2013 Annual Efficiencies Report
Utah Department of Transportation

State Legislature Version
Introduction

Efficiencies in the Utah Department of Transportation often generate cost savings for the public and the Department through better utilization of resources and innovative technologies. This report contains summaries of key efficiency initiatives from State Fiscal Year 2013. These efficiencies highlight the significant progress made during 2013 toward accomplishing the Strategic Goals of the Department:

- Preserve Infrastructure
- Optimize Mobility
- Zero Fatalities
- Strengthen the Economy

This report fulfills a statutory requirement for the Department to describe the efficiencies and significant accomplishments achieved during the past year to the State Legislature. Statements of time and cost savings are best estimates at the time of document preparation. This and past annual reports are available online at [www.udot.utah.gov/go/efficiencies](http://www.udot.utah.gov/go/efficiencies).
Table of Contents

Introduction ................................................................................................................................. 2
Bicycle Detection and Pavement Markings ................................................................................. 4
Flashing Yellow Arrow for Left Turns ....................................................................................... 5
Reflectorized Yellow Tape on Signal-Head Back Plates .......................................................... 6
Portable Weather Station for Advance Warning of Debris Flows ........................................... 7
Audio Over IP Highway Advisory Radio in Utah County ....................................................... 9
Commercial Vehicle Bypass (PrePass) .................................................................................... 11
Partnered Fiber-Optic Cable Installations ............................................................................... 13
Resolving Utility Conflicts through a Preserve and Protect Approach ............................... 16
Utah Prairie Dog Programmatic Agreement ........................................................................... 18
Performance-Driven Programming ......................................................................................... 19
Energy-Efficient LED Lighting Upgrades in Department Facilities ..................................... 21
iMAP GIS Tool ...................................................................................................................... 22
Improved Decision Making Using Mobile Data Collection ............................................... 24
MMQA Data Collection Teams ............................................................................................ 26
Bicycle Detection and Pavement Markings

**Savings:** Reduced bicycle-vehicle crashes and achieved qualitative savings from a single detection system for various transportation modes while collecting real-time performance measures.

**Efficiency:** Detection of vehicles and bicyclists at intersections improved safety by reducing potentially fatal bicycle-vehicle crashes; improved air quality by encouraging alternative transportation.

In fiscal year 2013, the Department’s Region Two and the Traffic Operations Center worked together to develop and deploy reliable bicycle detection for nine signalized intersections in Salt Lake City as part of the Department’s continued emphasis on facilitating alternative modes of transportation. The initiative encourages and accomplishes the following:

- Improves transportation options for all roadway users
- Reduces and prevents crashes
- Improves air quality
- Stimulates local economic development

The Department upgraded detection technology at these intersections by installing a Wavetronix radar matrix system to detect lighter-weight bicycles and new pavement markings to show bicyclists where to stop. Previously, cyclists would stop at red lights, determine whether they deemed it safe to cross, and then proceed through the intersection, often while the signal was still red. In addition to being illegal, this maneuver is unsafe and puts bicyclists and motor vehicles at greater risk for crashes. Installing this technology has promoted safety by encouraging all roadway users to observe the laws that keep them safe. It also works to position bicyclists as equals on the road and encourages cycling as a viable means of transportation. This is an asset for local economic development; companies that have recently relocated to Utah have reported that the region’s alternative transportation options (bicycling and mass transit) were a significant factor in their decision to come to the state.

The Department currently maintains 114.9 miles of bicycle lanes in Utah, including 80.9 miles in Region Two. Moving forward, the Department is working with the bicycling community to identify additional high-priority intersections where this detection technology can be installed.
Flashing Yellow Arrow for Left Turns

**Savings:** Potential annual public cost savings per installation ranging from $17,745 (property damage only) to $2,769,000 (fatality) from reduced crashes.

**Efficiency:** Improved safety at intersections that change from Protected/Permissive to Flashing Yellow Arrow left-turn phasing.

The Department and several jurisdictions throughout Utah are among the first in the United States to implement new flashing left-turn arrows. These new signals are being installed in place of the old, simple circular green signals in an effort to improve safety at intersections while realizing related cost savings.

A 2007 National Cooperative Highway Research Program (NCHRP) publication called the *NCHRP Web-Only Document 123: Evaluation of the Flashing Yellow Arrow Permissive-Only Left-Turn Indication Field Implementation* evaluates the safety effectiveness of the Flashing Yellow Arrow (FYA) permissive left-turn indication field installations. The study includes tables that summarize test results for the evaluation of left-turn crashes, indicating safety improvements with respect to crash experience. One table displays data for 13 intersections comparing the number of average annual left-turn crashes before FYA to the number of average annual left-turn crashes after FYA where the initial left-turn control was protected/permisive (P/P). All of the intersections showed a decrease in the number of left-turn crashes after the change to FYA except one, and that one had no change. The average annual reduction was 1.95 crashes per installation.

The National Safety Council recently published a document listing the estimated costs of unintentional injuries involving motor vehicles. It states the average economic cost of a fatality is $1,420,000, an incapacitating injury is $70,500, a non-incapacitating injury is $22,700, a possible injury is $12,800, and property damage only is $9,100.

Based on the above numbers, the annual cost savings per installation from reduced crashes after changing from P/P left-turn phasing to FYA permissive left-turn phasing would be $2,769,000 if the 1.95 reduction in the number of left-turn crashes were fatal crashes, all the way down to $17,745 if the 1.95 reduced crashes were property damage only crashes.

