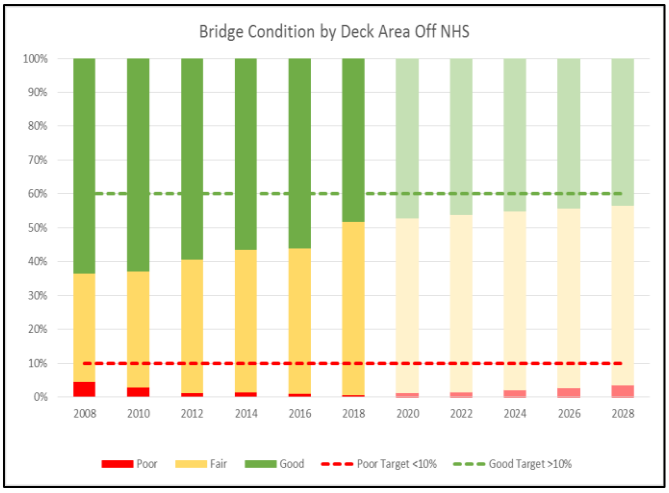


Figure 28. Non-NHS Bridge condition.

ATMS DEVICE FUNDING

A dedicated funding stream was created for ATMS devices in 2017 based on an analysis of the age and condition of each type of device. The backlog column in Table 9 defines the cost for replacing the number of devices that were beyond their life expectancy or that had already failed in 2017. The costs in each fiscal year column is based on the number of each device that will need to be replaced as it reaches its projected end of life. This analysis resulted in establishment of a long-term funding stream to replace existing devices using the life cycle plan developed and discussed earlier.

Table 10. ATMS Device Funding Needs.

DEVICE TYPE	ADDRESSED IN CONST.	BACKLOG (<2017)	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
VMS	$411,700	$1,361,055	$1,665,360	$823,400	$617,550	$1,852,650	$3,190,675
TMS	$219,000	-	$157,800	$1,166,000	$498,600	$1,009,800	$271,400
CCTV	$91,000	-	$6,500	$1,001,000	$6,500	$734,500	$1,287,000
Express Lanes	$100,200	$332,000	$148,500	$25,700	-	$261,000	$261,000
RWIS	-	-	$57,190	$29,475	$47,180	$131,585	$81,430
Comm switches	$25,575	$1,800,000	$100,000	$617,725	-	$289,875	-
Misc.	$24,000	$3,000,000	-	-	$1,284,000	-	-
Total	**$871,475**	**$6,493,055**	**$2,135,350**	**$3,663,300**	**$2,453,830**	**$4,309,410**	**$5,091,505**
							$17,653,395

The performance management plan for ATMS devices creates a condition tracking system that will provide a better understanding of the life-cycle for each device in the Utah environment. Future funding requests will be based on an analysis of this growing body of data and the increasing number of devices being installed.

SIGNAL SYSTEM FUNDING

In 2018, the signal system received $2.6 million of additional funding each year until at least 2021 to rebuild signalized intersections, due to the aging infrastructure. Previously, available funding was spent on minor repairs to keep signals operational and in good condition. Replacement and installation of new signals was funded primarily through projects on the STIP. A process for documenting and analyzing signal system rebuilds has been and is currently being established. This process includes:

- Evaluate each signalized intersection on a regular basis (approximately yearly) to give the infrastructure (steel, traffic signal heads, cabinets, underground, pavement quality) a score ranging from 1 (intersection is in poor condition and should be rebuilt) to a 5 (intersection is relatively new and infrastructure is in good condition).
- The target threshold is 95% or better. Overall Results are published at: Traffic Management Tactical Measures.
- Prioritize the low evaluation ratings (1&2) and rebuild the signals with the appropriated funding.
- Communicate signal replacement and upgrade needs to the Regions so they can incorporate the cost into the project scoping and construction estimates.

From this process condition trends will be established and then analyzed to determine the level of additional funding needed to meet performance targets across the state.

7. INVESTMENT STRATEGIES

Asset management investment strategies are developed by each UDOT Division and Region staff. These strategies guide program and project decisions for resource allocation that maintain and preserve transportation assets in the best condition possible with available funds. These strategies are developed and modified as needed to

- Achieve and sustain the state of good repair indicated by the federal and state performance targets.
- Follow the asset life cycle plan which improves and preserves the condition of the UDOT system.
- Achieve condition and performance of the NHS indicated by national goals relating to assets.
- Mitigate the risk assessment elements.

The investment strategies guide data driven decisions that ultimately result in projects that compose the STIP program which is the final annual investment strategy. The asset condition analysis is independent of the STIP process and establishes the annual and long-term investments and projects needed to meet the targets set within the TAMP process. If funding available is not adequate for the needs, additional funding is requested based on the needs projected by the data modeling and analysis to achieve and sustain the desired state of good repair.

PAVEMENT INVESTMENT STRATEGIES

Pavement Strategy 1: Maintain current condition of Interstate, NHS and other routes with over 1,000 AADT (high volume) so that greater than 60% of pavements are in good condition and less than 5% are in poor condition.

UDOT is currently meeting its pavement metric for high volume roads. By using a deterioration model that recommends Re-construction, Rehabilitation, and Preservation treatments UDOT can predict what projects are needed to maintain the pavement metric based on a three years funding projection. UDOT's current investment strategy uses the model's recommendations along with Region staff knowledge to decide on which projects will be funded. The legislature approves using a portion of the Transportation Investment Fund to provide for the ongoing maintenance of the additional lane miles added every year to the pavement system from new construction.

Figure 29. Pavement program by treatment type.

Pavement Strategy 2: Improve non-NHS and other roads with less than 1,000 AADT (low volume) so that greater than 30% of the pavements are in good condition and less than 20% are in poor condition.

New gas tax funding was approved in 2015 and phased in to reach the full amount by July 2018. An annual $40M of the new funding is dedicated to improving the condition of low volume roads that have been deteriorating due to lack of adequate funding. The pavement management deterioration model has been programmed with this dedicated funding for the low volume system. The recommended combination of preservation, rehabilitation and reconstruction treatments is projected to decrease poor condition and increase good condition roadways on this system through 2023 to meet the targets.

Pavement Strategy 3: Apply maintenance, preservation, rehabilitation, and reconstruction treatments that when combined with new construction replace one year of life to the statewide pavement system each year.

Calculate the Sustainability Index each year for the five-year pavement program to maintain a rolling average of 1.0 (100%) or greater. This index is a recently developed forward looking measure that supports and fine-tunes the pavement management deterioration model recommendations. It is calculated by multiplying each project's surface area of pavement by the expected years of benefit divided by the system surface area. (1 surface area = 1 lane mile = 5280'x12'). Values less than 1 indicate an expected decline in condition, while values over 1 indicate an expected improvement in condition.

The pavement investment strategies and management vision is further described in the Pavement Manual at this link: Pavement Design Manual of Instruction

BRIDGE INVESTMENT STRATEGIES

Bridge Strategy 1: Proactively provide preservation and rehabilitation treatments to bridges on NHS routes to maintain them at the target level of 85 % bridge health index.

As with pavement, not all state bridges have the same AADT, performance requirements, or associated risks. NHS routes tend to be the highest traveled routes as well as the routes that have the most impacts to the traveling public during major rehabilitation or replacement projects. For this reason, bridges on NHS routes have been assigned the highest performance target. Based on the analysis of the bi-annual inspection results a program of treatments is developed specifically for each bridge to keep it in good condition and extend the overall service life of the bridge.

Bridge Strategy 2: Apply a balance of proactive preservation and condition-based rehabilitation or replacement treatments on non-NHS State owned bridges to maintain a bridge health index of 80 % or greater.

State routes tend to have higher AADT than local routes, but lower risks and impacts to the traveling public than NHS routes. A slightly lower target (BHI 80) has been established for State owned bridges off the NHS. All bridges in poor condition are programmed for replacement over time and other State-owned bridges are evaluated and assigned treatments for rehabilitation or preservation work to meet the target of BHI 80. Specific treatments for each bridge are developed based on an analysis of the annual bridge inspection program results.

Bridge Strategy 3: Coordinate with local owners of bridges to develop an appropriate treatment plan when local funding is available to achieve the target level of 75% Bridge Health Index.

Locally owned bridges in general have the lowest AADT and exposure, and therefore have the lowest performance target (BHI 75). UDOT does not control the overall condition of the locally owned bridge system. Projects require a financial match from the local owner. If the local owner is unable to participate in the project, UDOT cannot complete the project.

The investment strategies and management vision is further described in the Bridge Manual which can be read at this link: Bridge Management Manual.

As with pavements, the Legislature approved using a portion of the State's Transportation Investment Fund to cover the growing number of structures throughout the transportation network. The State's Transportation Investment Fund (TIF) has helped to supplement funding to replace and or rehabilitate bridges on the NHS and State System.

ATMS DEVICE INVESTMENT STRATEGY

ATMS Strategy 1: Replace highest value devices prior to their end of expected life and failure in support of the UDOT Strategic Goals.

UDOT Traffic Management and Region staff participated in a Decision Lens prioritization workshop to determine the perceived value of UDOT's ATMS devices within the network. The ATMS device strategy is to replace the devices deemed highest value prior to their end of expected life and failure in support of the UDOT Strategic Goals. Investments are made in replacing highest priority devices first and replacing others in order of priority within the funding limits of each fiscal year. Funding needs will be tracked and adjusted as the system grows and life expectancy can be modified based on accumulated historical data and technology improvements.

