Efficiencies in the Utah Department of Transportation (Department) often generate cost savings for the public and the Department through better utilization of resources and innovative technologies. Two key areas in 2011 where the Department saved costs include the increased use of Cold In-place Recycling for asphalt pavement rehabilitation and a reduction in Full Time Employees as a result of better warehouse management and pavement data collection. The savings from these initiatives were redistributed within the Department to fund additional road and bridge preservation projects. This has enabled the Department to proactively maintain more of the highway system during the year and provide safer transportation infrastructure for the public.

This report contains summaries of key efficiency initiatives, selected by Department Executive Management, from State Fiscal Year 2011. These efficiencies highlight the significant progress made in accomplishing the Strategic Goals of the Department during 2011. Meeting these goals is a very demanding task in a state that is growing dramatically and with a limited tax base.

The Strategic Goals of the Department were recently updated and are shown below for both 2011 and 2012:

**Fiscal Year 2011**
- Take Care of What We Have
- Make the System Work Better
- Improve Safety
- Increase Capacity

**Fiscal Year 2012**
- Preserve Infrastructure
- Optimize Mobility
- Improve Safety
- Strengthen the Economy

This report fulfills a requirement for the Department to describe the efficiencies and significant accomplishments achieved during the last 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).
Rapid Concrete Pavement Rehabilitation

Savings: $2 million in costs for one project using a generic precast panel design

Efficiency: Reduced impact on traffic during panel replacement due to low or no on-site cure time, and use of generic precast design to reduce project cost

When aging concrete pavements experience significant cracking or other distress, one common method of rehabilitation is to replace the deteriorated panels with new panels. This prolongs the service life of the pavement and provides a smoother, safer ride for drivers. This past year the Department used both precast and cast-in-place panel replacements, saving significant project costs and preventing work zone traffic delay in the process.

Having used proven proprietary systems for precast pavement panels on past projects, the Department developed a generic design and bid this head-to-head with the other systems on the I-15 pavement rehabilitation project near Willard and Perry. The generic design reduced the unit price for intermittent slab replacement by over 50% compared to two previous projects that used a proprietary design. This resulted in project cost savings, over the previous project, of approximately $2 million. The generic precast panel design appears to be viable and is working well in-place on this project.

Traffic delays were minimal with the precast panel process since deteriorated panels were removed and replaced in a time window as small as five hours (at night) without any on-site cure time, the areas were opened to traffic during the next day, and hardware and installation were finished in the next five-hour nightshift. In contrast, conventional repairs with cast-in-place panels and typical concrete mixes require a week of cure time, high-early strength mixes require a few days of cure time, and both can cause significant traffic delay. The average life of a high-early concrete full-depth repair is about five years, whereas the precast panels installed on the I-15 project will last longer – potentially outlasting the pavement in which they were installed.

On two pavement rehabilitation projects, on I-80 and I-215 in the Salt Lake City area, the Department used a fast-setting concrete mix for full-depth panel replacements (cast-in-place). The unique cement used in the mix allowed the panels to gain sufficient strength in three hours to return traffic to the roadway. On these two projects, also done at night, using the special fast-setting concrete made a substantial reduction in traffic delay over other methods due to a higher production rate than precast panels and a lower return-to-traffic time than conventional concrete.
INNOVATIVE INTERSECTIONS

The Department implemented innovations at several busy urban intersections to improve travel time, capacity, and safety. These intersection types, achievements over the past year in using them, and their benefits to the public are described below.

Continuous Flow Intersection
Savings: $140,000 per day in user costs due to improved travel times on Bangerter Highway
Efficiency: Improved intersection capacity by 10 to 20%, reduced traffic delay, and improved safety

The Department’s first Continuous Flow Intersection (CFI) was built on Bangerter Highway at 3500 South and opened in 2007, followed by more CFIs in other locations in subsequent years. The CFI is an at-grade intersection that moves left turning vehicles out of the main intersection, thereby eliminating a signal phase and increasing the green time for all other movements.