Another trusted source, *NCHRP Report 493*, recommended the use of an FYA indication as the desired permissive-only indication when using P/P left-turn signal phasing. The report stated the FYA had a high level of driver comprehension, overcame many of the human factor issues with permissive only left-turn, and was shown to have the most versatile characteristics of all the permissive-only displays studied. Furthermore, the FYA had an important safety characteristic: drivers who did not understand the meaning of FYA tended to yield. This was in contrast to drivers who did not understand the meaning of the circular green indication, in which case drivers tended to assume the right-of-way and proceed without regard to approaching opposing traffic.
A greater understanding of the safety (crash history) and driver behavior before and after the installation of the FYA will greatly assist traffic engineers as they consider further incorporating the FYA into the transportation system. The reduction in the number of crashes and accompanying cost savings has helped the Department be more efficient because there are fewer crash reports to review, thereby reducing subsequent deliberation to decide whether changing left-turn phasing is necessary. The Department is also more efficient by decreasing the amount of time spent addressing complaints about delays, operations, or crashes involving left-turn phasing. The Department is more effective in greatly reducing or eliminating driver confusion about when it is safe and when it is not safe to make a left turn with FYA.

**Reflectorized Yellow Tape on Signal-Head Back Plates**

**Savings:** Estimated savings of $125,000 due to reduction of collisions at intersections.

**Efficiency:** Improved safety with newly installed reflectorized yellow tape by reducing overall crashes by approximately 14.9 percent at 25 intersections.

Department officials learned of reflectorized yellow tape being used on traffic signals in British Columbia, Canada, and through a peer exchange visit to the Ohio Department of Transportation. According to these agencies, the installation of this innovation improves safety and reduces the number of crashes by increasing the visibility of the signals at critical times (such as at dusk or dawn, or when there are lights and other distractions). Previous research shows that this simple safety improvement results in a 14.9 percent reduction in overall crashes at signalized intersections.

In FY 2013, the Department installed reflectorized yellow tape on the signal-head back plates at 25 signalized intersections statewide. Applying the 14.9 percent crash reduction factor to crashes at these intersections yields an estimated user cost savings of $125,000. This reflectorized tape is now standard for all new Department traffic signals and is being applied to existing signal heads as an upgrade.

The pictures below demonstrate the effectiveness of this product. The reflectorized tape enhances the view of the signal head in both daylight and nighttime hours. Note the many other nighttime distractions, such as street lights, business signs, and head lights, that are competing for the driver’s attention.
Portable Weather Station for Advance Warning of Debris Flows

**Savings:** Estimated $50,000 from reduced risk to field crews, motorists and equipment.

**Efficiency:** Contribute to overall safety, minimize equipment losses, reduce response time and minimize impact to commerce.

In the summer of 2012, the Seeley Fire burned ten miles of steep mountainous terrain in Huntington Canyon along SR-31. Burn scars create ideal conditions for flash flooding and debris flows by removing vegetation from the hillside. According to Richard Giraud of the Utah Geological Survey, rainfall over a new burn scar can produce flooding of 10 to 20 times the 100-year flood event. The Department’s Traffic Management Division responded by deploying a portable Road Weather Information System Environmental Sensing Station (RWIS-ESS) trailer within the burn scar in spring of 2013.

Prior to placing the RWIS-ESS, the burn scar vicinity was void of weather data for a radius greater than 20 miles. Accurate forecasts and weather monitoring requires high-quality, current weather information. The portable RWIS-ESS solved this problem. The exact positioning of the RWIS-ESS was essential. The ideal location was near Monument Peak, on the ridgeline above the burn scar on National Forest Service land.
When reacting to flooding, timely information is crucial. The portable RWIS-ESS e-mailed, texted and tweeted within seconds of detecting rainfall that exceeded critical thresholds. The Department’s contracted weather forecasters (NorthWest Weathernet) were in regular communication with Department maintenance personnel in the canyon, both to forecast before the rainstorm and provide continual updates during rainstorms. The portable RWIS-ESS information improved forecasts and allowed timely warnings to be issued as rainfall gathered in the watershed to produce a debris flow.

In addition to the Department maintenance sheds, the Department’s Weather Group shared the rainfall alerts with:

- Various divisions within the Department
- National Weather Service
- Utah Highway Patrol
- Emery County Sheriff/Emergency Management
- National Forest Service
- Utah Geological Survey

NorthWest Weathernet communicated with Department maintenance personnel and managers prior to every debris flow across SR-31 from the Seeley Burn Scar in 2013. As a result, no injuries, fatalities or equipment losses were incurred. Because of the portable RWIS-ESS, meteorologists were able to start with a forecast 24 to 48 hours in advance and communicate current information throughout the weather event. Working relationships are now stronger because the Weather Group and Department field personnel talk regularly.

In addition, the National Weather Service relied on RWIS-ESS rainfall alerts to issue Flash Flood Warnings. In addition, a larger community of agencies benefited from the alerts, leading to increased coordination in response to future debris flow events.

During the summer of 2013, SR-31 was closed six times due to debris flows. The portable RWIS-ESS trailer transmitted 18 rainfall alerts, and Department forecasters communicated with interested parties prior to each event. While the alerts and forecasts do not prevent debris flows, they reduce the chance that Department personnel, the Department’s contractors or the traveling public will be caught in the debris flows and allow for quicker, safer and more efficient clean-up.