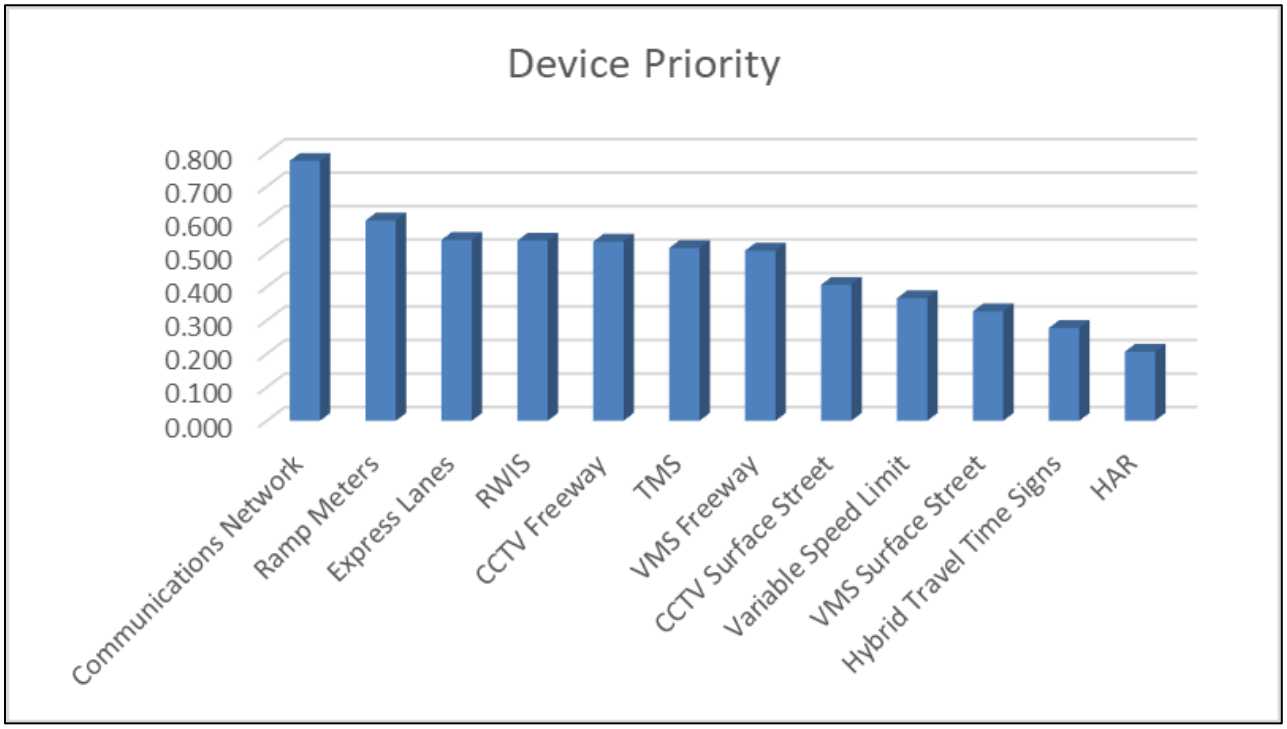


Figure 30. ATMS Device Funding Priority.

ATMS Strategy 2: Maximize funding by replacing devices within projects developed for other assets.

Traffic Operation Center staff coordinate with Region staff during the project planning and scoping phases. To the extent possible ATMS devices existing or proposed within the project limits are included in the project scope and construction budgets. This process minimizes disruption to the traveling public and maximizes funding available to replace and install ATMS devices.

SIGNAL SYSTEM INVESTMENT STRATEGY

Traffic Signal Strategy 1: Conduct preventative maintenance regularly on existing signal equipment to meet target of 95% of system in average or better condition.

The primary goal of signal system preservation management is to prevent the failure of equipment before it occurs. The preventative maintenance plan is designed to preserve and enhance equipment reliability by replacing worn components before they fail. Scheduled preventative maintenance ensures that components of the traffic signal system that are consumed in normal operation, and age or deteriorate, are regularly refreshed to prevent equipment failures. It also minimizes the potential for damage by others and if it occurs, accommodates repair in a timely manner.

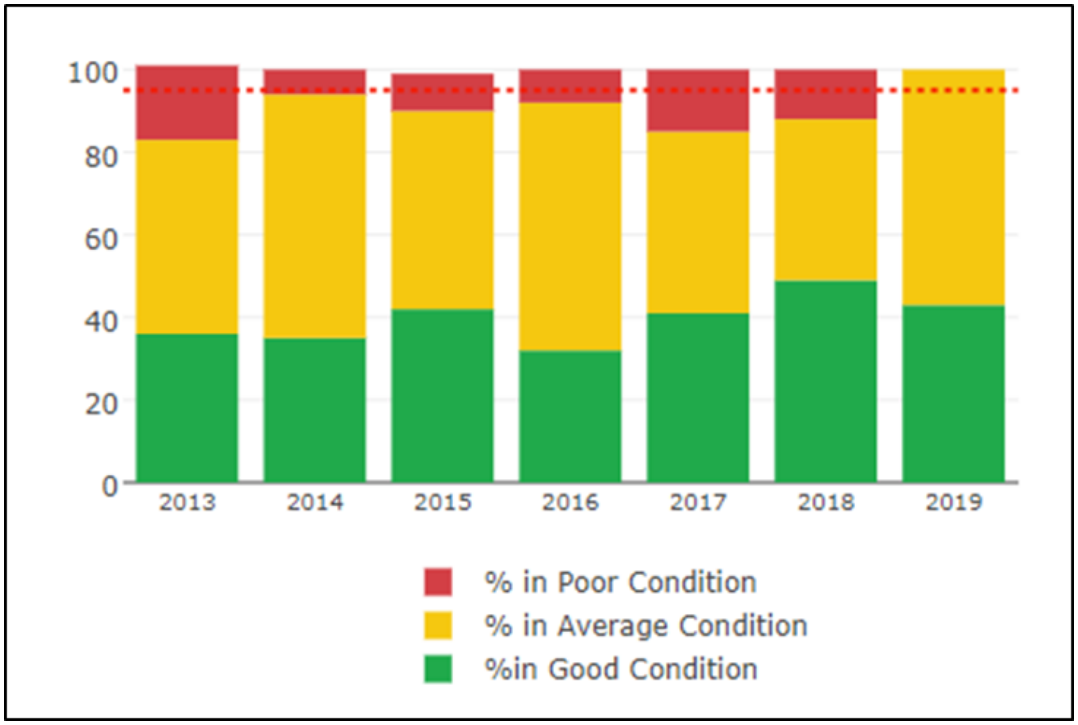


Figure 31. Signal system condition history.

Traffic Signal Strategy 2: Implement the emergency maintenance response plan when emergencies occur.

The Traffic Signal department has a written formal process and plan that details the priority, process and plan of emergency response to traffic signals (Emergency Response Plan for UDOT's Traffic Signals). This plan includes contact information and dissemination to appropriate staff. Following this established procedure allows traffic signals to be put back into service as quickly as possible following an emergency such as vehicle damage to equipment or environmental impacts.

Traffic Signal Strategy 3: Apply the established maintenance management process to minimize equipment downtime and unexpected failures.

UDOT maintains a team of trained staff with flexible hours to ensure availability during emergencies and regular business hours. The maintenance system creates monthly reports of all activities including inspection reports. The asset management system tracks equipment failures for analysis. Maintenance activities are coordinated with activities on other assets to achieve economic efficiencies.

The Traffic Signal Management Plan defines the goals, measures and strategies for UDOT management of the signal system. It can be found at this link: Traffic Signal Management Plan.

STIP PROCESS AND INVESTMENT STRATEGIES

The Statewide Transportation Improvement Plan (STIP) is UDOT's official work plan for the development of projects through conception, environmental studies, right of way acquisition, planning and advertising for construction for all sources of funds. Recommendations for projects that maintain the UDOT system and NHS in a state of good repair are a critical part of the STIP development process. These recommendations become part of the Region workshops in January of each year and eventually are approved as part of the Final STIP in October through the process depicted in the STIP Process Diagram.

The initial recommendations come through the condition analysis and projections of each asset. Projects are developed from these recommendations and associated work and costs are added to the investment strategy. The STIP process results in combining of projects, scheduling adjustments, and project phasing. The ultimate UDOT investment strategy is the final STIP approved annually by the Transportation Commission and FHWA.

UDOT is in the process of developing methodology to optimize the STIP program based on individual project contributions to the FHWA and UDOT performance-based goals. This methodology when complete will result in an investment strategy that optimizes available funding each year across the state and across assets.

8. SUMMARY

UDOT has a robust asset management plan for assets with the highest value and risk to the operation of the state transportation system. These tier 1 assets are pavement, bridges, ATMS devices and signal system. Tier 2 assets are managed based on condition trends. Tier 3 assets are reactively managed with repair or replacement when damaged.

Federal and state performance measures have been developed for the tier 1 assets and are supported by accurate and timely data collection and analysis. Targets for these measures have been established based on historical condition data and professional experience to maintain the NHS and UDOT system in a state of good repair. Pavements and bridges currently and historically have met the federal and state targets. Predictive tools are in place to ensure the appropriate mix of treatment strategies are proactively constructed to ensure the assets meet the targeted performance. ATMS devices are replaced at or near the end of their predicted life to ensure the overall system is functioning and reliable. The signal system is currently and historically below target condition. Signal elements are replaced on a prioritized basis by criticality to system operation and predicted end of life.

Risk is identified and analyzed at the program level in the areas of financial, information, operational and safety for each asset. A process is also being developed to analyze risk in a data driven process at the system level as a part of the intermediate planning process. Mitigation strategies for both levels of risk will be part of future project development.

In 2015 the Utah legislature passed a historic transportation funding package to comprehensively fund all modes of transportation, including roads, transit and active transportation. State funding and the federal portion of the gas taxes projected out ten years provides adequate funding for pavements, bridges and ATMS devices statewide to meet performance targets. Current funding is not adequate for the signal system to meet current performance targets. Signal system elements are being replaced on a prioritized basis with available funds. Investment strategies for each of the tier 1 assets that maximize the use of available funding are below.

- Pavement Strategy 1: Maintain current condition of Interstate, NHS and other routes with over 1,000 AADT (high volume) so that greater than 60% of pavements are in good condition and less than 5% are in poor condition.
- Pavement Strategy 2: Improve non-NHS and other roads with less than 1,000 AADT (low volume) so that greater than 30% of the pavements are in good condition and less than 20% are in poor condition.
- Pavement Strategy 3: Apply maintenance, preservation, rehabilitation, and reconstruction treatments that when combined with new construction replace one year of life to the statewide pavement system each year.
- Bridge Strategy 1: Proactively provide preservation and rehabilitation treatments to bridges on NHS routes to maintain them at the target level of 85 % bridge health index.
- Bridge Strategy 2: Apply a balance of proactive preservation and condition-based rehabilitation or replacement treatments on non-NHS State owned bridges to maintain a bridge health index of 80 % or greater.
- Bridge Strategy 3: Coordinate with local owners of bridges to develop an appropriate treatment plan when local funding is available to achieve the target level of 75% Bridge Health Index.
- ATMS Strategy 1: Replace highest value devices prior to their end of expected life and failure in support of the UDOT Strategic Goals.
- ATMS Strategy 2: Maximize funding by replacing devices within projects developed for other assets.

- Traffic Signal Strategy 1: Conduct preventative maintenance regularly on existing signal equipment to meet target of 95% of system in average or better condition.
- Traffic Signal Strategy 2: Implement the emergency maintenance response plan when emergencies occur.
- Traffic Signal Strategy 3: Apply the established maintenance management process to minimize equipment downtime and unexpected failures.
- Final investment strategy is the STIP approved annually by the Transportation Commission and FHWA.

