ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

2015 REPORT CARD for UTAH'S INFRASTRUCTURE

An independent review of the current state of infrastructure needs, capability and funding in the State of Utah by the Utah Section of the American Society of Civil Engineers

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EXECUTIVE SUMMARY

WHY A REPORT CARD?

The 2015 Report Card for Utah's Infrastructure is a tool that shows every citizen the extent, condition, and importance of the state's infrastructure assets that support modern life.

The purposes of the American Society of Civil Engineers Utah Section's (ASCE Utah) Report Card are:

- **Document** the current conditions and future requirements of Utah's vital public infrastructure;
- **Inform** elected officials and the general public of our current infrastructure's "health" and what is being done to address current and future challenges and risks;
- **Explain** what must be considered to effectively bring our infrastructure up to today's standards and prepare to serve a rapidly expanding and more urban population; and
- **Quantify** the potential savings that could be realized by Utah's residents as a result of a comprehensive and coordinated effort to provide a stable infrastructure future.

2015 Report Card for Utah's Infrastructure	
ROADS	B+
BRIDGES	B+
TRANSIT	B+
DRINKING WATER & SUPPLY	C
WASTEWATER & STORMWATER	C+
DAMS	B-
CANALS	D+
LEVEES	D-
SOLID WASTE	B-
HAZARDOUS WASTE	C+

ABOUT UTAH'S INFRASTRUCTURE

Utah's public infrastructure systems are at a crossroads of historic growth. Significant changes are needed as population density increases and the state's infrastructure faces new demands. Utah is seeing a rapid shift towards urbanization but also a transition in infrastructure use from an agrarian to urban corridor.

Both old and new infrastructure will require Utah's attention. In this assessment, available funding and needs information was compiled, and it is estimated that Utah's infrastructure needs over the next 20 years exceed $60 billion to both maintain and provide infrastructure for growing areas. As federal funding sources recede, the State of Utah will need to strive to be self-sufficient in Utah's planning and funding of infrastructure.

Much of Utah's underground urban infrastructure is old or approaching the end of its intended design life. In fact, a large portion of it was constructed in the period right after World War II as suburbs expanded, and some of it is even older. Take, for example, buried water and sewer lines. A common rule of thumb for the useful life of underground water and sewer lines is 50 to 70 years, and some of these lines are quickly approaching if not beyond this marker. What the facts tell us is that much of Utah's water and sewer infrastructure will begin to shows of wear and plans for replacement should be made now.

The lion's share of wastewater treatment plant construction costs occurred in Utah over the last 40 years were largely covered by federal Clean Water Act grants. These previous levels of funding are nonexistent today and likely will not return, but the need to upgrade, expand, renew and replace are just as real as during the post-World War II expansion and perhaps more so today. An almost identical form of population growth that characterized the 1950s has returned. Utah's population has tripled since the 1970s and is projected to double by 2050. This growth requires infrastructure to support it, and that infrastructure must expand or depend on core systems that are now more than half-a-century old.

The opportunity to rebuild is also an opportunity to rebuild stronger, safer, and adaptive infrastructure. FEMA, in conjunction with state and local agencies, has developed procedures for estimating damages from known seismic sources.

DAMAGE ESTIMATES FOR THE CORE METRO AREA EVENTS IN UTAH (IN BILLIONS OF DOLLARS)				
Seismic Event Location	**Ogden Earthquake Scenario**	**Salt Lake City Segment**	**Provo Segment**	**Washington Earthquake**
Event Magnitude	**6.5**	**7.0**	**7.2**	**65**
Total Estimated Losses - Transportation & Utilities	**$66.6**	**$33.3**	**$69.9**	**$55.8**

Source: www.shakeout.org/utah

Currently, it is questionable whether or not we are prepared to restore damaged infrastructure at this magnitude in the timely manner most citizens would expect or, perhaps most important, if we are prepared to start preparing Utah's infrastructure to be resilient and avoid some of these costs. We can prepare for and potentially avoid some of the destruction that an earthquake could bring, but we would need to consider it in Utah's plans, response programs, and in the budgets.

POSITIVE SIGNS OF ACTION TODAY

Utah's civil engineering community and many others believe in protecting the public good and being good stewards of the state's resources. Engineers have developed technologies and methods to work efficiently with available financial resources to provide for expanded and upgraded infrastructure, particularly in highway construction. It's worthy of mention that the Utah Department of Transportation (UDOT) led the way in innovative contract and delivery methods, such as the design-build process. Additionally, in construction technology, Utah and its contractors have perfected a methodology for constructing highway overpasses off site and rapidly moving them into place during times of minimal traffic interruption. These two advances by themselves have placed UDOT at the forefront of highway construction in the U.S., both technically and in cost efficiency. Additionally, Utah's Unified Transportation Plan provides a state-wide summary of anticipated 30-year needs for road capacity and maintenance as well as transit improvements and operations for Utah's metropolitan and rural areas which outlines a desired vision for transportation systems to meet the needs of their defined "future."

Municipal water supply agencies along the Wasatch Front and other areas have individually and collectively developed improvement and emergency response plans along their water lines—another example of Utah factually facing the future and making the most of creativity, initiative and available resources. The Salt Lake area also boasts a true wastewater reclamation facility that now cleans water to a level where it can be used for non-potable purposes, like irrigation, or can be discharged into the Jordan River. It resulted from a cooperative effort by the neighbors of this facility that is genuinely clean and helps preserve a valued environmental resource.

There are also several the behind-the-scenes planning efforts underway to manage existing infrastructure and resources that will be asked to extend its anticipated service life through continued population growth. Our municipal agencies, conservancy districts, state agencies and private non-profits, like *Envision Utah,* are committed to do their part to prepare for the future. Their efforts are noteworthy, but the impact would multiply many times over through a well-orchestrated and funded infrastructure approach. A piecemeal approach with our current and future infrastructure needs is not the most prudent course of attack, and it cannot be overlooked that the potential cost savings of an overarching strategy are significant.

RECOMMENDATIONS

If Utah wants to be a vibrant urban society and reap the benefits from it, we're going to have to move forward with a resolve to be innovators and collaborators who find a better way to meet pressing demands, just as we have done in design-build construction where Utah has been an leader and innovator.

1. **DEVELOP AND FUND PLANS TO MAINTAIN AND ENHANCE UTAH'S INFRASTRUCTURE:** Infrastructure investment must be increased to meet Utah's growing needs, but it also should be prioritized and executed according to well-conceived plans that focus on the health and goals of the system. The goals should center on freight and passenger mobility, allowing use of various modes (intermodality), and environmental stewardship, while encouraging resiliency and sustainability. The plans must reflect a better defined set of federal, state, local, and private sector roles and responsibilities and instill better discipline for setting priorities and focusing funding to solve the most pressing problems.

2. **PLAN TO COORDINATE AND SAVE:** First, our state government leadership must acknowledge that continuing to proceed piecemeal in the development of infrastructure strategies and plans for our complex, urbanizing populace is not practical nor a responsible means for dealing with the future. A comprehensive and coordinated infrastructure planning effort over the decade could bring efficiencies, savings, investment, and, most importantly, added safety. The state's growing population can be an opportunity but also a considerable challenge, and it is one that is clearly coming.