RWIS-ESS was originally designed for road weather mitigation in the winter. Portable RWIS-ESS trailers have proven to be a valuable summer resource when responding to wildfires and resulting burn scar
hazards. Increased safety is the primary goal. Instant RWIS-ESS rainfall notifications allow field crews to respond more quickly to weather. Weather forecasts provide managers with information to keep field crews and equipment clear of new and ongoing debris flow hazards. Efficient operations lead to reduced road-closure time, limiting potential negative impacts to commerce. Debris flow-related repair costs on SR-31 reduced from $600,000 in 2012 to $80,000 in 2013. Some of the reduction can be attributed to reduced magnitude of debris flows; however, some of that reduction is due to improved information regarding when and where debris flows will occur.

After demonstrating the success of this idea at the Seeley Burn Scar, the Department’s Weather Group deployed a portable RWIS-ESS to the Rockport Burn Scar in the summer of 2013 to monitor potential flooding on SR-32. The Traffic Management Division will continue to use this strategy whenever a fire creates a burn scar that threatens flooding on state roads.

Audio Over IP Highway Advisory Radio in Utah County

**Savings:** Equipment and construction cost savings of $500,000 in FY 2013.

**Efficiency:** Reduced cost of field equipment for Highway Advisory Radio by approximately 90 percent, and established a more reliable and easier-to-use system.

Audio Over IP (AOIP) Highway Advisory Radio (HAR) reduces equipment needs and simplifies the software necessary to run HAR. Low-powered AM radio stations have been used for this purpose for years in traffic management, but they were moderately costly and awkward to use. The AOIP HAR is far easier to use and much less expensive to install than previous options.

The AOIP HAR system leverages the Department’s fiber-optic network to make HAR simple and flexible. The old equipment included a recording device, a global positioning system (GPS) unit for synchronization and a controller to manage everything. With AOIP HAR, playback is handled by multicasting audio from the Department’s Traffic Operations Center (TOC). A simple decoder at the HAR site is directed to an audio stream that is broadcast on the Department’s fiber network. Synchronization between the new transmitter sites doesn’t require sophisticated controllers because sites are reading the same audio stream. Because the audio is streamed from the TOC directly to the site, the HAR messages are much more responsive. Under the old system, the message had to be downloaded to the site before it could start playing.

The software is simpler than the previous system, which had a separate proprietary server that interfaced with the TOC’s main software. In the new system, the main software generates the audio stream to HAR sites directly. The separate server in the old system was a too-frequent point of failure, and eliminating the server increases the reliability of the HAR system.
The new software also improves management of the HAR sites. It is now possible to group multiple HAR sites together to run the same message, or synchronized messaging, rather than posting the same message individually on each HAR. The new software also takes advantage of the existing text-to-speech engine software system at the Department TOC, which was already in place for the Department’s 511 Traveler Information.

Another significant part of the AOIP HAR method is use of audio verification stations (AVS) located in the field that allow end users to listen remotely to the transmitted output of the HAR sites. The AVS consists of a radio receiver near a HAR station tuned to the HAR station. The AVS audio output is encoded and sent back to the TOC using the fiber optic infrastructure. In the past, verification that the HAR was functioning required someone to drive to the HAR location and check their car radio. Verifying the new HARs can now be done in minutes without leaving the office.

The AOIP HAR technology was deployed at 11 sites in Utah County in FY 2013, resulting in reduced equipment cost of $45,000 per HAR site, or total construction cost savings of $500,000. All new HAR sites on the Department’s Fiber network will use the new AOIP technology. Existing HAR sites on the Department’s fiber network are being converted to the AOIP technology. This conversion uses the existing HAR transmitter, adding an audio encoder and an AM receiver and removing the recording technology from the site. Converting these HARs to AOIP improves their reliability, message synchronization and ability to logically group the HARs for message broadcasts.

In summary the AOIP HAR method has shown the following benefits to the Department:

- Improved reliability of the HARs
- Increased Department TOC operator efficiency when creating and sending voice messages to the HARs
- Allowed operators to verify that the HAR message is being broadcast correctly
- Allowed HARs to be logically grouped to simplify messaging
- Increased reliability of HAR devices in the field
- Increased reliability of the central HAR servers
- Decreased hardware costs for HAR sites by up to 90 percent, depending on the site

This new HAR technology has saved the Department more than $500,000 in construction and deployment expenses, increased the Department TOC operator productivity and improved traffic safety by getting traffic information quickly to Utah’s driving public.
Commercial Vehicle Bypass (PrePass)

**Savings:** More than $10 million in operational cost savings to the State and to commercial motor carriers in FY 2013.

**Efficiency:** Established a partnership with PrePass to provide electronic bypass for commercial vehicles at Port of Entry facilities if credentials, safety score and weights are in compliance.

The Department’s Motor Carrier Division has established a public-private partnership with PrePass. PrePass is an automatic vehicle identification system that enables participating transponder-equipped commercial vehicles to be pre-screened at designated Port of Entry facilities. Cleared vehicles are then able to “bypass” the facility while traveling at highway speed, eliminating the need to stop.

The benefits to the State and to commercial carriers from using PrePass in Utah over the last year were:

- Number of bypasses – 1,255,933
- Time savings – 104,661 hours (5 minutes saved per screening)
- Fuel savings – 502,373 gallons (0.4 gallons per pull-in)
- Emission reductions – 1,109 metric tons
- Operational cost savings – Over $10 million

Carriers contract with PrePass, and vehicles participating in the PrePass program are pre-certified. Carrier safety records and credentials are routinely verified with state and federal agencies to ensure adherence to the safety and bypass criteria established by PrePass and member states. If an approaching PrePass-equipped vehicle’s weight and credentials are found to be satisfactory, a green light and audible signal from the windshield mounted PrePass transponder advise the driver to bypass the weigh station. Otherwise, a red light and audible signal advise the driver to pull into the weigh station for regular processing.