9. NEXT STEPS

The next steps proposed in the continual maturation and improvement of asset management include:

- Developing a more formalized management process for some tier 2 assets
- Re-evaluate the contribution to decision-making of the current state performance measures to determine if they are the right measures to support UDOT Strategic Goals
- Finish the documentation of the signal system condition and analyze funding needs
- Imbed risk management into the intermediate planning process
- Mature and broaden the risk management process beyond the I-15 urban corridor
- Add Utah emergency projects to Emergency Funding map
- Create a TAMP dashboard to track data on assets
- Incorporate the transportation investment funds into the TAMP financial plan
- Continue collaboration across UDOT department boundaries to develop a program of construction projects that move UDOT toward meeting the Strategic Goals
    - Develop a feedback loop to continually update asset condition
    - Develop and refine process for forecasting of project contribution to goals and measures

APPENDIX A: ASSET MANAGEMENT OVERSIGHT STRUCTURE

To address Utah's infrastructure challenges and embrace opportunities, this TAMP updates the Asset Management Strategic Plan that has been in place since 2001. The updated version includes redefining the structure for asset management that oversees the program funding and implementation of the strategic plan. The purpose of the oversight structure is to provide recommendations to the Transportation Commission for approval that maximize system performance and funding. The structure creates new cross-sectional collaboration between traditionally separate functions of planning, design, construction, maintenance, traffic, and information technology. Collaboration will result in unified program recommendations based on a transparent, data-driven decision-making process. The oversight structure will assist UDOT in careful management of each asset throughout each phase of the asset's life by utilizing program alignment, organized and accessible data, and risk-based asset performance.

ASSET MANAGEMENT STEERING COUNCIL

The Transportation Systems Management Team (TRANSMAT) has been reformed and renamed the Asset Management Steering Council (AMSC). The reformed AMSC is chaired by the Director of Assets and consists of members as shown in Figure A1.

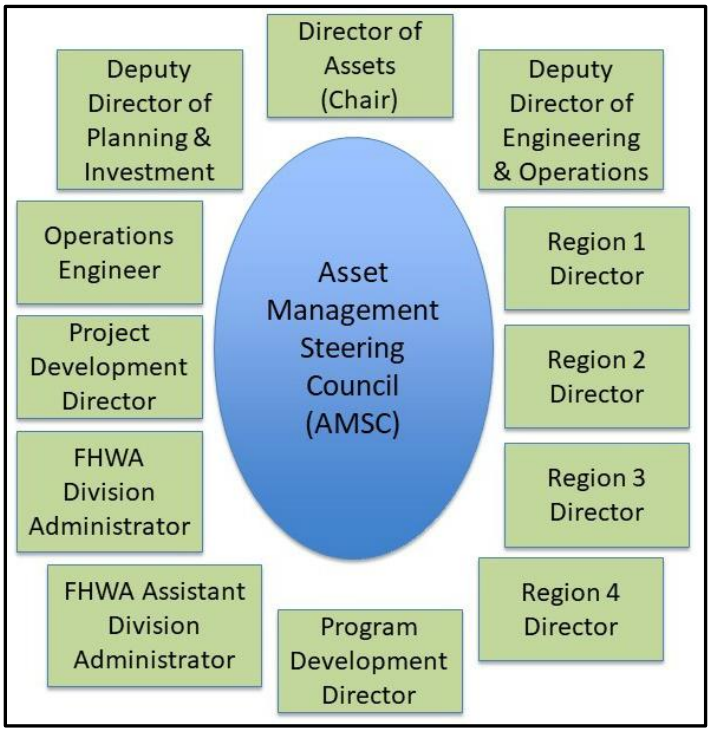


Figure A1. Asset Management Steering Council Membership.

Specific objectives of the AMSC include:

- Ensuring horizontal and vertical communication and integration across the organization relative to asset management.
- Providing direction and approving effective policies, programs, and processes, to ensure ongoing improvement of asset management.
- Evaluating the direction of asset management annually and reporting the results of UDOT's Transportation Program measurements.

ASSET ADVISORY COMMITTEE

The Asset Advisory Committee (AAC) has been formed to enhance the communication flow between the strategic work of the AMSC and the "boots on the ground" technical experts. This committee will implement strategies in a coordinated manner to continually improve the asset management process. The AAC is chaired by the Asset Management Engineer and consists of designated division leaders.

Figure A2. Asset Advisory Committee Membership.

Specific objectives of the AAC include:

- Recommending modifications to policies and processes to improve asset management practices to the AMSC.
- Working together across department boundaries to develop and recommend a unified program to the AMSC that maximizes system performance and funding.
- Aligning programs to determine the most cost-effective method of addressing asset needs.

The enhanced collaboration across functions is expected to lead to synergistic improvements for individual asset performance beyond the level that any one division could achieve. UDOT has shown great success due to collaboration while preparing for the 2002 Olympics, embracing Design/Build and other alternative contracting methods, initiating the use of Accelerated Bridge Construction (ABC), etc. This committee organization engages UDOT leaders to make strategic decisions and informs and educates employees throughout UDOT regarding the direction of asset management and their critical involvement.

Policy 07-13
Asset Management Oversight Structure UDOT 07-13
Effective: Revised: June 30, 2014

Purpose

To outline the responsibilities of the Utah Department of Transportation (Department) Asset Management Steering Council (AMSC) and the Asset Advisory Committee (AAC). These responsibilities include providing recommendations to the Transportation Commission pertaining to planning, developing, and preserving the investment in Utah's Transportation System and obtaining maximum cost effectiveness from transportation construction, rehabilitation, and maintenance programs. AMSC and AAC activities support the Department strategic goals:

1. Preserve Infrastructure
2. Optimize Mobility
3. Zero Fatalities
4. Strengthen the Economy

Policy

The AMSC and AAC provide recommendations to preserve the large investment in the State's roadway and transportation systems and provide a strategy to obtain an enhanced system of highways and related transportation modes that continue to meet the needs of Transportation System users. The teams assist the Department in obtaining cost effective solutions for system needs by using program alignment, organized and accessible data, and risk-based asset performance. The council and committee make sure all divisions of the Department are working together to present a unified program recommendation based on a transparent decision-making process.

ASSET MANAGEMENT STEERING COUNCIL MEMBERS

Deputy Director – Chair
- Program Development Director
- Project Development Director
- Operations Engineer
- Region 1 Director
- Region 2 Director
- Region 3 Director
- Region 4 Director
- Asset Management Director (Secretary)
- FHWA Division Administrator or designee

ASSET ADVISORY COMMITTEE MEMBERS

Asset Management Director – Chair
- Planning Director
- Traffic Management Engineer
- Traffic and Safety Engineer
- Engineering Services Director
- Structures Chief Engineer
- Maintenance Director
- Region 1 Representative
- Region 2 Representative
- Region 3 Representative
- Region 4 Representative
- FHWA Team Leader or designee

Various divisions, sections, and regions provide needed staff support and input to AMSC. AAC members may be invited to participate in AMSC meetings at the chairman's discretion. AMSC is authorized to establish pro tem teams and task forces to assist in accomplishing its responsibilities.

AMSC will consider strategic level Transportation Systems Management activities within the Department; make recommendations to the Transportation Commission; improve efficiency of the decision-making process; and assure consistent transportation systems management practices at all supervisory levels.

Specific responsibilities of the AMSC include:

1. Recommending Department transportation strategies to the Transportation Commission to implement and achieve the Department transportation policies.
2. Recommending policies and resource levels that support ongoing improvement of asset management and a unified transportation program.
3. Guaranteeing horizontal and vertical communication and integration across the Department relative to asset management.
4. Reviewing and reporting the results of the Department's Annual Transportation Program to the Transportation Commission and public.
5. Evaluating the direction of asset management annually in a joint meeting with AAC.

AAC oversees implementation of the Department's Transportation Systems Management Process.

Specific responsibilities of the AAC include:

1. Recommending to the AMSC modifications to policies and processes to improve asset management practices.
2. Working together across department boundaries to develop and recommend a unified program to the AMSC that maximizes system performance and funding.
3. Aligning programs to determine the most cost-effective way of addressing asset needs.
4. Determining the appropriate management level for each asset.

Definitions

A Transportation Systems Management Process provides a set of various tools or methods to assist decision makers in finding optimum strategies for providing and maintaining the transportation systems in an acceptable condition over a planned period. The process includes analysis programs and related data to include but not limited to the following transportation areas: Pavements, Safety, Structures, Mobility, Design, Construction, Maintenance, and Planning.

APPENDIX B: GAP ANALYSIS PROCESS AND RESULTS

In order to begin the process of evaluating the current situation of Asset Management, the *Asset Management Implementation Plan* (developed in June 2004 and updated in April 2006) was reviewed. It was noted that many of the actions identified in the plan had been achieved, and UDOT has had great success in regard to managing assets especially bridges and pavements. The document also identified that many of the divisions within UDOT were working towards the goals set forth as a strategic direction by senior leaders at the time. Over the past 8 years, there have been great technological advances and some change in direction in the strategic plan. These events have created new challenges and opportunities that are addressed in this TAMP.

SELF-ASSESSMENT AND GAP ANALYSIS

To identify the steps taken to raise asset management to a gold standard, self-assessments were completed. The assessments results were identified through a process of brainstorming sessions, surveys, and interviews specific to divisions (Figure B1).

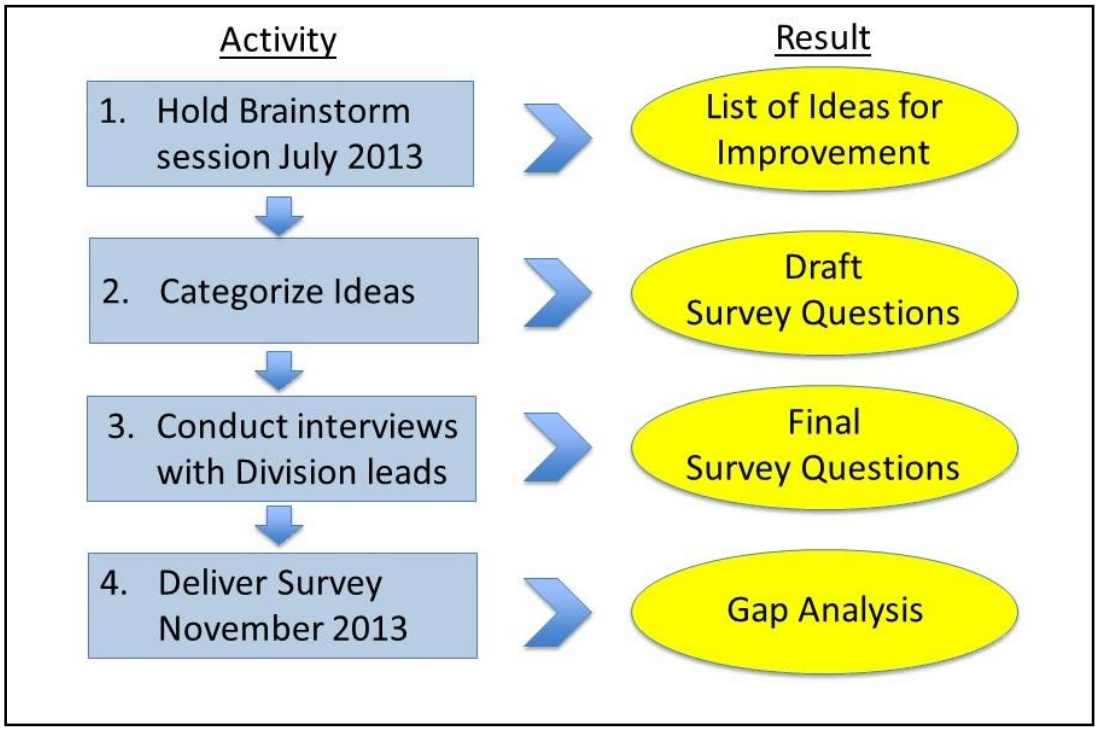


Figure B1. Self-Assessment and Gap Analysis Process.