3. **PLAN TO REBUILD TO REBOUND:** If something must be replaced, let's rebuild it to rebound when challenged. Our leaders should task experts to use current risk models and prepare forward-looking economic analysis that assesses the cost of inaction in the face of population growth and potential natural hazards, like an earthquake, and consider using a responsible portion of what will certainly be spent tomorrow strengthening our infrastructure today. To ensure local input, legislation should be adopted to have all major urban infrastructure agencies prepare comprehensive plans for dealing with Utah's unique threats and challenges over the next couple of decades, with specific five, 10, and 20-year plans for both actions and funding. In the future, these could become a resilience integrated planning process to develop effective unified strategies that would include preparing for, dealing with, and recovering from such natural disasters.

4. **INCREASE LEADERSHIP IN INFRASTRUCTURE RENEWAL:** Utah's infrastructure is a responsibility of local leaders, and leadership is needed to maintain and renew the infrastructure the generations before us have built. Bold leadership and a vision for how strategic infrastructure investment can help local communities are needed to reverse the current trends.

5. **PROMOTE SUSTAINABILITY AND RESILIENCE:** Today's infrastructure must meet the community's ongoing needs, and at the same time, protect and improve environmental quality. Sustainability, resiliency, and ongoing maintenance must be an integral part of improving the area's infrastructure. Today's transportation systems must be able to withstand both current and future challenges. Both structural and non-structural methods must be applied to meet challenges. Infrastructure systems must be designed to protect the natural environment and withstand both natural and man-made hazards, using sustainable practices, to ensure that future generations can use and enjoy what we build today, as we have benefited from past generations.

ROADS

INTRODUCTION

Roadways are an essential part of the overall economy and life in Utah. Commerce – the movement of all people, goods and services – depends upon a transportation network that operates efficiently. Utah's lifestyle is facilitated by the ability to get from home to work, school, stores, and recreational sites quickly. In addition, the impact of Utah's roads is felt far beyond the state's borders; the Interstate Highway System carries crucial freight through Utah to points north and east of the state. The impacts of a failure in these complicated systems can be felt well outside of Utah.

> **"WE DO NOT HAVE GREAT HIGHWAYS BECAUSE WE ARE A GREAT NATION,**
>
> **WE ARE A GREAT NATION BECAUSE WE HAVE GREAT HIGHWAYS."**
>
> -DeWitt Greer,
>
> former Chair of the Texas Highway Commission

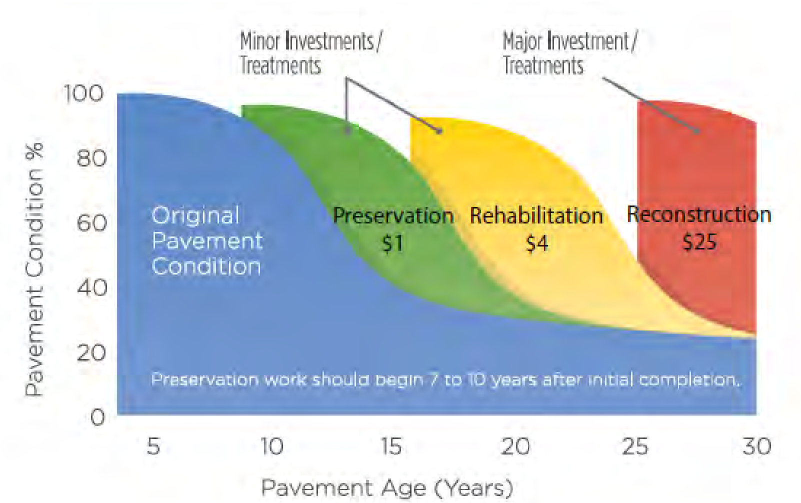
Utah has a history of investing in roads and expanding them as the population has grown. However, as maintenance and construction costs have risen, and roads have aged, the ability to preserve and extend the roadways has become limited. Since 1990, new lane miles in Utah have increased by only about 6%. During that same time period, Utah's population has increased by 60%, and the total number of vehicle miles that we have travelled has increased by about 80%. The double challenge is to maintain the vast inventory of existing roads in working condition while also meeting the pressing demands of growth. While Utah has done well, the future will require even more attention to maintain a growing network.

INVENTORY ANALYSIS

The Utah Department of Transportation (UDOT) maintains nearly 6,800 miles of roads throughout Utah. These roads are categorized into three levels: Interstate, Level 1, and Level 2. Level 1 roads generally have average daily traffic of over 1,000 vehicles and Level 2 roads have less than 1,000 vehicles per day. The vast majority of these roads are paved with asphalt (about 90%), while the remainder are paved with concrete. The total value of the asphalt and concrete pavements on these roads exceeds $19 billion. In addition, Utah's counties and cities operate and maintain thousands of miles of urban and rural roads.

Pavements have a finite life span. Deterioration is caused by traffic, especially heavy traffic, heat, freezing cycles, deicing salts, and other factors. Many of Utah's roads are over 50 years old, although most state-maintained pavement surfaces have had some kind of surface treatment in the past 10 years. UDOT maintains roads based on a proven philosophy referred to as "good roads cost less." Studies behind this philosophy have demonstrated that it is cheaper, in the long run, to perform routine maintenance several times on an asphalt surface, before the deterioration is apparent, than it is to let the pavement completely deteriorate then replace the pavement. Routine maintenance would normally involve removing and replacing a thin layer of asphalt surface every seven to 10 years, at a cost of five to 10 % of the cost of reconstructing the pavement entirely. This can be done several times, essentially doubling the pavement life, as shown in the graphic below. This routine maintenance cost, then, is essential to the efficient management of our roadway system assets.

"Good Roads Cost Less", taken from Utah's Unified Transportation Plan, 2011



UDOT performs extensive surveys on the conditions of all the roads within its jurisdiction. Factors which are evaluated include smoothness, cracking, rutting, and general deterioration (spalled concrete or pot-holed asphalt). Based on these factors, numeric scores are assigned and segments of each roadway are categorized as "poor," "fair," or "good." The number of miles of state-maintained roads in each of these categories and classes, subdivided by pavement type, is shown below.

Utah's Current Roadway Miles by Category

		Poor	Fair	Good
Interstate	Concrete	10.23	229.82	290.99
	Asphalt	6.97	68.11	1266.31
Level 1	Concrete	2.95	29.69	72.8
	Asphalt	58.14	806.89	1977.23
Level 2	Concrete	0	16.18	0
	Asphalt	28.55	754.06	1163.75

The information above indicates one of the byproducts of having limited maintenance resources: while the heavily travelled interstate highways are in relatively good condition (83% are "good" and 16% are "fair"), the Level 2 roadways have much lower ratings (59% are "good" and 39% are "fair"). Currently, there simply isn't enough money to adequately care for the nearly 2,000 miles of Level 2 roadways. Roadways maintained by local jurisdictions generally fare worse than the roads shown here, as cities and counties are required to spread their limited resources over many other municipal services.

Of course, roadways consist of more than pavement. Granular soils support the pavement surfaces, culverts carry water under the roadways, bridges carry traffic over rivers, roads and railways, fixed and electronic signs guide the drivers, guard rails keep vehicles from leaving the roadway corridors, signals control traffic at intersections, lights illuminate roads and interchanges at night, pavement stripes keep traffic moving uniformly, cameras and sensors monitor traffic movements, and buried fiber optic cable provides communications between the electronic devices. Maintaining roadways involves keeping all of these features in good condition. Operating the roadways safely goes beyond the physical features. Snow plows clear snow and ice during the winter, tractors mow grass and weeds along the roadside, emergency crews clear crashes, signal engineers alter signal timing schemes, and traffic operators redirect traffic around crashes and congested areas.