To build a CFI typically costs less than a grade separated option, and CFIs can handle 10 to 20% more traffic than a typical busy intersection. Safety is improved mainly by reducing traffic conflict points.

Five additional CFIs were added to the system in 2011, bringing the total number of CFIs for the Department in operation or under construction to nine. The five new locations include Redwood Road at 5400 South, and Bangerter Highway at 3100 South, 4100 South, 6200 South, and 7000 South. As a result, travel time savings over past configurations on Bangerter Highway between SR-201 and 7800 South are between two and four minutes per vehicle during morning and afternoon peak hours. These CFI improvements have resulted in estimated user cost savings of $140,000 per day.
Diverging Diamond Interchange
Savings: $11,000 per day in user costs in 2020 due to less delay from northbound Bangerter Highway to eastbound SR-201
Efficiency: Reduced cost of adding capacity to existing interchanges, reduced traffic delay and improved safety

The Department’s first Diverging Diamond Interchange (DDI) opened in 2010 at the I-15 American Fork Main Street interchange. The DDI channels the two directions of traffic on an arterial over each other before a limited-access highway and then returns each direction to the regular side after crossing the highway. This allows left and right turn movements onto the on ramps to be free flowing. The main goal of the DDI is to better accommodate left turn movements and eliminate a phase in the cycle for the signals.

In 2011 two existing interchanges were retrofitted as DDIs: Timpanogos Highway and I-15, and SR-201 and Bangerter Highway. Retrofitting these interchanges by utilizing existing infrastructure cost about one-fourth the cost of constructing a new interchange and took fewer months. DDI retrofit adds capacity without adding more lanes, improves traffic flow, reduces traffic delay, and improves safety with about one-half the traffic conflict points of other interchange types. The DDI also provides operation cost savings due to the fact that the service life of the interchange increases by about 5 to 10 years due to efficiencies in traffic flow.

For northbound traffic on Bangerter Highway accessing eastbound SR-201, the DDI improvements are estimated to reduce the delay per vehicle by five seconds by 2020, or about 36 hours of delay could be saved during the afternoon peak. This translates to projected user cost savings of $11,000 per day in 2020.

It is anticipated that DDIs will save the Department significant construction and operation costs every year, enabling effective servicing of more interchanges statewide that are in need of added capacity.
**Thru-Turn Intersection**

Savings: $87,000 per day in user costs by 2030 due to reduced intersection delay

Efficiency: Reduced traffic delay, improved safety, and less cost to build than widening

The Thru-Turn Intersection (TTI) is based on an innovative intersection design successfully implemented in other states around the country. The design replaces left turns and provides a designated lane that leads to a U-turn approximately 400 feet past the intersection. Motorists wanting to turn left travel through the intersection, make a U-turn, come back through the intersection from the opposite direction and turn at the intersection or their desired destination.

The TTI improves traffic flow, maintains access and enhances safety. There are fewer signal phases and more green time for other movements. By reducing left turns, the number and severity of crashes are greatly reduced. Additionally, the TTI is more bike and pedestrian friendly. The TTI costs less to build and provides more flexibility than simply widening the existing intersection.

In 2011 the Department constructed its first TTI at 12300 South and Minuteman Drive (US-89/State Street) in Draper. The intersection’s traffic flow was previously poor and was being maintained by coordinating signals for east-west travel at the expense of local businesses. Drivers experienced excessive delays of up to two minutes at various turns, and 2030 traffic projections predicted delays up to seven minutes. With the possible addition of 3,000 to 4,000 jobs at companies in the area, increased congestion would have been a significant challenge.

With the TTI in place, traffic flow is much improved. It is estimated that the 2030 peak hour delay at this intersection will be reduced from 298 hours (with the TTI not built) to about 64 hours with the TTI, resulting in user cost savings of $8,600 per peak hour or $87,000 per day.
ONE-PASS CONTRAST PAVEMENT STRIPING
Savings: Reduced traffic impact during reaplication of pavement lines on I-215
Efficiency: Striping visibility maintained with less impact to the travelling public

When an extra lane was added years ago to the west side of I-215, the process of shifting the lane lines resulted in shadows left by the pavement striping removal process. Drivers had a hard time following the lane lines, especially in wet weather at night. The Department added black contrast striping between the white skip lines, greatly improving guidance to drivers.