Vehicles bypassing inspection facilities save drivers and their companies valuable time on the road, thereby reducing fuel and operating costs while increasing productivity. PrePass also benefits the State and everyone who uses our highways by reducing congestion around inspection facilities and enabling state inspection staff to focus their efforts on carriers that demand the most attention.

The PrePass system enables enforcement officials to electronically ensure motor carrier compliance with state weight, safety and credential requirements before vehicles reach state inspection facilities. Trucks enrolled in PrePass are assigned wireless transponders that are mounted onto the vehicles’ windshields. As one of these trucks approaches a PrePass-equipped weigh station, an electronic reader on a boom over the road automatically scans the transponder and identifies the vehicle. A secure PrePass computer located inside the Port of Entry accesses the vehicle information associated with the transponder and validates it to ensure compliance with state requirements. At the same time, technologies such as weigh-in-motion scales are utilized to verify the truck’s configuration and ensure axle and gross vehicle weights are within acceptable limits.
Finally, as the truck passes beneath a second boom, a signal indicating whether the vehicle may bypass is transmitted back to the transponder. If the vehicle’s information cannot be validated, or if it is selected for a random manual inspection, a red light on the transponder alerts the driver to stop. If the vehicle’s credentials, safety and weight are all in order, a green light indicates permission to bypass the facility.

This technology provides several important benefits:

- Enables Port of Entry staff to focus on carriers that are most likely to be noncompliant
- Rewards carriers with good safety records
- Prevents trucks from queuing on roadways and shoulders
- Reduces lane changing and merging around weigh stations
- Gives carriers a major incentive to conform to safety regulations and credential requirements
- Increases facility efficiency by allowing carriers to be electronically screened and to bypass Ports of Entry based on state criteria
- Increased motor carrier productivity and shipper efficiency
Partnered Fiber-Optic Cable Installations

**Savings:** More than $5.6 million in reduced construction costs.

**Efficiency:** Minimized construction traffic impacts and installation of additional traffic management fiber-optics through consolidated construction operations.

I-15 is a natural transportation corridor in Utah, not only for trucks and cars, but also for high-speed, fiber-optic communications. Rural areas of I-15 lack communication coverage, including fiber and conduit. Periodic I-15 construction projects help fill in the communication gaps and make it possible for telecommunication companies to reach underserved areas with broadband services and facilitate traffic management devices for the Interstate. Working with a telecommunications company can leverage public funds and more than double the number of miles that can be covered for the investment.

The Department’s Traffic Management Division and all Regions partnered with three private telecommunications companies and Ogden City to consolidate construction operations while improving the traffic management fiber-optics and communications network in canyons and rural areas. These efforts saved the taxpayers more than $5.6 million in reduced construction costs. Consolidated construction operations minimized construction traffic impacts. After construction, the new fiber-optics added broadband capability to critical areas of the network, supporting enhanced cell service, 911 access and the capability for traffic management of cameras, signs and weather monitoring equipment. Partnering with private telecommunications companies and municipalities has yielded benefits to all parties. The projects described below exemplify benefits for the public, private business, and the Department.

**Big Cottonwood Canyon (SR-190)**

During the summer of 2013 in Big Cottonwood Canyon, the Department partnered with the international wireless infrastructure provider, Crown Castle, to install 15 miles of fiber-optic cable, poles and other facilities in the canyon. Crown Castle paid to install the power, conduit and fiber facilities, a value of nearly $4 million to taxpayers, in order to provide wireless service throughout the canyon. The Department provided right-of-way and assisted with permitting. In exchange, the Department is able to access the fiber to expand its Intelligent Transportation System network by adding roadway cameras, traffic sensors and Roadway Weather Information Systems (RWIS) to the canyon, all of which will be connected to the fiber-optic cable, and tied into the Department’s fiber network. In exchange, Crown Castle will be able to access excess conduit capacity of like value on the Department’s statewide system for their future expansions.
This infrastructure will provide residents, businesses and visitors a full-range of wired and wireless services, including:

- Continuous voice service, including 911 emergency services
- High speed 4G data transmission to support smartphones, tablets, and other devices
- Services provided by major wireless carriers

The Department will be able to use this new network to monitor traffic and weather, provide more current data to maintenance and snow plow crews, and warn drivers of hazardous conditions and closures, improving safety and mobility. Initially, the Department will install six cameras on Crown Castle’s antenna poles and three RWIS sites. In the future, additional cameras, sensors and variable message signs could be added. A similar partnership is underway for Little Cottonwood Canyon, which will be completed in 2014.

**Ogden Canyon (SR-39)**

In Ogden Canyon, the Department took advantage of a major waterline construction project being undertaken by Ogden City to install fiber-optic conduit along the waterline. The shared construction process in this 5-mile canyon saved the Department about $550,000. In a partnering arrangement, Syringa installed fiber-optic cable in the Department conduit, providing additional savings of $100,000. Both the Department and Ogden City will have access to the fiber, allowing for traffic monitoring and management and remote monitoring of water treatment and conveyance activities. Project construction took place between January and September of 2013.