CAPACITY FOR GROWTH

It is well known that Utah's population and economy is growing. Expanding the state's transportation system is necessary to accommodate this growth and is similarly required to encourage and support future economic growth. Over 72 million miles are logged each day on Utah roadways. This equates to an average of almost 10,000 miles per person per year. As indicated in the introduction to this section, over the past two decades, Utah's population has grown by 60% , but the additional lane miles has increased by only one-tenth of that amount. Certainly, Utah has become more efficient in how existing lane miles are used, through traveler information and traffic management, but growth has still far outstripped Utah's capacity.

Additional capacity comes in many forms. Sometimes entirely new highways provide those new lanes. Legacy Highway in Davis County, the Mountain View Corridor in western Salt Lake County, and the Southern Parkway in Washington County are some recent examples of new highways which are meeting current and future transportation needs. More frequently, additional lanes on existing corridors provide new capacity. The recent expansion of I-15 in Utah and Washington Counties are examples. Passing lanes often provide additional safety and capacity; even though they are only a few miles long, they reduce congestion by allowing faster traffic to pass and reduce crashes by providing safe passing zones. Express Lanes have also increased capacity along the Wasatch Front by managing traffic and encouraging carpooling.

FUTURE NEEDS

Utah's Unified Transportation Plan, a document recently published jointly by UDOT, the Utah Transit Authority (UTA), and four Metropolitan Planning Organizations (Cache, Dixie, Mountainland, and Wasatch Front) makes an estimate of Utah's transportation needs for the next 30 years. This analysis is based on a very specific list of projects that resulted from detailed planning efforts. The projects include maintenance and operational needs, replacement and reconstruction projects, and new capacity projects to accommodate and foster growth.

Transportation Financial Needs, 2011-2040

Transportation Need	Estimated Cost (2011 Dollars)
Highway Maintenance & Operations	$21 billion
Highway Capacity	$28 billion
TOTAL:	$49 billion

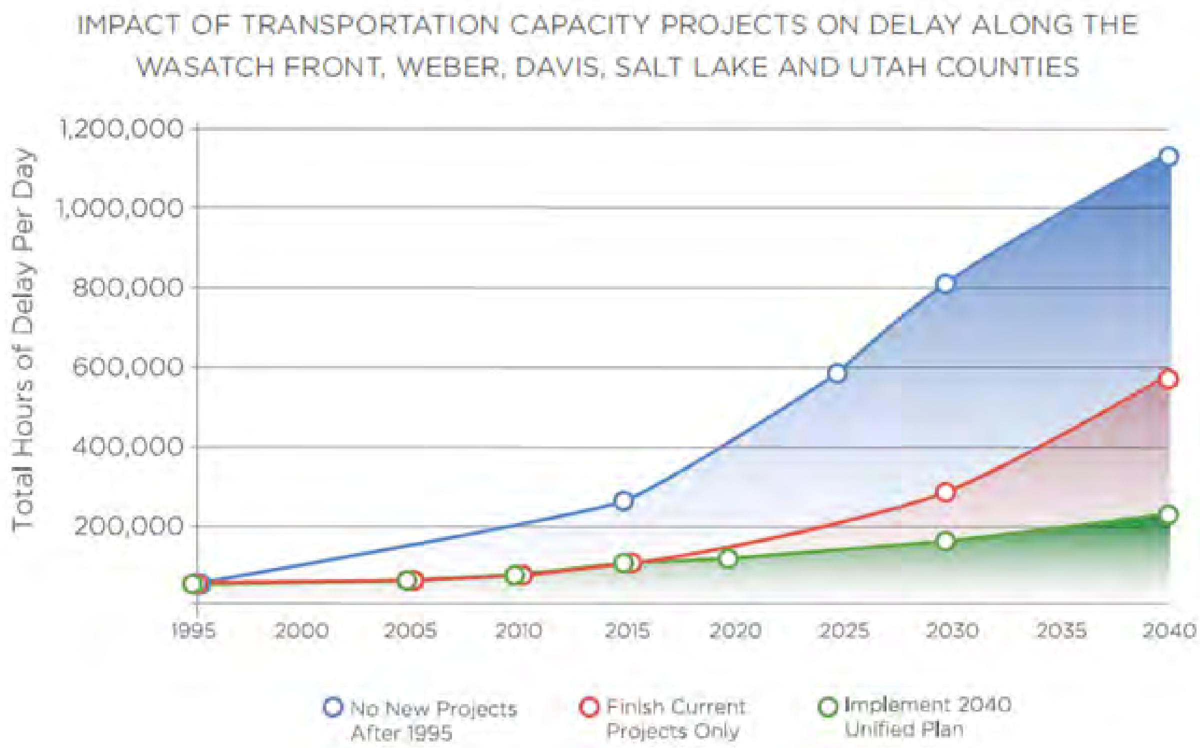
The projected highway transportation needs for the next 30 years exceed the revenue sources that are currently used for transportation. The Unified Transportation Plan document indicates that current funding sources will account for about $43.4 billion over the next three decades, in 2011 dollars. However, this amount includes transit revenues, so the amount available for highway transportation is less than this value. UDOT's annual budget is approximately $1.2 billion per year, equivalent to $36 billion over the next 30 years. Some of this budget, however, is used for overhead costs, staff salaries, and projects that do not fall within the project categories included in the Unified Transportation Plan estimate. The estimated shortfall between funding that is available and the $49 billion needed to meet the needs in the foreseeable future is $15 to $20 billion.

CONSEQUENCES OF FAILING TO INVEST

Utah has long recognized that a good, well-functioning transportation system improves the quality of life and stimulates the economy. A recent study completed by the Economic Development Research Group for the American Society of Civil Engineers calculated the economic cost of continuing to invest at current levels in the highway transportation system. Without additional investment, the report concluded that the U.S. economy would lose more than 877,000 jobs and the GDP would be suppressed by $897 billion by 2020. Closer to home, damaged roads cost Utah motorists $332 million per year in extra vehicle repairs, that is over $115 per person!

One of the major consequences of inadequate transportation capacity is the time spent delayed in traffic. Utah's Unified Transportation Plan presents an analysis of the impact on total delay of capacity improvement projects along the urban Wasatch Front. As shown in the figure below, taken from that report, transportation investments since 1995 have significantly reduced traffic congestion. Without those projects, current vehicle hours of delay would be nearly 250,000 hours, or twice what they are now. The impact of those investments continues to benefit Utah motorists, with significantly reduced delays projected out another 30 years.

Transportation Capacity Projects on Delay, Utah's Unified Transportation Plan



By investing and completing the capacity projects listed in the Plan, total delays in 2040 are projected to be just over 200,000 hours, or about 40% of the delay we would experience without these projects. The benefits of investment are clear.