Specific activities were taken to understand the gaps associated with Asset Management as described below.

Activity 1. The Asset Management Steering Council participated in a facilitated discussion of the purpose of a five-year strategic plan and issues currently faced by council members. This discussion in July 2013 resulted in a collection of comments and questions written on post-it notes by voting and non-voting council members.

Activity 2. The discussion facilitators, RiversQuest Consulting and V-I-A Consulting organized the comments and questions from the July meeting into major categories (Figure B2). The percentages presented are based on 79 total post-it notes collected. The actual comments are included in Appendix C.

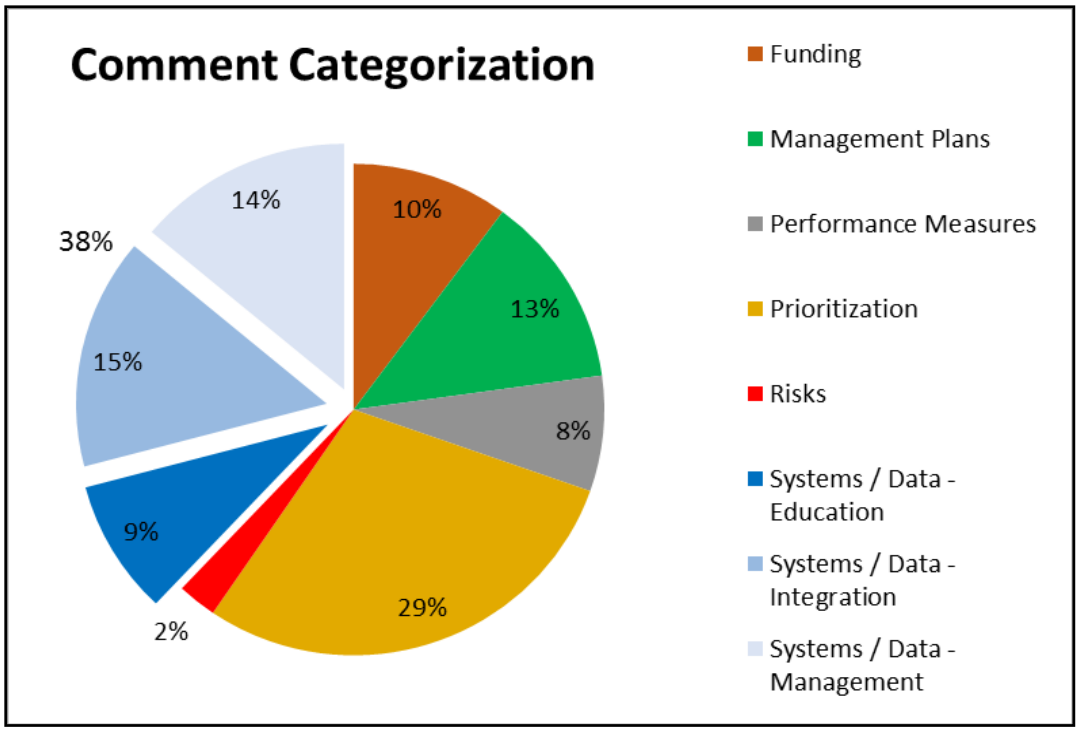


Figure B2. Comment Categorization Results from Assessment and Analysis.

Activity 3. Questions were developed from the comments gathered in Activity 1 and incorporated into a Gap Analysis Survey. The initial questions were fine-tuned and minimized based on individual discussions with senior UDOT leaders.

Activity 4. Eleven questions were presented to the TRANSMAT Committee during the November 2013 meeting (See Appendix C). Each statement was rated in two ways.

a. The statement was rated on level of importance to the UDOT program on a scale of 1-5. The scale was defined as 1-very important to 5-unimportant.
b. Next each statement was rated on a scale of 1-5 relative to UDOT's current level of performance with 1-excellent and 5-poor.

Twenty-three meeting participants recorded their answers with a handheld device and results which were immediately available for each statement.

The meeting facilitators analyzed the results and incorporated the information into a report for consideration. Senior leaders elected to reorganize TRANSMAT into the Asset Management Organization Structure noted above.

GAP ANALYSIS RESULTS

The gap between the importance of each statement and the current status of UDOT performance as rated by the TRANSMAT Committee members is depicted in Figure B3. Appendix D contains the details of the voting results. The results show the biggest gaps are in areas related to information technology. As technology rapidly advances much more data is gathered and the challenge comes in gathering the knowledge from each function and making it available to others. Information systems support a coordinated, seamless approach to Asset Management.

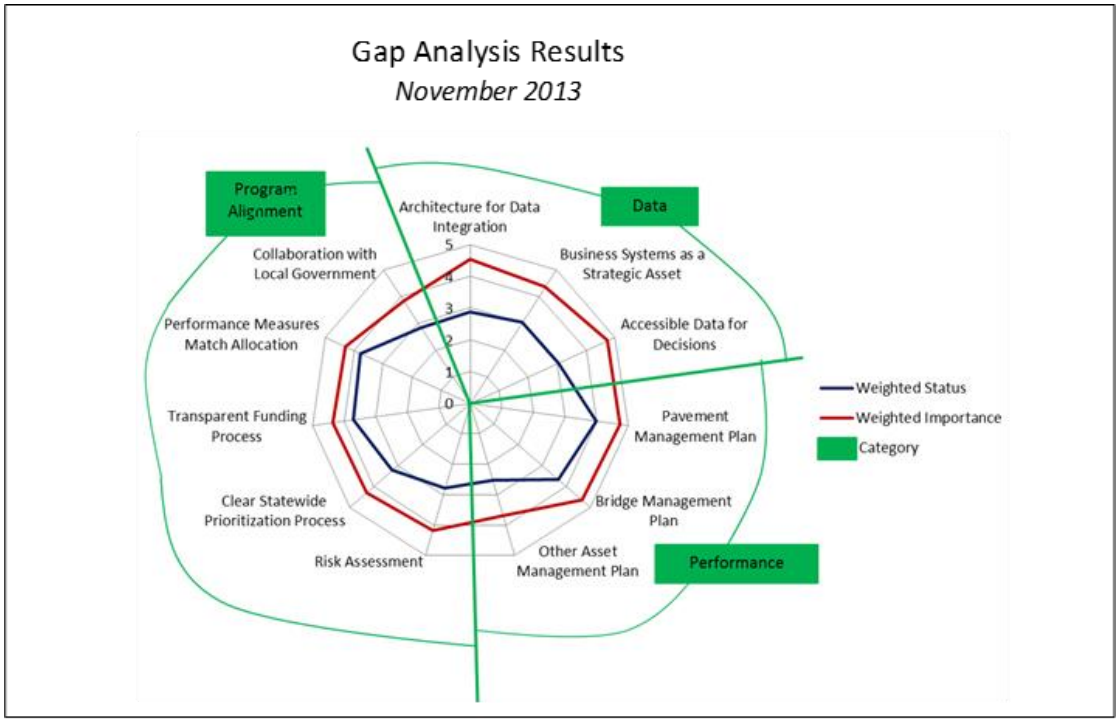


Figure B3. Gap Analysis Results.

Further discussion of the gap analysis results led to the identification of three major areas of focus.

- The three questions related to data show the largest gaps and the highest importance of all the questions. These questions focus on the organization and accessibility of data for business systems across UDOT.

- Three questions related to asset performance and identified a need to focus on performance measures and different levels of management plans for assets.

- The remaining questions relate to aligning programs within UDOT and with partners to ensure transparent and data driven decision processes are in place to build and maintain public trust.

These major areas of focus became objectives for the five-year plan and led to defining the asset management goal.

APPENDIX C: COMMITTEE COMMENTS, JULY 2013

TRANSMAT COMMITTEE COMMENTS REGARDING ASSET MANAGEMENT PLAN

Comment Provided By	Ideas	Responsibility	Category
Non-Voting Member	This group determines how well funding is set / prioritized	Steering Committee	Funding
Non-Voting Member	We should improve how we sweep the corners for money left on projects	Steering Committee	Funding
Non-Voting Member	What can be done to maximize the use of the public's money? If we recapture money more quickly does that help?	Steering Committee	Funding
Non-Voting Member	Need: Enhance the ability to quickly evaluate program balances and delivery	Steering Committee	Funding
Non-Voting Member	Need: to define what is intended in fund types that Transmat approves. Agree to update "Fund Fact Sheets" yearly.	Steering Committee	Funding
Non-Voting Member	Need: To consider Active Transportation Policy in funding decisions.	Steering Committee	Funding
Voting Member	Definition documentation for funding types and processes. Basically, setting the rules for when funds can be used, combined, etc. When does it require Commission action?	Steering Committee	Funding
Non-Voting Member	Need: To identify what can be spent on bridges using Purple and Orange Book projects if it is allowed.	Structures	Funding
Voting Member	Life cycle replacement plan for ATMS / Signal systems	T&S	Management Plan - Other
Non-Voting Member	Need to put culverts in our program. Need to track them and see where we are at	Asset Management	Management Plans - Other
Non-Voting Member	Capacity is an asset. Public trust is an asset. How can we manage these non-tangible assets?	Steering Committee	Management Plans - Other
FHWA	Is congestion or capacity throughout a tangible asset? (Time to get to work, speed, volume, ridership)	T&S	Management Plans - Other
Non-Voting Member	Mobility is an asset. How do we manage?	T&S	Management Plans - Other
Non-Voting Member	We should consider safety, choke, Pt, capacity as an asset	T&S	Management Plans - Other