As a result of this unique partnership between the Department, Ogden City and Syringa, the following benefits have been realized:

- Vital communications link for an investment of about a quarter of the normal cost of such an installation, a link we thought we might never have because of the sensitivity of the canyon
- Capability to manage traffic more effectively and safely in and around the canyon.
• Residents of the canyon and Ogden Valley have improved cell and broadband service through Syringa’s network
• Ogden City has fiber-optic service to their water treatment plant at the top of the canyon and to key pipeline control facilities along the canyon corridor

I-15 from Scipio to Fillmore

Scipio is an area of the state that had limited access to high-speed communication systems. The Department included fiber and conduit in the I-15 Scipio to Holden project. In this rural area there was no place to connect to a communications line that could provide enough bandwidth to handle the needed traffic management devices. The Department reached out to several telecommunication companies that had expressed interest in this area. CentraCom partnered with the Department to extend the Scipio to Holden conduit system all the way to the Fillmore variable message sign. This more than doubled the length of the conduit for each party.

This project has yielded benefits to both the Department and CentraCom:

• Costs of deployment of 26 miles of conduit and fiber were greatly reduced for the Department and CentraCom. The Department costs for this distance would have been $2.2 million. The Department costs were reduced to $950,000 through partnering.
• High-speed fiber-optics is now available in an area that only had copper service. This will help promote economic development for this rural area.
• The Department can manage traffic along the highway corridor with real-time data that will give travelers faster and more accurate information on road conditions.
• The Department can now connect directly to a high-speed circuit provided by CentraCom to transport the traffic data back to the Traffic Operations Center.

Summary

Agreements with private telecommunications companies have greatly facilitated the expansion of the Department fiber network and have yielded broad, public-private benefits to all parties. These three projects have been particularly beneficial due to the sensitivity of the environment, the rural character of the corridors, and the need for enhanced traffic management and safety.
These projects support the Department’s Final Four Strategic Goals to Optimize Mobility and reach Zero Fatalities through an enhanced ability to manage traffic in rural areas of the state, and to Strengthen the Economy by improving cell and broadband service to residents, businesses, and tourists. The projects also demonstrate the Department’s commitment to Local Collaboration and Operational Excellence, two Emphasis Areas in the Department’s Vision Statement.

**Resolving Utility Conflicts through a Preserve and Protect Approach**

**Savings:** $754,000 total ($377,000 for the Department) and 121 days saved on the US-89 State Street Project in Orem.

**Efficiency:** Significantly reduced engineering, materials, splicing and construction costs and time while reducing traffic impacts, improving construction safety and maintaining uninterrupted service to telecommunication customers.

In 2013, the Department completed the US-89, State Street road widening project, 2000 North Orem to 100 East in Pleasant Grove. The roadway improvements placed in conflict 3 miles of CenturyLink telecommunication infrastructure. The conventional approach to resolving conflicts of this type is the costly relocation of infrastructure to move it outside the roadway pavement. In order to keep the project on schedule and budget and maintain uninterrupted service to customers of the telecommunications lines, CenturyLink and the Department partnered together during the design phase to come up with a better approach. To meet these objectives, CenturyLink engaged Terra Technologies, LLC and, together with the Department, developed plans and alternative construction methods that would allow for the preservation and protection of the telecommunication facilities. The solution was the use of two Terra Technology products and processes called Terra Cap and Terra Move.
Terra Cap is a proprietary product designed to be an alternative solution to utility relocation/replacement. Terra Cap creates a nearly impenetrable barrier to protect the utility and can be installed within the pavement structure. Terra Cap can be installed with conventional construction equipment and in conjunction with other roadway work. Terra Cap can be installed at a lower cost than relocating the utility.

Terra Move is a proprietary process by which underground utilities can be moved up to 20 feet horizontally, 16 feet vertically or any combination of the two with no splicing and no interruption to service. This process is used when conflicts are unavoidable and relocation is the only solution. Terra Move can be used in varying soil conditions and terrain. The benefits are reduced costs, shorter project schedules and the elimination of downtime to customers.

During construction of the US-89 project, 2,000 feet of existing telecommunication ducts and cable lines were lowered out of the way of roadway excavation through the use of the Terra Move process. Additionally, nearly 2,000 feet of telecommunication infrastructure was protected in-place with Terra Cap. These combined efforts not only saved CenturyLink and the Department both time and resources, but the impacts to the travelling public were minimized through shorter lane closure durations and the avoidance of duplicative work such as hardscape removal and restoration.

The cost for the conventional removal and replace approach was estimated at $1,600,000. The costs using the preserve and protect were $846,000, resulting in a total of $754,000 and 121 days saved on the project. Since the Department pays 50 percent on utility relocation, the savings to the Department on this project were $377,000. As a result of the preserve and protect approach, costs were reduced nearly by half over the conventional remove and replacement approach. These cost savings were achieved by reducing costs in engineering by 57 percent, materials by 84 percent and eliminating all splicing. Additionally, the preserve and protect approach reduced the number of days of construction and installation by 55 percent. Because this process eliminates the need for splicing, the project saved an additional 10 percent on costs and 62 percent in the number of resource days. Overall, the Department was able to keep the project on schedule and budget, and CenturyLink was able to maintain uninterrupted service to their customers.
Utah Prairie Dog Programmatic Agreement

**Savings:** Eliminates up to 135 days per project of review by the U.S. Fish and Wildlife Service.

**Efficiency:** Agreement streamlines the environmental review process, requires less staff time, clears projects in advance of when needed, and yields a predictable response from federal agency consultation.