CONCLUSION

The economy and lifestyle in Utah, as in the entire United States, is heavily contingent on having an efficient, adequately-sized, and well-functioning transportation system. It is based on being able to get people and goods from place to place. Utah has a long history of investing in the network to accommodate growth and keep it running well. But, today's investments still fall short. Adequate future investment, which will clearly require finding some additional revenue sources, will yield economic benefits to Utah's citizens. Following the recommendations made in the Unified Transportation Plan for the future of our transportation system is the starting point to improvement

BRIDGES

INTRODUCTION

Highway bridges are a key element to the surface transportation system. Even if the roadway corridor and pavements are in excellent condition, inadequate or deficient bridges can severely restrict traffic flow. Utah has a good record of maintaining and replacing our bridges, and is nationally known for innovative construction techniques employed over the past decade. On average, UDOT currently builds 34 new structures and rehabilitates eight existing structures per year, which leaves a projected shortfall of 10 to 20 new structures each year. Utah's bridges are in better condition than those of many other states, however, there are still unmet needs.

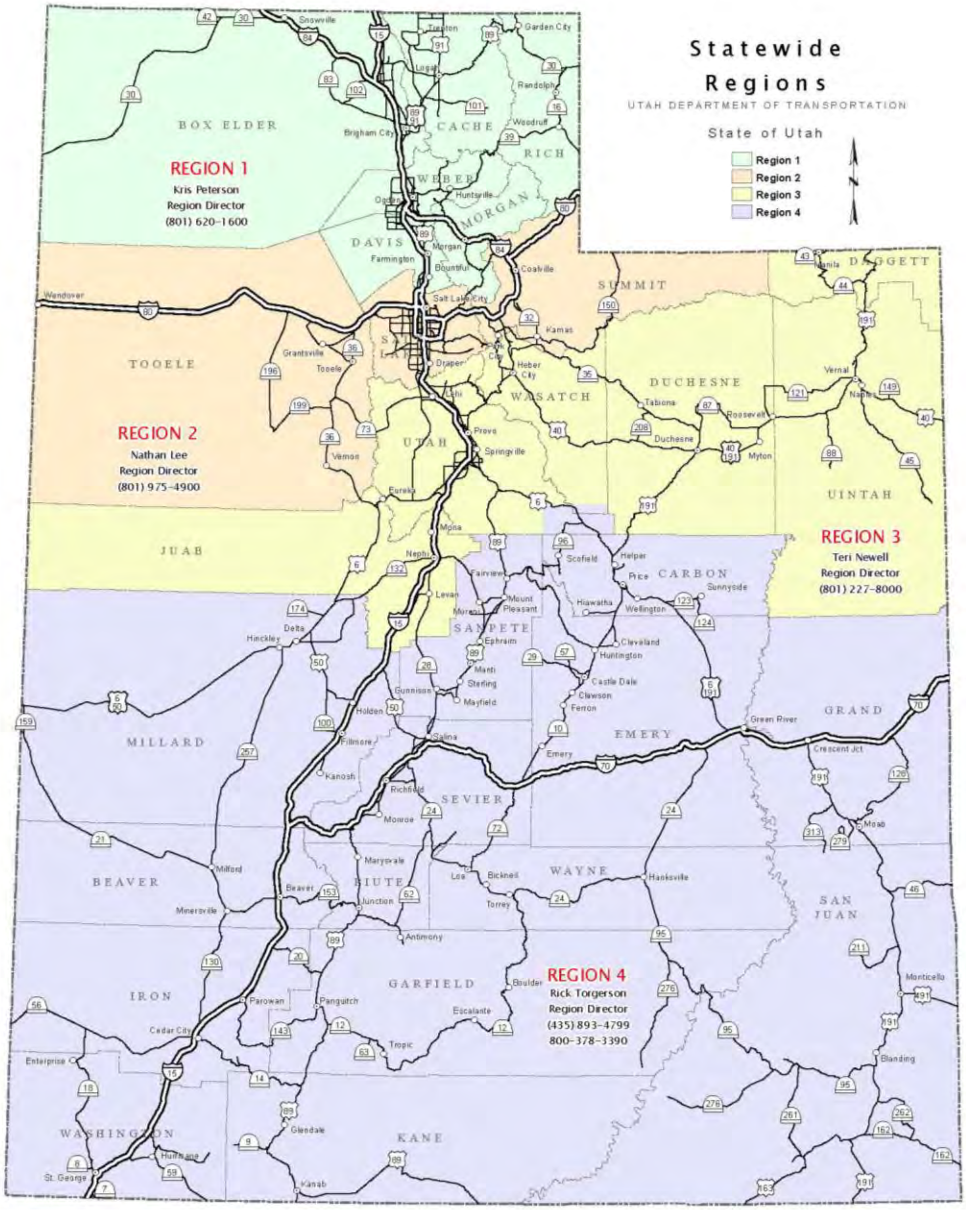
INVENTORY ANALYSIS

There are over 2,900 highway bridges in the state of Utah. The estimated replacement value of all these bridges is over $ 5 billion dollars. The Utah Department of Transportation maintains 1,888 of these bridges. The remainder belong to local jurisdictions, as they are located on city and county roads. Unlike the bridges in many states, which often span large rivers, the majority of Utah's bridges span other roadways and are of moderate length. They are usually constructed of either steel or concrete beams, with concrete decks. The concrete decks are often overlaid with polymer overlays or asphalt to extend their service life.

The table below shows the location of the Utah Structures by Region with a region map provided in the figure below. While a large number of bridges are found in the populated Wasatch Front, there are many UDOT bridges in other, more rural counties. Bridge lengths range from 20 feet to 3,090 feet, 45% are single span bridges and only 11% exceed three spans.

Utah Bridge Structures by UDOT Region

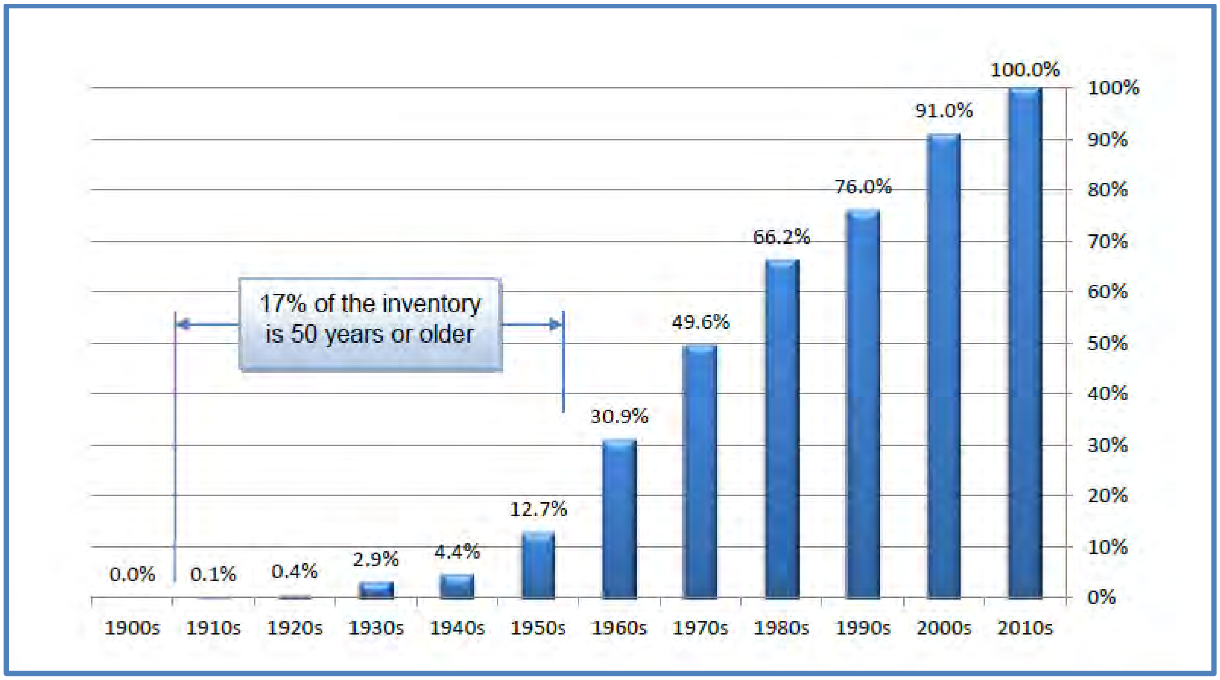
Owner	Region 1	Region 2	Region 3	Region 4
State	332	496	237	453
Local	173	207	170	272
Total	495	703	407	725