Comment Provided By	Ideas	Responsibility	Category
Non-Voting Member	Need to show target level for concrete pavements. Big dollars coming at UDOT for older sections.	Asset Management	Management Plans - Pavements
Non-Voting Member	Bridge: We need a plan for every structure on every road	Structures	Management Plans - Structures
Non-Voting Member	Bridge: Define / plan for off system bridge, develop a strategy, preservation, funding	Structures	Management Plans - Structures
Non-Voting Member	Need: A plan for every bridge	Structures	Management Plans - Structures
FHWA	Have you checked out the FHWA's INVEST tool to examine a projects sustainability of the sustainability of our planning process?	Planning	Performance Measures
Non-Voting Member	Need: to establish asset performance measures with FHWA so UDOT isn't reporting by project then we can deliver project by asset needs instead of project specific inventories.	Steering Committee	Performance Measures
Non-Voting Member	Need: Quarterly reports on each asset and accomplishment.	Steering Committee	Performance Measures
Non-Voting Member	How do we measure success in asset management? Do these measure change by asset type? What impact does design, concept, development have on asset management	Steering Committee	Performance Measures
Non-Voting Member	ATMS devices need performance standards	T&S	Performance Measures
Non-Voting Member	Safety: How do we measure performance?	T&S	Performance Measures
Voting Member	Plan for every road: Cost/Benefit ratio should be calculated to see if it's worth it to develop a plan.	Asset Management	Prioritization
Voting Member	Develop asset priority list	Asset Management	Prioritization
Voting Member	Develop a process and prioritize our assets for analysis and recommendation	Asset Management	Prioritization
Voting Member	Due to constraints, we should evaluate those assets of highest value and cover those of greatest need. Can't do them all.	Asset Management	Prioritization
Voting Member	Different levels of asset management are available – we need to identify what level is needed for each asset – maybe B/C?	Asset Management	Prioritization
Non-Voting Member	Need: to move to Statewide Prioritization Process based on strategic goal (UDOT and MAG Process).	Planning	Prioritization
Voting Member	Project Delivery – Implications of TRANSMAT decisions should be considered	Project Delivery	Prioritization
Comment Provided By	Ideas	Responsibility	Category

Non-Voting Member	Communicating the prioritization process	Steering Committee	Prioritization
Non-Voting Member	What added methods can be used to prioritize other assets and projects types? Where are we on financial cross asset management? How to value work on asset to another, comparing apples to oranges.	Steering Committee	Prioritization
Non-Voting Member	Define assets to be managed, Rank Assets	Steering Committee	Prioritization
Non-Voting Member	Use Engineer / Business Decision for maintaining assets	Steering Committee	Prioritization
Non-Voting Member	Asset prioritization – which assets should we focus on first? What can we afford to do now?	Steering Committee	Prioritization
Non-Voting Member	Improve how recommendations are made to Commission progress / process	Steering Committee	Prioritization
Non-Voting Member	We need 3-year program by region to do the right project at the right time	Steering Committee	Prioritization
Non-Voting Member	Are there best practices defined that can help guide our program?	Steering Committee	Prioritization
Voting Member	Use data to rank projects (based on need)	Steering Committee	Prioritization
Non-Voting Member	Safety: How do we measure working with other projects (bridge, pavement)	T&S	Prioritization
Non-Voting Member	Choke Pt projects make it data derived not even distribution	T&S	Prioritization
Non-Voting Member	Need: Three-year plan for safety projects	T&S	Prioritization
Non-Voting Member	When balancing project cost against minimal decrease in safety, how is minimal defined? What is an acceptable decrease & how do you quantify cost to safety?	T&S	Prioritization
Non-Voting Member	Safety: Identify how we prioritize safety projects	T&S	Prioritization
Voting Member	Use crash data to prioritize safety projects	T&S	Prioritization
Non-Voting Member	Continue down the path of sign replacement. More reflective not necessarily changing the sign bridges. (Not as critical as culverts)	Asset Management	Prioritization
Comment Provided By	Ideas	Responsibility	Category
Voting Member	Incorporate risk analysis into asset management processes	Asset Management	Risks
Voting Member	Better define our risk analysis / factors	Project Delivery	Risks
Non-Voting Member	What is the program for minor rehab and preservation? Where can it be found? Does it state the treatment type?	Asset Management	Systems/Data - Education
Non-Voting Member	UPlan is the tool to Use!!! One stop shop = Efficiency	Steering Committee	Systems/Data - Education
Non-Voting Member	Employees need education and training on UPlan and UGate	Steering Committee	Systems/Data - Education

Non-Voting Member	Communication	Steering Committee	Systems/Data - Education
Non-Voting Member	Low trust in the data in UPlan and UGate. Need to know the source of the data.	Steering Committee	Systems/Data - Education
Voting Member	We need to educate stakeholders about assets data and UPlan	Steering Committee	Systems/Data - Education
Voting Member	Educate department on what data is available. Consolidate and build systems to make it readily available.	Steering Committee	Systems/Data - Education
Non-Voting Member	What level of integration is enough to feed asset management?	Asset Management	Systems/Data - Integration
Non-Voting Member	We do a good job with pavement and fund allocation, but the data and allocation are about 2 years behind. Example: Core project has made pavement good in Utah County but won't see funding levels change for 2 to 3 years. Can we get data change faster?	IT	Systems/Data - Integration
Non-Voting Member	Need data collection that is recent and relevant IE: Traffic data needs to be newer than 3 years old	IT	Systems/Data - Integration
Voting Member	Continue building business systems that share and integrate data	IT	Systems/Data - Integration
Non-Voting Member	The TMD has data that other groups / regions need to make better decisions	Planning	Systems/Data - Integration
Non-Voting Member	Can we afford to do cross asset analysis? Can we afford to not do cross asset analysis?	Steering Committee	Systems/Data - Integration
Voting Member	Like to see us focus on cross assets analysis for pavement and bridges	Asset Management	Systems/Data - Integration
Non-Voting Member	Integrations of our data systems is poor. Information is siloed, Communication is siloed	IT	Systems/Data - Integration

Comment Provided By	Ideas	Responsibility	Category
Non-Voting Member	What do we know about our current assets? How can big data help us drive asset decisions?	IT	Systems/Data - Integration
Non-Voting Member	Need: Widen data collection by gathering other data from stakeholders (InRix, Freight, Events)	IT	Systems / Data - Integration
Non-Voting Member	Bridge: Can we begin showing bridge data on UPlan / UGate	Structures	Systems / Data - Integration
Non-Voting Member	Do we have enough data to do asset analysis? Deterioration process? Current condition? Last modification?	Asset Management	Systems / Data - Management
Non-Voting Member	Would better systems improve our ability to manage our assets?	Asset Management	Systems / Data - Management
Voting Member	Collect data for additional assets	Asset Management	Systems / Data - Management
Non-Voting Member	Our systems are assets we need to manage and some of our systems are inhibiting our abilities.	IT	Systems / Data - Management
Non-Voting Member	Asset also includes system improvement to optimize use of funding (ePm, Database, New PDBS)	IT	Systems / Data - Management
Non-Voting Member	Data Quality: Should a QIT be established for management?	IT	Systems / Data - Management

Voting Member	Identify priority systems and where the data should reside. Where is our system money best spent?	IT	Systems / Data - Management
Voting Member	Improve systems to better manage our money (Free up contingences)	IT	Systems / Data - Management
Voting Member	Increase data quality management	IT	Systems / Data - Management
Voting Member	Data quality: is there a lack of credibility?	IT	Systems / Data - Management
Non-Voting Member	Shouldn't our systems (technology) be another asset we should manage?	IT	Systems/Data-Integration
Voting Member	Incorporate highway safety manual in standards process – as well as early project involvement	T&S	Systems/Data-Integration

Legend:

Voting Member Comment
Non-Voting Member Comment
FHWA Member Comment

APPENDIX D: GAP ANALYSIS QUESTIONS AND VOTING RESULTS

UDOT Asset Management Steering Council Gap Analysis Questions

UDOT Systems / Data

- UDOT has established a quality data information architecture to promote the integration of business systems for unified asset management.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

- Business systems are treated as a strategic asset to help make data driven decisions.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

- Necessary data is easily accessible to make data driven cost/benefit decisions.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

UDOT Project Prioritization

- A clear, well documented state-wide prioritization process is in place.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

- Management plans have been / are being developed for ***pavements*** including life-cycle analysis, identification of performance measures, and data required for cross analysis.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

- Management plans have been / are being developed for ***bridges*** including life-cycle analysis, identification of performance measures, and data required for cross analysis.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

- Management plans have been / are being developed for ***other assets*** including life-cycle analysis, identification of performance measures, and data required for cross analysis.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

UDOT Funding

- The types of funding, the uses of funding, and the process to fund projects is transparent.

1. Very Important
2. Important
3. Somewhat Important
4. Of little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

UDOT Performance Measures

- Asset management performance measures are consistent with the UDOT strategic direction and with the criteria used to set program priorities, select projects, and allocate resources.

1. Very Important
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3. Somewhat Important
4. Of Little Importance
5. Unimportant

1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

UDOT Risk Assessment

- Resource allocation includes assessment of probability and severity of risk associated with each asset.

1. Very Important
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3. Somewhat Important
4. Of Little Importance
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1. Excellent
2. Above Average
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Collaboration

- UDOT liaison's with local governments share information and knowledge to further the development of asset management in Utah.

1. Very Important
2. Important
3. Somewhat Important
4. Of Little Importance
5. Unimportant

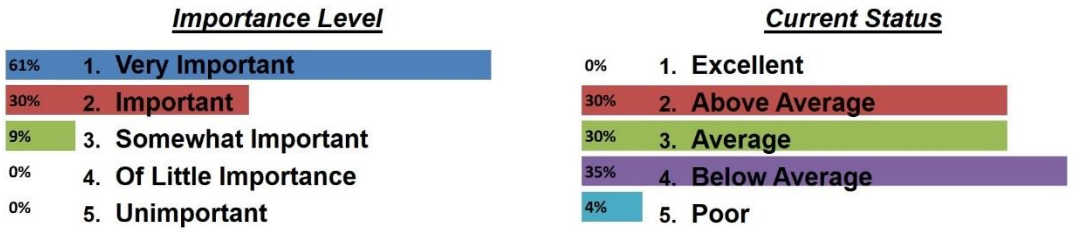
1. Excellent
2. Above Average
3. Average
4. Below Average
5. Poor

GAP ANALYSIS VOTING RESULTS

UDOT Systems / Data

Information Architecture

#1 Survey Results:
UDOT has established a quality data information architecture to promote the integration of business systems for unified asset management.