Utah prairie dogs are a federally threatened species offered protection by the Endangered Species Act of 1973. Utah prairie dog habitat exists throughout the southern portion of the state and often overlaps with the Department’s highways. Every Department project within prairie dog habitat requires consultation with the U.S. Fish and Wildlife Service (USFWS) to determine the effects of the project on the individuals and habitat. This consultation costs the Department time and money.

As such, the Department, in cooperation with the Federal Highway Administration, conducted formal consultation with the USFWS to determine the temporary and permanent impacts to the Utah prairie dog and its habitat from implementing our Pavement Preservation Program over the next 20 years. Department Environmental Services staff utilized the UPPlan geospatial system to estimate the total acres of impact to the species over the life of the Agreement. Performing this formal programmatic consultation as a one-time event in advance of the environmental analysis rather than for each individual project saves between 30 and 135 days to the environmental schedule per project.

This Programmatic Agreement covers all projects in the Department’s Pavement Preservation Program which occur within Utah prairie dog habitat (Beaver, Garfield, Iron, Kane, Piute, Sevier, and Wayne counties). Prior to having the agreement, each project in these counties which had the potential for having Utah prairie dogs required the preparation of an individual biological assessment by the Department staff biologist. This programmatic agreement eliminates the need for preparing an assessment for each project and, as such, results in time savings of staff.

Additional schedule savings can be realized in the construction phase of a project. Because there are limits to when species surveys can be performed and construction can occur within occupied Utah prairie dog habitat, having an agreement in place means that the Department can provide biological
clearance in advance of when it is needed, thus allowing for better coordination of construction timing and avoiding delays.

Performance-Driven Programming

**Savings:** $2.25 million in opportunity costs gained in FY 2013.

**Efficiency:** Developed and improved processes to strengthen Utah’s economy by reprogramming our limited transportation funds on the next highest-priority projects.

The Department has made significant progress in Performance-Driven Programming. By adjusting project cost estimates at key milestones, the Department’s Programming Group was able to reprogram unspent funds to other projects, which allowed us to execute more projects in 2013. By executing these projects in the current year we saved on future inflationary costs. Also, by implementing a projected program delivery schedule we are now able to advertise our projects at the most attractive time which has resulted in improved bids.

Aggressively evaluating and tracking program and project funding, including current costs and anticipated expenses, made expedited reprogramming of available project dollars possible. These dollars were then put back quickly into the economy on the next highest-prioritized projects. This not only put the funding back to work immediately for consultants, contractors and the Department, but also reduced inflationary costs that would have occurred. From 2010 to 2013, based on the Department’s Average Unit Bid Prices, the average construction cost index increased by 9 percent. These inflationary costs are eliminated when the funding balances are put right back to work.

An integral part of this improvement involved creating the Active Project Summary report. This automated report compares a project’s construction budget to the actual expenditures to-date, as well as the anticipated or projected expenditures. This allows for a quick view and instant determination of a project’s status, both by budget and schedule. By using this report at key milestone points along a project’s life (“Award”, “Construction Complete” and “Final Voucher”), the Department was able to free up additional dollars and allowed for more efficient use of that funding. During the 2013 Federal Fiscal year, approximately $50 million dollars were removed at “Award” and reprogrammed onto the next highest-priority projects. Additional funding was also removed and reprogrammed at “Construction Complete” and at “Final Voucher.”
Previous to these new procedures, the funding typically would have remained on the projects until close out. In the 2013 Federal Fiscal Year, if reprogramming took place even one year later, based on a very conservative average construction cost index of 4.5 percent, it would have resulted in opportunity losses of $2.25 million due to inflationary costs.

The new automated report also includes performance measures for each project to allow for better project management: Payments vs. Original Contract Amount, Time Elapsed vs. Percent Complete, Percent Construction Engineering Used vs. Percent Project Complete, and Percent Construction Engineering Budget Used vs. Estimated Construction Engineering Budget.

This report was completed by using existing database systems, but what is new is that it brought together data from multiple systems into one easy-to-use report. This type of view was previously unavailable. The old process was inefficient, requiring access to and knowledge of the various systems and use of manual calculations. The project budget recovery was typically completed only at the end of the project rather than at the key milestones, as is now the case.

Because of these efforts and pursuing programming efficiencies, the Federal Highway Administration has indicated that the Department leads the nation in having the fewest inactive funding obligations. Inactive funds are obligated Federal funds for an eligible transportation project or activity, against which no expenditures have been charged for a one-year period. This means that in Utah, projects that have funding obligated on them are being put to work and are progressing.

Another part of the Performance-Driven Programming initiative was the need to track and predict our obligation rate throughout the year. This is now possible because of the development of a report that displays our federal obligation limit and current obligations by month, and projects future obligations.
based on a project’s advertising date. This tracking and projection enables the Department to meet its federal obligation limit and qualify for redistributed funding. This provides additional dollars into our program. By tracking and projecting our obligation performance, we are promoting and encouraging optimal advertising times for projects. This enables the Department to advertise projects at the best time to receive the most competitive bids possible.

**Energy-Efficient LED Lighting Upgrades in Department Facilities**

**Savings:** Total electricity cost savings of approximately $15,000 from lighting upgrades and Department LED initiatives.

**Efficiency:** Replacement of existing T12 lamps with new energy-efficient lamps; implementation of reductions in electrical needs and associated pollution.