The ages of Utah's bridges varies, with the oldest having been constructed in the early 1900s. The figure below shows the ages of the 1,888 UDOT-owned bridges. Each vertical bar on this chart indicates the number of bridges which were constructed prior to or during that particular decade. Over half of the bridges were built between 1970 and 2010, and nearly 25% have been constructed since 1990. This is indicative of the aggressive highway construction program that has been underway at UDOT over the past several decades. However, this still leaves almost one-third of Utah's bridges reaching their 50-year design life by the end of this decade.

ALMOST ONE-THIRD OF UTAH'S BRIDGES WILL REACH A 50-YEAR DESIGN LIFE BY THE END OF THIS DECADE

Cumulative Age Distribution of State Owned Structures by Year Built



Although new bridges generally have a design life of 75 years, bridges built before 1980 are more susceptible to seismic damage because of the rapid advances in seismic engineering techniques since that time. Luckily, many of the longer-span interstate bridges along the Wasatch Front have been replaced over the past 20 years.

Bridges are particularly vulnerable to the effects of weather. Road salts speed up deterioration in concrete decks and cause corrosion of the steel reinforcement. When physical conditions deteriorate significantly, a bridge may be deemed structurally deficient (SD). Structurally deficient bridges are not inherently unsafe, but it does mean that they require significant maintenance, rehabilitation, or replacement. A SD bridge, when left open to traffic, typically requires significant maintenance and repair to remain in service and eventually rehabilitation or replacement to address the deficiencies. The Structures Division at UDOT identifies SD bridges for consideration in the Replacement and Rehabilitation Program.

The UDOT Annual Bridge Report provides details on the condition of bridges in Utah. Currently, 2.9% of Utah's bridges (UDOT and locally owned) are structurally deficient. This is less than half of the national average. About 65% of the bridges have an overall structural condition of "good", according to the National Bridge Inventory Standard (NBIS); most of the remaining bridges have a "fair" rating because of the condition of the deck, superstructure, or substructure.

NEEDS EVALUATION

In recent years, many of Utah's bridges have been replaced as part of major construction projects. While some additional projects of that type are planned and some bridges will be replaced through those projects, many of the remaining, older bridges are in rural areas along our interstates or local highways. It is less likely that these bridges will get replaced without specific funding being directed toward them.

Structures built prior to 2000 were typically designed to meet a service life of 50 years. Structures built prior to 1964 are expected to be nearing the end of their service life. There are at least 240 state owned structures that will require consideration for replacement or rehabilitation in the near future. Each decade approximately 300 to 400 bridges will be nearing the end of the service life. These structures will also need to be considered for replacement or rehabilitation. On average, UDOT currently builds 34 new structures and rehabilitates eight existing structures per year, which leaves a projected shortfall of 10 to 20 new structures each year.

CONCLUSION

The highway system in Utah is dependent upon safe, well-functioning bridges. Over the past two decades, much progress has been made on improving the bridge inventory in Utah, resulting in bridges that are in much better condition than others around the nation. However, fiscal resources fall short of the need as bridges continue to age. Additional resources will need to be invested to maintain Utah's good bridges and rehabilitate or replace those which are in poor condition or beyond their service life. Adequate future investment will require new revenue sources, such as increases in the state gasoline tax. Progress has been made, and more will be made if we raise additional revenue needed to remedy the situation.

TRANSIT

BACKGROUND

Transit networks in Utah have improved significantly over the past 30 years. With more than 100 miles of fixed guideway services and over 46 million annual riders in the state, transit has grown considerably. There are still pressing needs for system enhancement, expansion and financial stabilization, but overall, Utah residents in urban areas are seeing types and levels of service that have not been experienced in their lifetimes. There are few providers in Utah's rural areas beyond community and local government social service transportation, but this is a reflection of population location, funding availability and density.

WITH MORE THAN 100 MILES OF FIXED GUIDEWAY SERVICES AND OVER 46 MILLION ANNUAL RIDERS IN THE STATE, TRANSIT HAS GROWN CONSIDERABLY.

CONDITION AND CAPACITY

The most significant provider of public transportation services and facilities in Utah is the Utah Transit Authority (UTA). UTA provides transit services throughout the Wasatch Front including Salt Lake, Davis, Weber, Utah counties and portions of Tooele, Summit and Boxelder Counties. This service area covers nearly 80% of Utah's population and the areas of greatest transit demand. Other urban systems include:

- The University of Utah's Shuttle system,
- SunTran in St. George City,
- Cache Valley Transit District in Logan area and
- Park City Transit in the Park City area.

All transit service planning is coordinated through one of four Metropolitan Planning Organizations in Utah as part of the long range planning process. Utah Transit authority operates Commuter Rail (FrontRunner), Light Rail (TRAX), Bus and Paratransit services as well as providing carpool and vanpool services.

SERVICE STATISTICS (2011)

Mode	Annual riders (unlinked trips)	Fleet	Operating Cost per revenue mile	Cost of service per passenger trip
Commuter Rail	1,611,000	34	$10.66	$12.74
Light Rail	15,333,000	71	$9.06	$2.27
Bus	21,560,000	481	$6.79	$5.00
Demand Response	561,000	173	$6.86	$36.27
Vanpool	1,417,000	438	$0.47	$2.67
Total	40,488,000			

Source: www.ntdprogram.gov

The other transit systems in Utah are somewhat modest by comparison but are an important element in the overall transportation picture for the state.

Operator	Estimated Annual Riders
Cache Valley Transit District	2,100,000
Park City Transit	1,900,000
University of Utah Shuttle System	1,600,000
SunTran – St. George	420,000
Total excluding National Park Service	6,200,000
Total Including UTA	**46,700,000**

Source: www.ntdprogram.gov

Park City's Main St Trolley

Transit ridership growth has been generally flat and remains so largely as a result of economic factors, pricing and service cutbacks that resulted from local and federal funding reductions. However, expected growth has been dampened by economic sluggishness and the slow progress of land use changes in the region. Following national ridership patterns, Utah's youthful population, along with the addition of a growing senior cohort could grow transit use in the future.

St George's Sun Tran

Transit supportive land use trends have been improving in the Wasatch Front as developments of medium and higher density have been constructed and planned for transit station areas. Transit, bicycle and pedestrian amenities have been provided in new and infill developments. Salt Lake City has been supportive in building and supporting livable communities efforts. There have been several targeted efforts to boost transit ridership among employees and students. Salt Lake City, the University of Utah, and several major employers have partnered for many years to improve transit access to major traffic generating areas and current trends are quite positive for further success. The University of Utah began to offer students, faculty and staff very deeply discounted transit passes in the early 1980s. With the expansion of transit options to the University, the program has grown immensely and been of great value to UTA and the University of Utah. Recently, the program was expanded to include transit service as part of ticketed athletic events on campus. Based on that program, Salt Lake City began offering discounted transit passes to city residents for purchase through their utility bills. These efforts will lead to longer-term trends that will have positive transportation, air quality, and community efficiencies over time.