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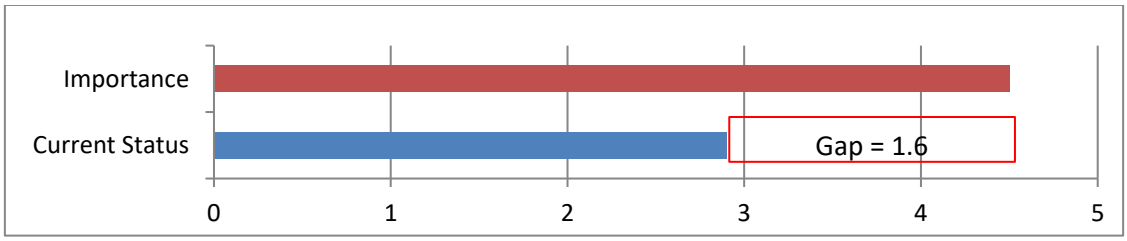
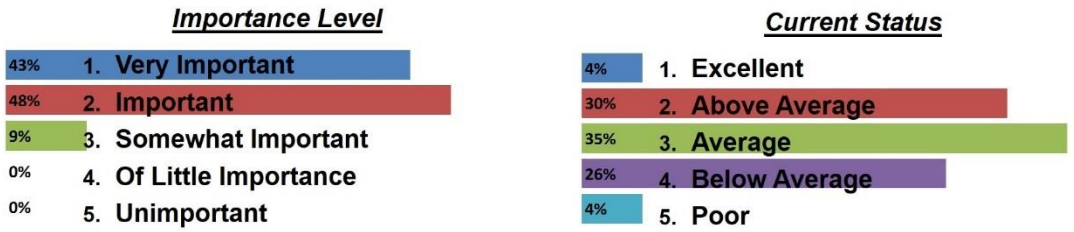


#2 Survey Results:
Business systems are treated as a strategic asset to help make data driven decisions.



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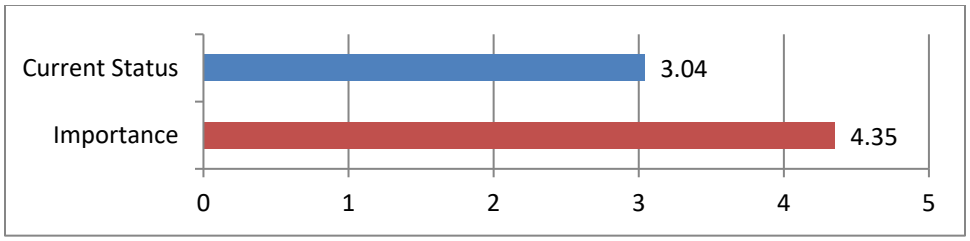
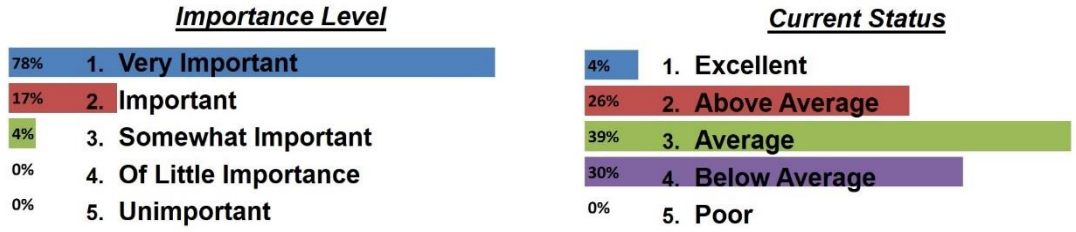
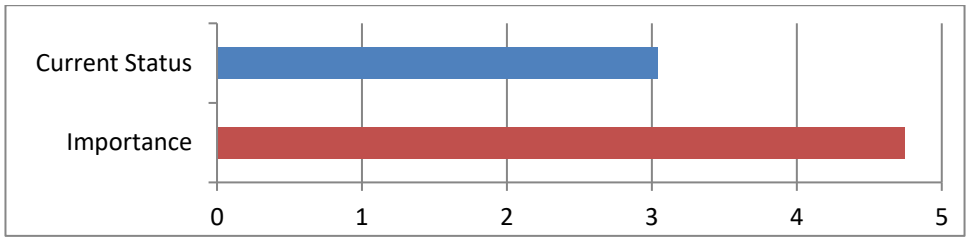


Necessary Data Available

#3 Survey Results:
Necessary data is easily accessible to make data driven cost/benefit decisions.



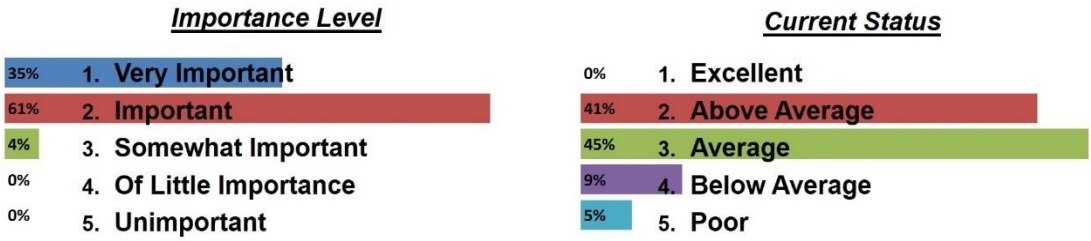
Gap Analysis



UDOT Project Prioritization

Prioritization Process

#4 Survey Results:
A clear, well documented state-wide prioritization process is in place.



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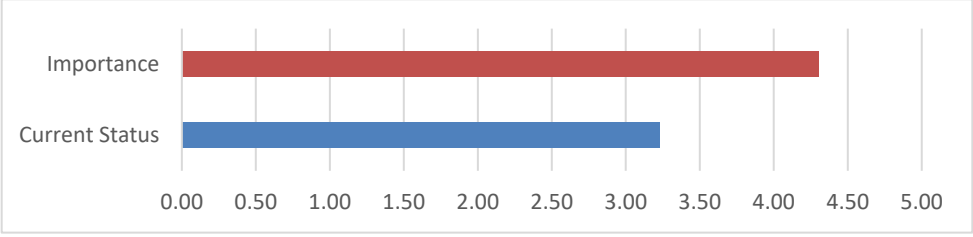
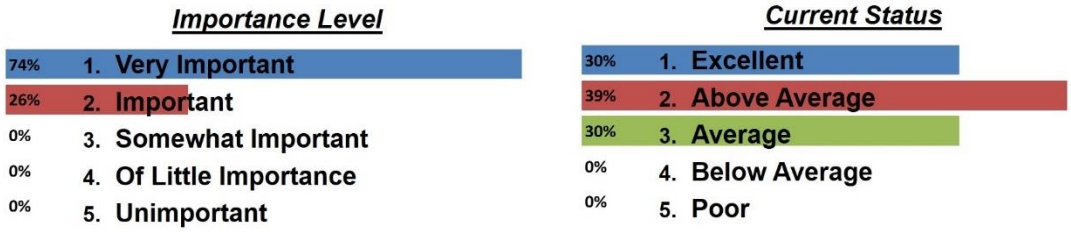


Management Plans for Pavements

#5 Survey Results:
Management plans have been / are being developed for pavements including life-cycle analysis, identification of performance measures, and data required for cross analysis.



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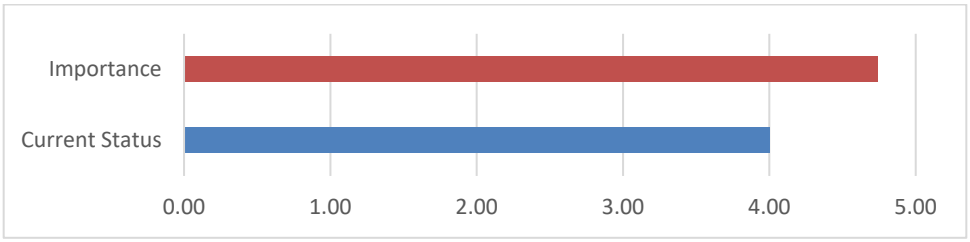
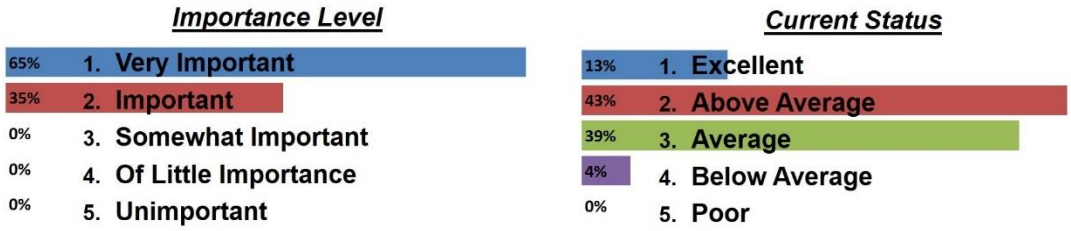
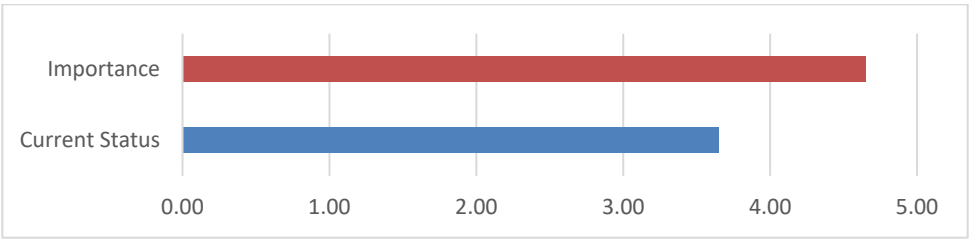


Management Plans for Bridges

#6 Survey Results:
Management plans have been / are being developed for bridges including life-cycle analysis, identification of performance measures, and data required for cross analysis.

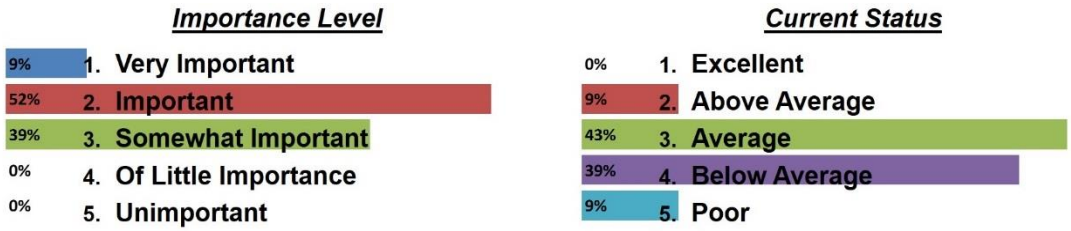


Gap Analysis:

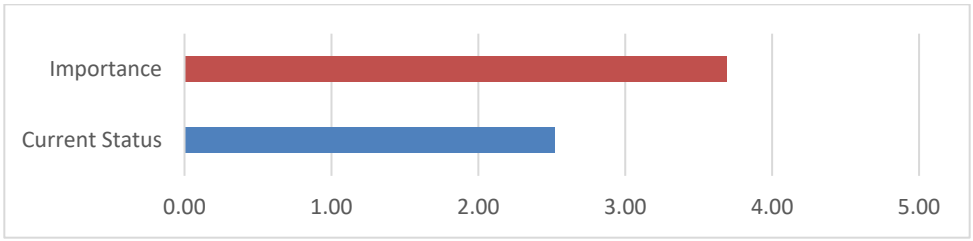


Management Plans for Other Assets

#7 Survey Results:
Management plans have been / are being developed for other assets including life-cycle analysis, identification of performance measures, and data required for cross analysis.