Since the contrasting of the striping was completed, side impact crashes have been reduced by 25% on I-215. However, the process of applying white skip lines with black contrast lines between them required two separate passes, each pass impacting traffic. The Department partnered with a local striping contractor, who was planning on buying a new paint truck, to include multiple paint tanks and a separate pump for black-only to facilitate painting white skip lines and contrasting black lines at the same time. This new truck was recently used to restripe I-215. Applying skip and contrast lines with the new, one-pass process has resulted in lower impacts to the travelling public during restriping.
ENVIRONMENTAL STREAMLINING WITH UPLAN

Savings: Up to $54,000 annually in project costs for future years
Efficiency: Reduced time to prepare environmental documents with better access to data

This past year, for the first time, the Department used UPlan to prepare the Categorical Exclusion (CE) environmental documents for a project. UPlan is an interactive planning and analysis tool developed by the Department that provides access to data to support informed discussions and decisions. It is a geographic information system (GIS) web application that facilitates synchronizing plans and projects with other state agencies, local governments, federal agencies, utility companies, and within the Department’s many divisions and regions.

The simplest of CEs are prepared by the Department to support mainly pavement preservation activities and highway safety improvements. Most of these types of projects are within the existing disturbed road footprint, so it is unlikely that impacts to environmental resources would occur. The majority of the work associated with preparing a CE is in reviewing multiple databases and consulting with other state and federal agencies. Since UPlan contains the majority of these environmental data in one location, the time needed for completing environmental resources reviews can be decreased by at least one week.

On the Department’s first UPlan CE, extra effort was exerted by Department staff and a consultant as they created a template for future CEs and prepared the necessary project report to assess environmental impacts and associated maps. As such, there were likely no significant cost savings on this project from using UPlan.

Preparation of environmental documents for additional projects using UPlan is planned and underway. It is anticipated that UPlan could likely be used in the preparation of 60% of future CEs prepared by the Department, saving approximately $18,000 to $54,000 annually in project costs. On-going efforts to streamline environmental approvals and permitting through innovative practices such as programmatic mitigation are included with UPlan.
COLD IN-PLACE RECYCLING PAVEMENTS
Savings: $10.8 million in project costs for one year compared to other rehabilitation alternatives
Efficiency: Reuse of old pavement materials and time savings of months over total reconstruction

Cold In-place Recycling (CIR) continues to be a beneficial method for the Department to rehabilitate aging asphalt pavements while saving project costs. CIR involves milling up a deteriorating pavement, adding a rejuvenating binder, re-compacting the recycled material with standard rolling equipment, and returning the pavement to service. This technique has been used successfully on minor roads in Utah for more than 30 years. The significant advantage to this system is the on-site, cold processing of the milled material, which saves on material and hauling costs. These recycled pavements typically receive three inches of hot-mix asphalt as an overlay. However, roads with low traffic volume can be chip sealed (liquid asphalt applied and then gravel spread) directly on the CIR pavement.

The Department in the past year completed five significant pavement rehabilitation projects using CIR over 46 total miles on the following routes: SR-32, US-40, SR-73, US-89, and US-191. The 9-mile SR-32 project near Kamas saved four months and $4.7 million with CIR and an overlay, over the alternative of total reconstruction. The time savings on this project represent significantly less impact to the travelling public. The other four projects saved over $6.1 million total with CIR and an overlay, over the alternative of milling and replacing with hot-mix asphalt. Of note, the 9-mile US-191 project near Bluff addressed severe lateral cracking in the pavement and included a top layer done with a newer, central plant cold recycle alternative.