Recent lighting upgrades in the Department’s maintenance stations, rest areas and overhead lighting showed savings from 40 to 50 percent in energy consumption. The total bill was reduced from $36,000 to $31,000, a savings of $5,000 with the initial implementation in only three areas. Together with the rest of the Department Light Emitting Diode (LED) initiatives, the total savings is estimated to be about $15,000. Additional information on these initiatives is given in the following paragraphs.

Department maintenance station lighting upgrades have continued during the past year by replacing existing T12 lamps with new, more efficient T8 lamps for area lighting and general building lighting. We expect to continue these updates for two to three stations per year, contingent upon rebates and grants. This initiative complements the renewable energy implementations completed in several Department facilities. LED lighting delivers efficient illumination while creating savings and reducing maintenance costs. Energy-efficient lighting reduces the amount of conventional electricity required to operate a maintenance facility by as much as 40 percent.

LED lighting upgrades are also being performed in rest areas, ports of entry and some overhead lighting in intersections. LED lighting offers multiple advantages, including superior life, lasting many times longer than traditional lamps. Maintenance personnel are replacing exterior parking, ramp, and roadway intersection lighting with new LED lamps that use approximately 30 to 40 percent of the energy but also reduce the maintenance trips to replace burned-out bulbs. There is a significant reduction in both electrical needs and associated pollution.
Some of the Department facilities that have been upgraded to LED lighting are the South Valley maintenance station in Salt Lake City, the Grassy Mountain and Summit rest areas, and several locations in the Department’s Region Two. For instance, the Wells rural intersection area near Wendover has experienced a reduction in its monthly consumption of energy by as much as 54 percent compared to monthly consumption from last year. In another example, Region Two has been transitioning several of its overhead lighting fixtures to LED during the past year. The power consumption has decreased, and another benefit is that the total count of lights effectively operating is substantially increased. In a typical interchange with conventional fixtures, the average percentage of lights operating properly is about 75 percent. With LED, it is 100 percent and will remain that way for 20 years or more.

Energy-efficient lighting upgrades will continue in the future and more savings are expected. This initiative is letting the Department cut operational costs while improving lighting quality. These upgrades will expand to other areas and Regions as more opportunities become available, saving the Department thousands of dollars in the future.

iMAP GIS Tool

**Savings:** Estimated $200,000 in software development and upgrade costs saved.

**Efficiency:** Reduced application development costs and improved data capture on projects and mapping of crashes, resulting in better data analysis.

iMAP is a common map code base that the Department has reused in many geographic information system (GIS) applications, like UDOT Projects and Linear Bench. This code base has provides opportunistic reuse capabilities where we can integrate a custom mapping tool into an application with limited costs. This mapping tool provides an easy to-use way to generate comprehensive, accurate geospatial data.

iMAP has driven efficiencies on a few different levels, one of which is data quality. Good data is important to the Department for adequate analysis and project planning. Implementation of iMAP into the Electronic Program Management (ePM) system has provided the Department with a mechanism to collect accurate data on project locations, which is then used throughout the Department. This tool is effective and easy to use. A user simply clicks the project location on a map and the relevant location information about that project is automatically stored. iMAP has also been implemented into the Safety Crash Management System to enable users to easily map crash data, which we can leverage for analysis downstream in program development.
The most visible utilization of this data is on the UDOT Projects website. This website also uses the same iMAP tool, in its own implementation, to display the ePM data. This is important efficiency. iMAP has improved our geospatial application development process. UDOT Projects’ map element is the same iMAP tool that is used in ePM but in its view-only functionality. In this form, iMAP provided developers with a “ready-to-use” map tool, which was easily incorporated into the UDOT Projects website. Because the development team did not have to start from scratch, they saved hundreds of hours of development time.

The iMAP GIS tool is helping the Department become more transparent with its data and the ability for on-demand analysis. If the Department were tasked with a question about American Recovery and Reinvestment Act of 2009 (ARRA) projects, we would be able to use this tool to produce answers very quickly.

iMAP has been used in three other Department applications: Linear Bench, Highway Reference Online and the Safety Management System Crash Database. These applications were able to leverage the code base already built, and complete geospatial integration without expensive development efforts. This tool does not require large database upgrades like some other software tools, in turn saving the Department tens of thousands of dollars of development monies and even more in sunk costs on legacy systems.
Improved Decision Making Using Mobile Data Collection

**Savings:** Estimated annual cost savings of $3.4 million in better pavement management and $400,000 in reduced design survey.

**Efficiency:** Reduced pavement maintenance and surveying cost as a result of improved access to asset data.

The Department has approximately $30 billion in its inventory of assets such as pavements, bridges, signs and culverts. Recently, the Department partnered with private industry to complete the geospatial inventory of nearly all above-ground highway assets. The inventory relied on the latest technologies, including mobile LiDAR (Light Detection and Range), high definition cameras, and global positioning systems (GPS). Assets inventoried included pavement distress, roadway geometry, pavement surfaces, pavement markings, signs, traffic signals, intersections, walls, barriers, structure clearance and billboards. All of these assets have been entered into the Department’s geospatial databases (UGate and UPlan).

During the last year the Department began using the output from this collection effort to reduce costs and improve efficiencies. Examples of two such efforts were improvements to the pavement management program and cost reduction for field surveys.