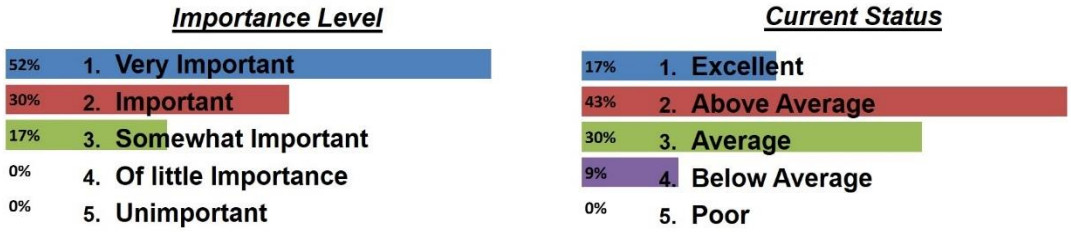
Gap Analysis:



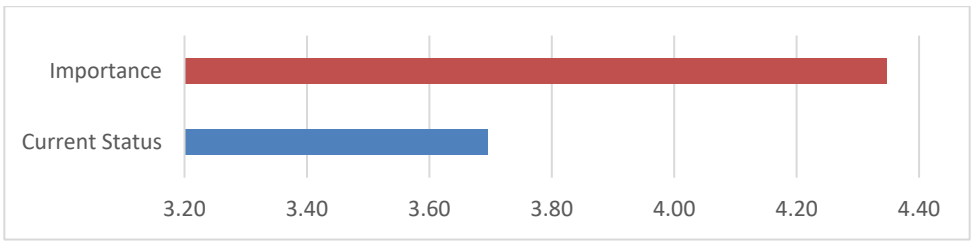
UDOT Funding

Funding Transparency

#8 Survey Results:
The types of funding, the uses of funding, and the process to fund projects is transparent.



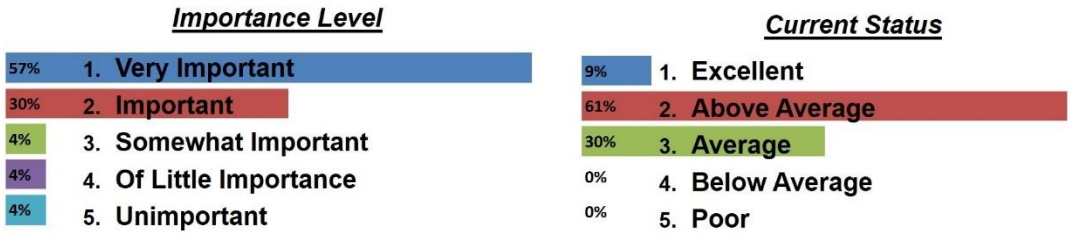
Gap Analysis:



UDOT Performance Measures

Alignment of Performance Measures

#9 Survey Results:
Asset management performance measures are consistent with the UDOT strategic direction and with the criteria used to set program priorities, select projects, and allocate resources.



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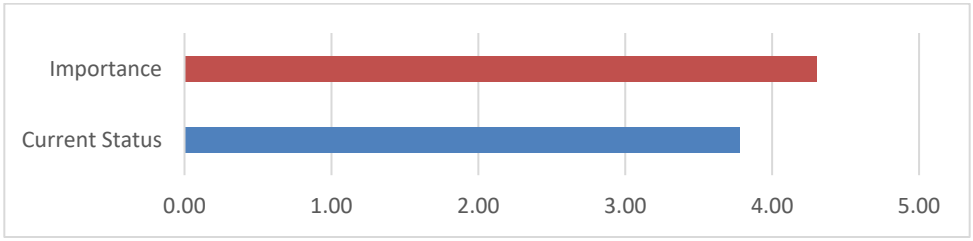
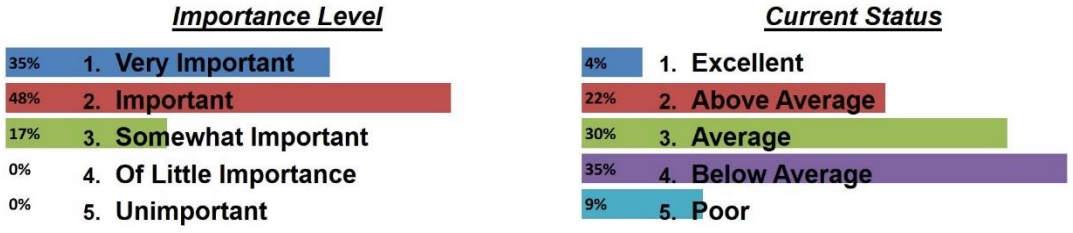


UDOT Risk Assessment

Risk Assessment

#10 Survey Results:
Resource allocation includes assessment of probability and severity of risk associated with each asset.



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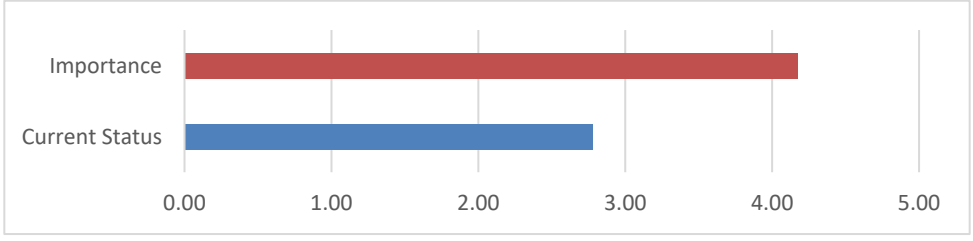
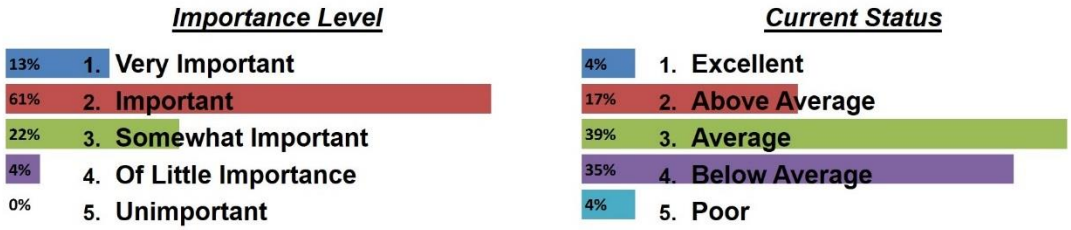


Collaboration

Local Government Collaboration

#11 Survey Results:
UDOT liaison's with local governments share information and knowledge to further the development of asset management in Utah.



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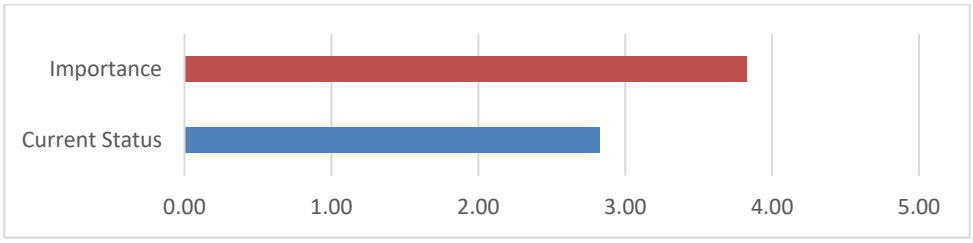

APPENDIX E: ASSET TIERS AND RISK ASSESSMENT

Tier 1 Assets

- Tier 1
  - Highest value assets
  - Highest risk of negative financial impact for poor management
  - Very important to UDOT performance plan
  - Has a significant separate funding source
  - Management includes
    - setting targets, goals
    - Sophisticated data collection
    - Predictive modeling and risk analysis

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Pavement	$24B	6	3	8	7	6	**1**

Financial –

- Have separate and stable funding source to preserve condition but level 2 roads are underfunded.

Information –

- Data is readily available on all but data is not as good on level 2 roads.

Operational –

- Pavement failure or deteriorated condition adversely impacts mobility in a wide section of system, detours limited or are already carrying heavy load.

Safety –

- Pavement failure or deteriorated condition moderately impacts safety of public travel.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Bridges	$5B	6	3	8	8	6	1

Financial –

- Have separate and stable funding source that is not adequate to preserve all bridges at desired condition levels.

Information –

- Data is available from regular inspections and Mandli data but is not as good on off system bridges.

Operational –

- Bridge failure or load posted adversely impacts mobility of a wide section of system, detours limited or are already carrying heavy load.

Safety –

- Bridge failure has very high public safety ramifications.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
ATMS/Signal Devices	$793M	6	6	5	5	5.5	1

Financial –

- Separate funding source is available and not adequate for needs.

Information –

- Location data available, accurate data is currently not available on age or condition of devices.

Operational –

- Replacement activities are likely and moderately impact operations.

Safety –

- Failure is a significant safety hazard but redundant devices temporize consequences.

TIER 2 ASSETS

- Tier 2
  - Moderate value assets and substantial importance to transportation system operation
  - Moderate risk of negative impact for poor management or asset failure
  - May have a separate funding source
  - May be lack of redundancy that increases risk
  - Management includes
    - Accurate data collection, less than annually
    - Risk assessment primarily based on asset failure
    - May include spreadsheet predictive strategy
    - May include condition targets for proactive strategies

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Pipe Culverts	$1B	6	7	5	3	5	**2**

Financial –

- Limited separate funding and not adequate for regular preservation activities. However, pipe culverts are routinely included in pavement preservation projects.

Information –

- Limited location data is available and is difficult to obtain due to urban linked piping systems.
- Condition is unknown and is difficult and costly to obtain.

Operational –

- Pipe culvert failure may have significant mobility impact depending on traffic volumes and extent of failure, reconstruction may take significant effort due to conflicts with utilities and other assets but probability of failure is low.