As CIR technology continues to improve, the Department has begun developing a performance-based CIR specification that will maintain the time needed to return the road to traffic (in as little as six hours) while also allowing for competition in the marketplace. Since the desired CIR curing performance is currently available through very few material suppliers, during the past year the Department created a sole source CIR specification, gained approval of the Federal Highway Administration, and implemented the specification to allow the continued use of this beneficial process in the Department’s projects. The new performance-based specification will replace the sole source specification once it is completed.
PAVEMENT PRESERVATION MANAGEMENT
Savings: Potentially thousands of dollars per year from effective management of $25 billion in pavement assets
Efficiency: Improved data collection, access, and pavement modeling for project recommendations

The Department manages $25 billion in pavement assets. To help with optimizing limited tax dollars and selecting pavement preservation and rehabilitation projects, the Department contracted with private industry to automatically collect pavement distress data at highway speeds with the most advanced technology.

The data from the pavement distress collection was loaded into contractor-supplied, cutting edge pavement management software and includes pavement images and road view images, as well as measurement of higher-quality surface cracking data and previously unavailable data. All of the data was then integrated into a common database that can be accessed through the Internet by all users as well as through a desktop application for more detailed analysis. The additional data and the common database enhanced the Department’s ability to model pavement condition, recommend future projects, and forecast future budget needs.

Contracting with the vendor has resulted in both dollar and time savings. This change has allowed the Department to do with one less Full Time Employee. Additional savings have occurred that have allowed the Pavement Data Collection group and the Regions to utilize their staff for other assignments. The information has provided the Pavement Management group with a more complete set of data many months sooner than was possible prior to the vendor’s involvement. This has resulted in a more effective decision making process for project recommendations and funding needs.

Estimating an increase in pavement life of 1 to 2% per year by using cutting edge data collection and pavement modeling, savings to the Department could be approximately thousands of dollars per year.
PRECAST CATCH BASIN
Savings: $300,000 in project costs in one year compared to previous cast-in-place design
Efficiency: Reduced cost of catch basin by 30% and increased rate of construction

The Department’s Central Hydraulics Section and Structures Division championed and advanced a new precast catch basin design, costing approximately 30% less per unit than previously used cast-in-place designs due in part to simpler steel reinforcement. A catch basin is a buried drainage box used roughly every 300 feet along storm drain systems. Therefore, some Department projects have many catch basins and have the potential of significant cost savings with the precast catch basin design. This new design saved the Department about $300 per catch basin, or an estimated $300,000, on projects over the past year. Similar savings are expected in the future since the precast design has become the most popular box in new projects.

In addition to saving project costs, the precast catch basin design has contributed to speeding up construction (no on-site cure time), thus saving time and reducing traffic delay on projects. The precast design has improved safety since the catch basins can be backfilled immediately and do not need concrete forms, thus reducing tripping hazards.

In developing the precast catch basin design, Department engineers performed the structural review and supervised the testing of the full-scale prototype boxes. Coordination of the full-scale testing was done at no cost to the Department.
WAREHOUSE CONSOLIDATION
Savings: $46,000 in annual travel cost from converting warehouse to upgraded regional headquarters
Efficiency: Reduced warehouse inventory and staff and new focus on as-needed supply ordering

The Department uses various warehouses to store and distribute commodities used frequently by Department personnel in maintaining the highway system and safely performing their work. Consolidating of warehouses was accomplished in various ways over the past year and resulted in more efficient use of supplies, staff, and the buildings themselves.

Some warehouses saved costs by reducing their staff and their inventories. The Department reduced warehouse staff by at least three Full Time Employees in the consolidation process, and in some cases these warehouse duties were given to other existing personnel. Consolidation was also accomplished by using more local vendor delivery services and just-in-time inventory selection. The latter includes warehouse staff assisting in the ordering of requested supplies and directly shipping the inventory to the end user location. Since the orders could be shipped to the individual maintenance sheds, the crews spent less time going to the warehouse and in turn became more efficient. An example of reducing inventory is in Region Three, where in 2008 a warehouse carried over 500 different commodities worth over $250,000, and in 2011 it carried about 300 different commodities worth $160,000.