MAINTENANCE AND FUTURE NEEDS

Impressive amounts of fixed guideway transit have been built along the Wasatch Front in the last two decades. Light rail and commuter rail did not exist in operation 25 years ago in the region, marking a transition point in the Utah transit. Most systems have been built out significantly, and only modest system extensions are currently planned. Commuter rail, light rail, streetcar and bus rapid transit service growth will likely be of moderate scale for the next 10 to15 years. Challenges will include the maintenance, operation and upgrade of the systems that have been built over the last two decades as they age.

Future planning efforts are currently focused on transportation issues in the Wasatch Mountains and the growth and linkage of areas in Summit, Morgan and Wasatch Counties, known as the Wasatch Back, to transit networks in the urban regions. These efforts will eventually lead to further development and geographic expansion of transit networks.

UTA announced through its 2040 Unified Transportation Plan its goals to double transit ridership by 2020, increase bus services by 50% in the same time period, improve transit trip times by 25% and restore bus services that were cut in recent years for budget balancing purposes. The plan also calls for a two-thirds increase in sales tax funding in the district to achieve these goals.

UTA's Trax

Park City, St. George and Logan have all conducted various transit expansion and service improvement studies in recent years. As funding improves and stabilizes it is likely that there will be some service expansion in those other urban areas as well.

The unprecedented and explosive growth in rail transit in northern Utah stands as a tremendous story of success and determination. Over 100 miles of fixed guideway services have been implemented in the last 25 years which is a huge testament to the people of Utah and many of the public officials and dedicated employees that helped make it happen. Utah has some of the newest rail transit services of any comparable urban area in the nation.

FUNDING

The greatest challenges facing transit statewide, but particularly in northern Utah are financial. Federal funding sources for capital projects have diminished greatly in the last ten years and show no sign of returning to previous levels.

UTA in particular has financed its rail construction program through sales tax revenue bonds. Sales tax revenues have recovered slightly since 2008, but still remain tenuous in terms of growth. Debt service payments will be a drain on UTA’s resources for many years to come. This financial pressure will make UTA’s goals of restoring and increasing bus services very challenging unless funding rates are increased.

Controlling operating costs of their transit system will also be a challenge in the future for UTA and the other transit operators. Nearly all cost indicators have increased slightly over the last five years and while fuel costs have moderated in the near term, labor and equipment costs continue to rise slowly.

UTA must manage not only its internal cost structures, but also balance its goal for fare revenue. Currently, UTA has raised its base fares to levels that are comparable to much larger cities and exceed the levels

Front Runner - Into the Future

of peer agencies. While everyone must pay a fair price to use the system, UTA must balance passengers' payment and perception of value.

Overall, transit in Utah is becoming more relevant and critical in communities as they grow. Transit is slowly overcoming land use and planning inertia and starting to establish a market relevance that it has not had since the early 20th century. In the near future, transit providers must continue to provide customers, attractive, affordable and cost effective service both now and into the future.

DRINKING WATER & SUPPLY

OUR WATER

Water is a vital necessity for any community to subsist and to thrive. Equally important is the state of our current infrastructure that provides water—reservoirs, aqueducts, treatment facilities, storage, and distribution systems. Historically, Utah has had plenteous water supplies and adequate distribution to water users as a result of water management infrastructure functioning to manage drought cycles. Some of the amazing but little known facts behind Utah's water supply history are all the previous developments and complex sets of infrastructure that make it available for individuals and businesses to use.

BRIEF HISTORY AND CURRENT CONDITIONS/TRENDS

When the pioneers entered Salt Lake Valley in 1847, one of the first things they did was to divert water out of City Creek for farming and gardening irrigation purposes. That practice expanded in Salt Lake Valley until all Wasatch Canyon Creeks were tapped to provide domestic and farming water. The pattern of tapping flowing creeks, sometimes with minor impoundments, continued throughout most of Utah for about a half-century. Major mountain reservoir construction was initiated around the turn of the 20th Century with the Strawberry Project that included Strawberry Reservoir and an impressive diversion tunnel for trans-basin delivery water to the Spanish Fork River.

Since then many mountain reservoirs have been constructed, some by local entities such as Salt Lake City—Parleys and Big & Little Cottonwood Canyons—and others by some combinations of entities like the Provo River Water Users Association. The Deer Creek Dam was constructed as part of the Provo River Project to store water diverted from the Provo, Weber and Duchesne Rivers under Project and Association water rights. The dam was constructed from 1938 to 1941 as part of President Roosevelt's National Recovery Act of 1933.

Deer Creek Dam and Reservoir

Projects like these facilitated the growth of Utah throughout the 20th Century. A consequent dependence on high mountain water, accumulated in the form of winter snow, defines infrastructure needs in Utah. Furthermore, there are essentially no more of these sources left to tap, except for some extremely expensive possibilities, namely the Bear River Project and the Lake Powell Pipeline. The former would impound lower Bear River flows that currently discharge into the Great Salt Lake and pipe them to Northern Utah communities, allocating 220,000 acre-feet to Cache County and Conservancy Districts along the Wasatch Front. However, even with the aggressive water conservation target of 250 gallons per person per day, this will support an increased population of about 780,000. Current population trends indicated that this total will be achieved in 21 years which means any increased supply will have to come from further aggressive conservation and converted uses. The Lake Powell Pipeline is an alternative for Southern Utah, and would be the most expensive Utah water development project ever. The Division of Water Resources' most recent cost estimate (June 2008) for the entire project is $1.064 billion. The project would consist of approximately 139 miles of pipeline from Lake Powell to Sand Hollow Reservoir near St. George. At full development the pipeline is planned to annually deliver up to 80,000 acre-feet per year to the Washington County and Kane County Water Conservancy Districts. The state would build the project and the districts would repay the costs through water sales. At an average per person use rate of 150 gallons per day, this project would support about 190,000 families (in about 30-or-so years at projected population increase estimates), and the apportioned cost of the pipeline is estimated to be $5,000 to $10,000 per family.

With large mountain impoundments and equally large delivery pipelines, the municipal water supply picture in Utah is subject to increased risk. The major risk factors that impinge on our water supply are:

- Seismic threats to both dams and transmission lines;
- Climate changes over the past several decades have consistently affected precipitation patterns over Utah, mostly reduced snowpack (see Climate & Water Supply sidebar); and
- Population growth, which is continuing to take place at record rates—essentially doubling in the next four decades—will place unprecedented demands on water supply systems.

SEISMIC THREATS

A major threat that is mostly unseen by the general public consists of critical transmission lines from the dams and reservoirs to the points of use: our urban communities in the valleys and flats. Because the main storage reservoirs lie in the mountains, our transmission lines must cross the seismic faults that have developed at the intersections of mountains and plains. Moreover, there are many fault traces that show multi-foot movements. Those deflections would rip any of our water transmission lines apart, causing long-term loss of water supplies at time when they are needed most.