**Pavement Distress Surveys, Pavement Condition Forecasting and Pavement Management Improvements**

A proactive schedule of preservation treatments is the most effective way to preserve the state’s investment in pavements. Before any construction begins, the overall condition of the pavement needs to be determined. Biannually the Department’s contractors measure the pavement health of each mile of the entire state highway system. Last year the Department used state of the art 3D crack detection technology. Cracks, ruts, and concrete faulting distresses were calculated and quantified by the exact length, width and depth by using advanced computer algorithms, line lasers, and high speed cameras.

The Department is now able to recommend specific projects, allocate budgets and predict future pavement conditions more accurately than ever before. Forecasting is reported by type of facility (Interstate, National Highway

![](image1.png)

Pavement/asset inventory vehicle

![](image2.png)

Statewide pavement forecast
System, urban, rural), material (concrete, asphalt) and region.

An annual expenditure of about $220 million a year is required to maintain the condition of the entire state pavement system. This funding level provides the greatest benefit at the lowest long-term cost. During the past six to eight years, available funding has been approximately $180 million per year. The Department, in recognition that funding levels were inadequate to preserve the entire statewide road network, created a tier system of highways: Interstates, Level 1 (Average Annual Daily Traffic, AADT > 2,000) and Level 2 (AADT < 2,000). The Department recognized that funding was sufficient to maintain Interstate and Level 1 Roads but not low traffic volume roads (Level 2 Roads).

The active administration of a robust pavement management program and the incorporation of the latest pavement distress technologies have allowed the Department to lower the thresholds of what roads are now actively managed. Now the Department actively maintains roads that have more than 1,000 vehicles a day. Approximately 775 additional miles have changed from Level 2 to Level 1 Roads. The continual execution of a dynamic pavement management program and the use of the latest pavement distress technologies have produced approximately $3.4 million in annual savings.

Reduced Survey Design Cost

LiDAR was the technology used with high-definition (HD) cameras to inventory all of the assets mentioned above. The LiDAR sensors emit and receive up to 1.6 million points of data per second. The points are then used to create a three-dimensional, high-definition model, referred to as a “point cloud,” of the surrounding environment. The points within the cloud are accurate to one another to within one inch. But the absolute accuracy, or how each point ties to the physical earth, can have a 3-foot error. While the relative accuracy is more than adequate to provide an asset inventory, it was not accurate enough for design. The Department, working with industry, was able to calibrate each of the 1.6 million points to each other and to how each was “tied” to the exact earth location. The added engineering accuracy added value to the original point cloud and improved the absolute accuracy from plus or minus three feet to plus or minus one inch, delivering accuracy well within the tolerance required for design.

The Department has used the “calibrated point cloud” on several projects. The Department contracted with local survey and engineering companies on one such project, Interstate 80 in Silver Creek Canyon near Park City, to validate the accuracy of the “calibrated cloud”. The companies estimate a cost savings
of 25 percent over traditional survey. They also report a reduction in the time required to produce the survey and an invaluable benefit of safety for survey personnel who spend far less time in the vicinity of traffic. The cost of design survey varies from project to project. Generally preservation projects require little to no survey, while reconstruction projects require a complete fencepost to fencepost survey. The Department projects an annual dollar savings of approximately $400,000 when this process and technique is perfected and adopted across all projects.

MMQA Data Collection Teams

**Savings:** Estimated operational savings of $50,000 during FY 2014 (over FY 2013) with designated data collection teams.

**Efficiency:** Reduced human error and increased data consistency while reducing the number of assets measured, the frequency of data collection and the number of people collecting data.

The Department’s Maintenance Management Quality Assurance (MMQA) program has been taken to a new level to improve its efficiency and accuracy. Each measure was revised to make the data collection effort more efficient by reducing both the number of assets measured and the frequency of data collection. In addition, beginning with the Spring 2013 data collection cycle, the Department began using designated data collection teams within each of its four Regions to collect the MMQA data.

The Region teams consisted of a total of 30 people statewide, providing more consistent data than 160 people in the past. This freed up more maintenance staff to focus on maintenance needs on the road. The MMQA teams were selected from our current maintenance workforce and assigned to perform only MMQA tasks during the counting seasons in areas throughout their respective Regions. It is important to note that not all maintenance crews were impacted with
the MMQA designation process. Therefore, while most of the maintenance stations in the state are able to keep all their resources even during MMQA counting season, the designated teams are gathering consistent and effective data, thus making the process more efficient. For example, Maintenance Station 2427 previously used their entire staff of 12 people, to collect MMQA data for several days during MMQA counting seasons. In contrast, by using consolidated designated teams, this station’s personnel have been able to spend more time on the road maintaining our highway system. In fact, making this change allowed the statewide maintenance budget for MMQA data collection to be reduced from $735,000 in FY 2013 to $685,000 in FY 2014, an operational savings of 7 percent or $50,000.

Using data collection teams has proven to be not only more cost efficient but also more accurate than having each station collect their own data. After collecting data in one or two stations’ areas, the teams develop an understanding of what to look for and how to look for it, and, consequently develop a routine that allows them to perform the counts quickly and accurately while saving money for the Department.

It is anticipated that this new MMQA initiative will create more savings once the program is fully implemented by our maintenance forces. This has reduced total effort in data collection, and has enabled the Regions to better use the data to justify needs for future resources. Having accurate and consistent data is critical to making important budgeting decisions. The improved process gives confidence to decision makers to compare MMQA targets to Region performance-measured data. Accurate information from MMQA is used at the statewide, Region, area, and maintenance station levels to report level of maintenance achieved and to help establish targets for future level of maintenance in consideration of available budget and resources.