In Region Four the warehouse consolidation strategy allowed a reduction in staff and warehouse inventory and a building to be converted into the regional headquarters. To save building lease costs of $108,000 annually, the Region Four administration office was consolidated to a Department-owned warehouse. Remodeling and adding a small addition to the Richfield warehouse cost approximately $1.4 million. This annualizes to a net benefit of a 13-year lease. The new facility also allowed for an increase in video conferencing capabilities, thus reducing staff travel time for meetings considerably as well as the costs of vehicle usage. Region Four travel cost savings for the year, due to the office move and carpool and video conference efforts, amounted to approximately $46,000.
PRE-WETTING DEICING MATERIALS
Savings: $500,000 in deicing material costs for the first year of implementation
Efficiency: Up to 15% reduction in salt used and associated reduction in winter slide-off crashes

When applying solid salt and grit as roadway deicing materials, some of these materials are typically lost through bouncing of the truck and roadside scatter. To help reduce the material loss, the Department began pre-wetting the solid deicing materials placed on Department-maintained roads. This started in 2010 on a successful test basis and grew to approximately 50% implementation among maintenance stations statewide in 2011. By reducing application losses, less total material was required to accomplish the same pavement condition service levels as achieved in prior years. Hauling less material to the road for application also reduced cycle times and round trips required to accomplish the same level of service. Reduced trips directly reduced fuel consumption and operator time to complete the same tasks, thus reducing fuel consumption, emissions, and overtime costs simultaneously.

By applying pre-wet solid deicing materials, one station in Region Two reduced salt use by 15% from prior years’ average usage, saving $14,000. One station in Region Four reduced net salt use by 12% while reducing winter slide-off crashes on I-15 north of Enoch by 10%. Department-wide cost savings from pre-wetting of deicing materials for 2011 were about $500,000. Estimated annual savings for future years are up to $650,000.

Additional benefits of pre-wetting deicing materials include: 1) faster production of brine, thus reducing the time required to achieve wet pavement; 2) better adhesion of pre-wet materials to roadway surfaces, causing less scatter than with dry materials when subjected to vehicle wind wash; and 3) lower chloride concentrations in soils and watercourses due to reduced net chloride application.
AUTOMATIC VEHICLE LOCATING FOR DEICING

Savings: $10,000 in deicing costs for one year and a potential for $120,000 annual cost reduction
Efficiency: Reduced salt use by 14% through better salt application monitoring

Another method used by the Department for deicing efficiency is the use of automatic vehicle locating (AVL) and reporting technology by some maintenance stations. AVL is a system that uses computers to collect and transmit real-time information on the actual locations of vehicles—in this case, snow plows—and other characteristics. The Department’s new process involved calibration of deicing material spreaders, employee training, closed-loop ground speed controllers, AVL equipment, automated reporting of road conditions, and automated snow log reporting. The end result was better monitoring of salt application during snow removal from roadways.

Crew-wide use of this process by one maintenance crew in Region Two reduced salt use by 14%. In addition to reduced salt use, using AVL resulted in less report completion time and helped avoid deicer over-application. Applying the right material at the right time, in the right amount, reduced ice formation and kept pavements clearer during and after storm events.

The process saved $10,000 in deicing costs for the first year and is estimated to save $15,000 annually in future years. Deploying these techniques statewide could result in $120,000 annual cost reduction.
HEAVY EQUIPMENT EFFICIENCIES
Savings: Over $120,000 in equipment costs in one year Department-wide
Efficiency: Reduction of older state-owned equipment and leasing or renting newer equipment as needed

Throughout the Department those who oversee heavy equipment have reduced their inventory of state-owned equipment, maintained effectiveness with the remaining fleet, and utilized lease and buy-back programs to save equipment costs. This type of equipment includes excavators, rollers, loaders, farm tractors, and graders. The amount of older equipment was reduced, and newer equipment was leased or rented as needed. Another cost saving method used was the buy-back program, in which needed equipment was purchased at competitive prices by the Department under an agreement that the vendor would buy back the equipment within a few years of the purchase.

Cost savings to the Department from reduction of state equipment and the lease and buy-back programs were over $120,000 for the past year. Additional savings were realized in less time spent on repair of the older equipment, as well as an increase in the productivity of newer equipment. Some of these savings were utilized on road materials to help maintain more of the highway system.