This situation is not unlike water supply to the San Francisco Bay Area, where the Hetch-Hetchy pipeline crosses the Hayward Fault. The City of San Francisco decided not to accept the risk of a rupture of the Hayward Fault, funding the design and construction of pipeline modifications that could withstand statistically-supported fault deflections. This kind of engineered defense is what Utah must consider if we prepare to lessen the future consequences of preventative actions. Our water transmission lines are our most vital lifeline; they deserve protection.

CONDITIONS

Much of Utah's underground urban infrastructure is old, very old. A large portion of it was constructed in the period right after World War II, during the suburb expansion. A significant portion older yet. A common design guideline for the useful life of underground water and sewer lines is 50 to 70 years, with the latter value resulting from practical considerations, especially for pipes installed in the mid-1900s. Our water underground infrastructure is reaching the end of its useful lifespan and should be scheduled for replacement now.

In both the cases of water lines and sewer lines the major consideration is leaking and broken pipes. For water lines the biggest concern is contamination of water supplies, with public health being the most important factor. All kinds of conditions exist in underground soil, from just being wet with dirty water to containing harmful chemical constituents to carrying sewage away to be treated.

Unfortunately, sewage often emerges from old, leaky sewer pipes. Prior to the mid-1900s it was common to construct sewers including house laterals with clay pipe. This material is easily broken, and when excavated it is usually broken. When it does break, it can contaminate the soils underground and potentially the adjacent ancient water lines.

In an analysis prepared in 2005, the typical installed value of community water systems (mostly pipes) was about $7,000 per equivalent residential unit. Today it would be more, around $8,200. Further, it is estimated that around 200,000 Utah homes were provided with subsurface water and sewer services before 1965; these systems are now 50 years old or older. Combining the above factors, including commercial and industrial users, it is estimated that Utah has nearly $2 billion worth of subsurface water lines that should be scheduled for replacement soon, if not now.

Yet looking at the comprehensive list of future project funding and assistance requests, as compiled by the state's major water agencies, local and regional agencies are only projecting that $427 million will be needed for renovation and/or replacement of existing pipeline infrastructure in the next five years. It appears that municipal water systems are accumulating unmet needs for replacement of ancient pipelines. Total expenditures in the upcoming half-decade are stated to be $4.55 billion, with over 90% of it directed to existing storage and treatment, plus system expansions, and only 10% proposed for distribution pipe replacements.

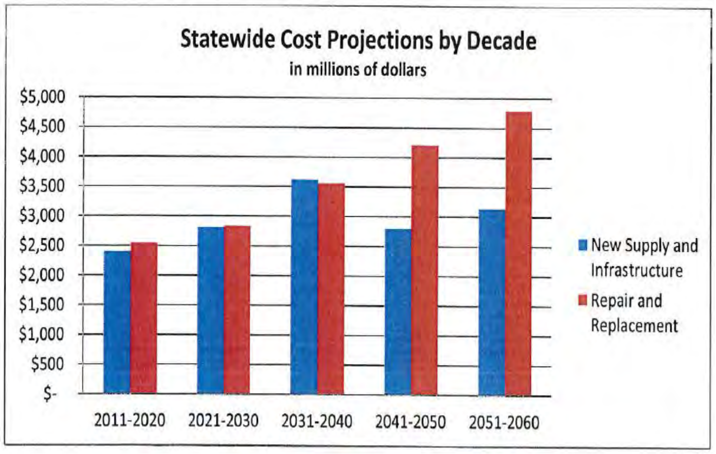
CAPACITY AND COSTS

It appears that most local and regional water supply systems generally have adequate capacities to support current users. Many of those that are anticipating increased demands seem to be actively planning and budgeting to meet those increased demands. If we examine the $4.55 billion discussed above, or the $12.73 billion tabulated for the next 20 years, it can be easily concluded that new and expanded systems are anticipated throughout the next two decades, it is difficult to attempt to apportion the $12.73 billion between existing and new water users, because some of these funds are designated for improvements to existing systems and some to service a growing population. The state-wide 20-year incremental population is forecast to be 1,184,000, yielding a total population of 4,113,000. Further, many local water agencies do not practice long-range planning. All of the above leads us to the rather obvious conclusions:

- Many local and regional water systems appear to believe they have adequate *current capacities.*
- Reasonable estimates of current restoration or replacement needs suggest that much is being ignored (out of sight, out of mind) as indicated by the amounts actually being budgeted for these purposes.
- Published current and future funding requests by local and regional water agencies total nearly $13 billion over the next 20-year period, averaging $547 million per year. The

latter translates to $542 per household per year for our current population (2,928,000). Inasmuch as the proposed expenditures relate mostly to infrastructure elements (not operations and maintenance), the above amount is equivalent to an increase of $45 per month for an average family.

- It is apparent that from strictly a financial point of view we will be facing some major challenges in securing adequate funding in order to provide adequate municipal water services for our growing population.



A more detailed analysis of Utah's Municipal Water Needs was prepared by a group of our state's major water supply agencies: The Utah Division of Water Resources, and the following Water Conservancy Districts - Jordan Valley, Weber Basin, Central Utah and Washington County, along with the Metropolitan Water District of Salt Lake City and Sandy. They project that the estimated costs through 2060 for repair and replacement of water infrastructure will be $17.9 billion, plus $14.8 billion for new capital facilities (in 2013 dollars). As can be seen, with a state population projected to more than double during that same period, Utah is faced with significant challenges in planning, designing, building, and financing our future water needs.

Irrespective of which set of forecasts is the more accurate, the amount of money that will be required to repair, renovate, replace and expand our water systems is enormous. The detailed needs analysis referenced above yields a total of about $33 billion in the next 50 years. It is vividly apparent to us that some form of optimization of water infrastructure systems is in order. We do not believe that we will have sufficient financial resources to spend $33 billion for water, plus amounts of the same magnitude for transportation systems, wastewater, solid wastes, seismic safety, and a host of other pressing urban needs. The anticipated rate of population increase forecast for urban Utah shouts for a systematic and comprehensive analysis of how we should deal with it in a coordinated and optimum manner.

WATER STORAGE RESERVOIRS

In Northern Utah there is a series of major reservoirs that capture high mountain runoff, mostly snowmelt, and detain it for later season use along the Wasatch Front. These reservoirs include Wanship, East Canyon, Mountain Delle, Little Delle, Jordanelle and Deer Creek reservoirs. Because of their importance to water supply in "the Valley" these reservoirs have received a lot of attention relative to maintenance. Jordanelle is the most recently constructed, so its current maintenance is much less than older counterparts. Two of the reservoir dams currently or recently have received major maintenance or renovation attention: East Canyon and Deer Creek. The former has undergone major renovation to improve its structural strength and seismic stability. The latter has received necessary improvements to the structure, as well as much improved water withdrawal facilities. These major municipal water supply elements are receiving the attention they deserve, and they do not represent major maintenance problems or issues. The transmission lines connecting these storage facilities to municipal users are a vastly different situation.

CAPACITY

The capacity of existing reservoirs appears to be adequate based on current needs. Reservoirs were constructed to store water from the rivers and streams that is used throughout the state. The reservoirs were sized to store the volume of water developed. To the extent that the water supply is adequate there is adequate storage capacity. In fact, with a reduction of in-flows (reduced snowpack runoff) in recent years, the capacity may even be greater than needed to store the water currently available.

Utah's reservoirs have been constructed over a period of greater than 100 years. Functional adequacy and obsolescence is a function of the individual dam associated with each reservoir and the water resource management policies being utilized. For the most part the reservoirs are serving the purpose for which they were created. The functional adequacy and obsolescence of the dams associated with Utah's reservoirs is being addressed in another section of this report. In the past 20 years there has been only one major reservoir constructed in the State of Utah.