Safety –

- Pipe culvert failure likely to have advance warning of water back up or sagging pavement and therefore lesser safety risk and low probability.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Signs	$300M	7	5	3	3	4.5	2

Financial –

- Very limited separate funding source available.

Information –

- Data is available on location but not condition
- Sign age is unknown prior to 2004.
- Percentage meeting current standards unknown.

Operational –

- Sign structure failure may have significant operational impact.
- Sign redundancy reduces operational risk.

Safety –

- Regulatory signs replaced immediately when necessary.
- Other missing or damaged signs replaced as a project element.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Walls	$3.4B	3	3	5	3	3.5	**2**

Financial –

- No separate funding source and not regularly included in preservation projects.

Information –

- Data is available on location but not condition.

Operational –

- Wall failure may have significant impact on system mobility depending on height and location. Many can be reconstructed in shoulder area with limited operational impact.

Safety –

- Wall failure consequences depend heavily on height and location and failure is very rare.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Rumble Strips	$ 6M	3	4	2	5	3.5	2

Financial –

- Rumble strips are installed as project elements.

Information –

- Location information is available, condition data is not easily collected.

Operational –

- Replacement activities are completed on the shoulder with low impact to operations.

Safety –

- Failure is a moderate safety hazard with moderate consequences due to other safety features such as shoulders, guard rails, etc.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
ADA Ramps	$ 20M	2	2	1	5	2.5	2

Financial –

- Separate funding source is available for required installations.

Information –

- Data is not easily available on location.
- Condition is monitored by maintenance as part of other activities.

Operational –

- Replacement and installation activities do not significantly impact operations.

Safety –

- Failure is a moderate safety hazard with moderated probability.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Barrier	$450M	3	1	4	2	2.5	2

Financial –

- Separate funding source is available to add barrier where needed based on safety assessments, if funding lost would have negative impact on fatalities.

Information –

- Data on location and type collected routinely.

Operational –

- Barrier usually can be repaired and added in the median or on the shoulders with minimal impact to system mobility.

Safety –

- Barrier is repaired and replaced by maintenance as needed due to crashes and most of the time still effective even when hit.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Pvt. Markings	$ 42M	2	1	2	5	2.5	2

Financial –

- Maintenance allocates funding for pavement markings every year.

Information –

- Data is readily available on location, amount and type of markings.

Operational –

- Replacement activities are rolling and do not significantly impact operations.

Safety –

- Failure is a moderate safety hazard but probability is moderated due to maintenance monitoring condition.

TIER 3 ASSETS

- Tier 3
  - Low value assets
  - Low risk of negative impact for poor management or asset failure
  - Management includes
    - Accurate data collection, less than annually
    - Risk assessment primarily based on asset failure
    - Included in projects when condition warrants
    - Reactive - Repaired or replaced when damaged

Assets Managed as Tier 3

Asset	Tier
Cattle Guards	3
Interstate Lighting	3
Fences	3
Rest Areas	3
Curb and Gutter	3
Trails	3
Bike Lanes	3
Surplus Land	3
At-grade crossings	3

APPENDIX F: PERFORMANCE-BASED PLANNING AND PROGRAMMING MEMORANDUM OF AGREEMENT

PERFORMANCE-BASED PLANNING AND PROGRAMMING
MEMORANDUM OF AGREEMENT

In accordance with 23 CFR 450.314 - Metropolitan Planning Agreements, this agreement is made and entered into this 16 day of April 2018, by and between the Metropolitan Planning Organizations, hereinafter designated as "MPO(s)", the Utah Department of Transportation, hereinafter designated as "UDOT", and the Public Transportation Agencies;

WHEREAS, the MPO(s), have been duly constituted under the authority of Title 11, Chapter 13, Utah Code Annotated, 1953, as amended (the Interlocal Cooperation Act), and pursuant to Section 3, Executive Order of the Governor of the State of Utah, dated 27 May, 1970; and

WHEREAS, UDOT's powers and responsibilities are listed in Utah Code Section 72-1-201 et seq. and include general responsibility for planning, research, design, construction, maintenance, security, and safety of all state transportation systems; and

WHEREAS, the Public Transportation Agencies powers and responsibilities are listed in Utah Code Annotated, Title 17B, Chapter 2a, Part 8; and every public transit provider that receives Federal financial assistance under 49 Utah State Code chapter 53 is to develop a Transit Asset Management Plan (TAM), or be part of a group TAM; and provided that the Utah Transit Authority, a tier I provider, and Cache Valley Transit District, a tier II provider, are providing their own TAM; and Park City Transit, Basin Transit Administration, SunTran, and Cedar Area Transit, tier II providers, are participating in the UDOT group TAM; and

WHEREAS, The provisions contained in this document respond to requirements in 23 CFR 450.314 (h) stating: "The Metropolitan Planning Organizations (MPO(s)), States (UDOT), and the providers of public transportation shall jointly agree upon and develop specific written provisions for cooperatively developing and sharing information related to transportation performance data, the selection of performance targets, the reporting of performance targets, the reporting of performance to be used in tracking progress toward attainment of critical outcomes for the region of the MPO (see § 450.306(d)), and the collection of data for the State asset management plans for the National Highway System (NHS)";

NOW, THEREFORE BE IT RESOLVED, that the parties hereto, the MPO(s), UDOT, and the Public Transportation Agencies do mutually resolve and agree as follows:

1. **Developing and Sharing Information Related to Transportation Performance Data**
    a. UDOT will provide the MPO(s) with a subset, for their urbanized areas, of the state performance data that UDOT used or uses in developing statewide targets.
    b. MPO(s) that choose to adopt their own targets will provide any supplemental data used in determining any such target, to UDOT or the Public Transportation Agencies, or both.

c. Public Transportation Agencies that are part of the UDOT TAM will provide their transit data to UDOT within four months of their fiscal year end.
d. Public Transportation Agencies creating their own TAM will provide transit data by asset class for the FAST Act transit performance measures to UDOT and MPO(s), in their transit regions, within four months of their fiscal year end.

2. **Selection of Performance Targets**
   a. UDOT will develop statewide performance targets for each of the FAST Act performance measures, in cooperation with the MPO(s) and the Public Transportation Agencies.
   b. Public Transportation Agencies will develop their measures in the UDOT TAM or, if creating their own TAM, they will cooperate with their respective MPO(s) and UDOT when establishing transit targets.
   c. MPO(s) will cooperate with UDOT or Public Transportation Agencies, or both, in supporting the statewide targets or in establishing their own MPO targets. UDOT or Public Transportation Agencies, or both, will be given an opportunity to comment on the MPO(s) targets.
   d. UDOT, MPO(s), and Public Transportation agencies will develop and set targets as required by 23 CFR Parts 450 and 771, as well as 49 CFR Part 613, as applicable.

3. **Reporting of Performance Targets**
   a. UDOT and Public Transportation Agencies will report the statewide performance targets to FHWA and FTA, as applicable, and shall provide a copy of such reporting to the MPO(s).
   b. MPO(s) will report their performance targets to UDOT and their Public Transportation Agencies in the form of a memorandum or meeting minutes from their board.
      i. If the MPO(s) choose to adopt the targets of UDOT or the Public Transportation Agencies, or both, documentation of the MPO(s) support of the appropriate targets shall be provided to UDOT or the Public Transportation Agencies, or both.
      ii. If MPO(s) choose to adopt their own targets, written notification that the MPO(s) will set a quantifiable target, for the performance measure within the MPO planning area, with its associated data will be provided to UDOT or the Public Transportation Agencies, or both.

4. **Reporting of Performance To Be Used In Tracking Progress Toward Attainment of Critical Outcomes For The Regional Area.**

a. Reporting of targets and performance shall conform to 23 CFR 490 (National Performance Management Measures), 49 CFR 625 (Transit Asset Management), 49 CFR 673(Public Transportation Agency Safety Plan), and 49 CFR 450.334 (Obligated Projects).
b. UDOT will include information outlined in 23 CFR 450.216 (f) (Development of Long-range Statewide Plan) in any statewide transportation plan amended or adopted after May 27, 2018, and information outlined in 23 CFR 450.218 (q) (Development of STIP) in any statewide transportation improvement program amended or adopted after May 27, 2018.
c. MPO(s) will include information outlined in 23 CFR 450.324 (Development of Metropolitan Transportation Plan) in any RTP amended or adopted after May 27, 2018, and information outlined in 23 CFR 450.326 (d) (Development of TIP) in any TIP amended or adopted after May 27, 2019, and conform to 23 CFR 450.306 (d) (performance based approach).

5. **Collection of Data for the State Asset Management Plans for the NHS.**
   a. UDOT will be responsible for collecting bridge and pavement condition data for the State asset management plan for the NHS.

Changes

Alterations, extensions, supplements, or modifications of the terms of this Agreement as detailed herein shall be agreed to in writing by the parties concerned, incorporated as amendments to this Agreement, and made a part thereof.

Termination of Agreement

If, through any case, the parties fail to fulfill in a timely and proper manner the obligations under this Agreement, or if any of the parties shall violate any of the covenants, Agreements, or stipulations of this Agreement, or if any of the parties so wishes to withdraw from this Agreement, they shall thereupon have the right to terminate this Agreement by giving written notice of such terminations and specifying the effective date thereof, at least sixty (60) days before the effective date of such termination. If any one of the parties terminates their participation in this Agreement, it shall not affect the obligations of the other parties to this agreement.

Miscellaneous

Each party agrees to undertake and perform all acts reasonably necessary to carry out the intent and purposes of the Agreement at the request of another party.

The failure of any party to insist upon strict compliance of any of the terms and conditions or failure or delay by any party to exercise any rights or remedies provided in this Agreement, or by law, will not release any party from any obligations arising under this Agreement.

Each party represents that it has the authority to enter into this Agreement. This Agreement may be executed in counterparts by the parties.

IN WITNESS THEREOF, the MPO(s), UDOT, and the Public Transportation Agencies have executed this Agreement as of the date first written.

Holly H. Daines

Date: 4/16/18

Name: Holly Daines
Title: Chair, Cache Metropolitan Planning Organization

Date: 4/19/18

Name: Andrew Gruber
Title: Executive Director, Wasatch Front Regional Council

Date: 4/18/18

Name: Andrew Jackson
Title: Executive Director, Mountainland Association of Governments

Date: 4/26/18

Name: Chris Hart
Title: Chair, Dixie Metropolitan Planning Organization

Date: 4/25/18

Name: Carlos Braceras
Title: Executive Director, Utah Department of Transportation

Date: 5-7-18

Name: Jerry Benson
Title: President/Chief Executive Officer, Utah Transit Authority

Date: 4-17-18

Name: Todd Beutler
Title: General Manger, Cache Valley Transit District