ENVIRONMENTAL AND SAFETY CONCERNS

New reservoir storage facilities are facing increased scrutiny from both environmental and safety perspectives. Current urban water supply reservoirs, and their associated watersheds, are experiencing increasing urbanization pressure. This can, and often does, create safety issues both from the perspective of keeping drinking water sources clean and protecting downstream lives and property in the event of flooding from high and sustained runoff or the failure of the associated dam,

The hazards and risks associated with water supply reservoirs revolve around the impounding dams constructed to create the reservoir. Seismic risk associated with the associated dams creates two potential issues. The safety of people downstream in the event of a failure and the dangers associated with losing a major source of water are both major concerns. The immediate danger is the potential for loss of life and property in the event of a failure. The loss of a water supply would impact the affected area for some time and likely lead to rationing water. The loss of a water supply could, in the long term, have a greater negative impact than the initial failure of the dam.

The State of Utah has programs underway to strengthen and enhance some of the dams that have been determined to be the most susceptible to earthquake damage.

Prolonged decreases in the snowpack supplying water to the reservoirs would result in unused capacity. Under these conditions existing reservoirs would continue to have adequate capacity. Some of the unutilized capacity may be used if additional water development projects are constructed. With lesser amounts of water stored, pollution impacts may increase. Runoff from watersheds and shoreline sources (many reservoirs receive heavy recreational use) could lead to higher concentrations of pollutants which could cause significant problems.

RECOMMENDATIONS

Our recommendations are: (1) be protective of key watershed areas, and (2) continue to promote and institute water conservation. Allow water rates to penalize excessive users. This practice has been well developed in Southern California and has created an enviable water conservation record.

WATER TREATMENT

CURRENT SITUATION

All public water supply systems that use surface water of any kind have been required to use contemporary water treatment technology to remove impurities and disinfect the water prior to distribution. Groundwater (well) systems are exempt from treatment, provided that regular testing affirms the potability of the supply, and disinfection is routine.

Utah's newest major water treatment facility, the Utah Valley Water Treatment Plant, is operated by the Central Utah Water Conservancy District. It is the first Direct Filtration plant to be constructed in Utah. This plant serves Orem and Provo cities. With a capacity of 80 million gallons a day (MGD), this treatment plant is in Orem, Utah. It treats water conveyed from the Provo River and Deer Creek Reservoir for Orem City. It was designed to provide municipal water to Provo City and northern Utah County communities.

The raw water source for the plant is in the Provo River at the Olmsted Diversion, which is about seven stream miles from Deer Creek Reservoir where water is also stored for treatment plants in Salt Lake City. There is currently a cooperative watershed management program in place involving several local, state and federal agencies.

The Weber Basin Water Conservancy District has provided drinking water to municipalities, water companies and individuals in Davis, Weber, Summit and Morgan Counties for over 50 years. Approximately one-half of the total drinking water demand in Davis and Weber Counties comes from the District. WBWCD operates three water treatment plants with a combined capacity of 94 million gallons per day (MGD). The treatment plants have some of the most advanced methods for drinking water treatment in the world.

ENVIRONMENTAL AND SAFETY ISSUES

Some recent projects have served to publicize an increasingly important issue: toxic chemical and hazardous organics contamination of groundwater. Near the beginning of the 20th Century copper mining evolved to a major industrial undertaking. One method of recovering copper (and other heavy metals) from low-grade ore is to circulate strong acids through it, leaching out the metals. Unfortunately, other constituents also are leached out, and these remain with the waste acidic leaching fluid, contaminating the groundwater downstream of the leaching operations. The Southwestern part of Salt Lake Valley's groundwater has a massive accumulation of inorganic pollutants that originated with copper mining operations. The extensive pool of contaminated water was being considered for Superfund status by the U.S. Environmental Protection Agency (EPA). However, the Jordan Valley Water Conservancy District (JVWCD) intervened and was able to convert penalty funds into the planning, construction and operation of a large-scale demineralization water reclamation facility. What made this possible was the scale of the problem, the small number of participants—one of which, Rio Tinto/Kennecott Copper—is still in business and has the ability to pay for the environmental damages, the scale of the contamination problems, and the foresight of the leadership at JVWCD.

Several other serious groundwater contamination situations are the result of the discharge/dumping of petroleum-based solvents, many of which are extremely toxic. Several of these sites are or were military facilities that were used for vehicle and/or airplane maintenance. One such site, near the University of Utah, has resulted in the closure of a major municipal water supply well. Another site that has not received much attention to date is Hill Air Force Base. Based on anecdotal information massive amounts of toxic liquid wastes were discharged onto the ground in years gone by. That site will likely require extensive treatment and rehabilitation.

MUNICIPAL WATER

CAPACITY

Transmission capacities were generally designed to meet the delivery abilities of the water supply developed. To the extent that water supplies are adequate, so are the transmission capacities. However, there is not a great deal of unused capacity in the current transmission facilities. As future water supplies are developed, or expanded, new or expanded capacity will be required to meet anticipated population growth and consequent demand increases.

CONDITION

Design and construction of the transmission facilities in the State are not believed to be a significant issue. Many of the projects were designed and constructed as part of U.S. Bureau of Reclamation projects, and they were built to its standards. Subsequent transmission construction projects have been built to those original standards, or higher. There are believed to be no significant issues associated in this area. Maintenance on the major transmission lines has been ongoing over the years. This has resulted in prolonging their lives.

The transmission pipelines serving parts of Weber, Davis, Salt Lake and Utah Counties were part of water resources projects constructed in the 1950s and 1960s. They are now 50 to 60 years old, and although transmission lines are currently functioning adequately, it is not too early to begin looking at some replacement due to age and the deterioration that comes with the passage of time. Improvements in pipeline technology have made pipelines more durable and reduced friction loss, thus essentially increasing capacity.

Another issue associated with transmission pipelines is the protection of the right-of-way. Some transmission lines serving Salt Lake City, for example, are nearly 100 years old. Some of the alignments run through what was, at the time of construction, open undeveloped land. Today this land is heavily developed. It is almost certain that some of those lines have had structures constructed over, or very near, them. Salt Lake City is not the only city in Utah where this situation exists.

SAFETY, HAZARDS AND RISKS

Virtually all major transmission pipelines from Davis County to Utah County at some point cross, or follow, the Wasatch Fault. The water supply is on one side of the fault, and the major part of the demand is on the other side, presenting design and maintenance challenges. Water must be brought across the Wasatch Fault. Alignments cannot reasonably be changed.

Risks of damage from a seismic event are significant, from a loss of to life and damaged property perspective, but also the problems associated with losing a significant portion of the water supply for a metropolitan complex with over 4-million people.

Detailed emergency response plans are needed, and are currently being developed by the major water suppliers in the State. However, statutory restrictions on agency financial reserves seriously limit the abilities of many water supply organizations to maintain adequate disaster equipment and supply resources. Also, response plans for each of the retail suppliers also needs to be completed and coordinated with the water wholesalers that may be providing water to the retail entity.

The biggest threats to transmission facilities in Utah are, and will continue to be, seismic. Most of our population lives on, or near enough to a major fault to be impacted by a significant seismic event. This hazard has been discussed in the Environmental and Safety section of this report.

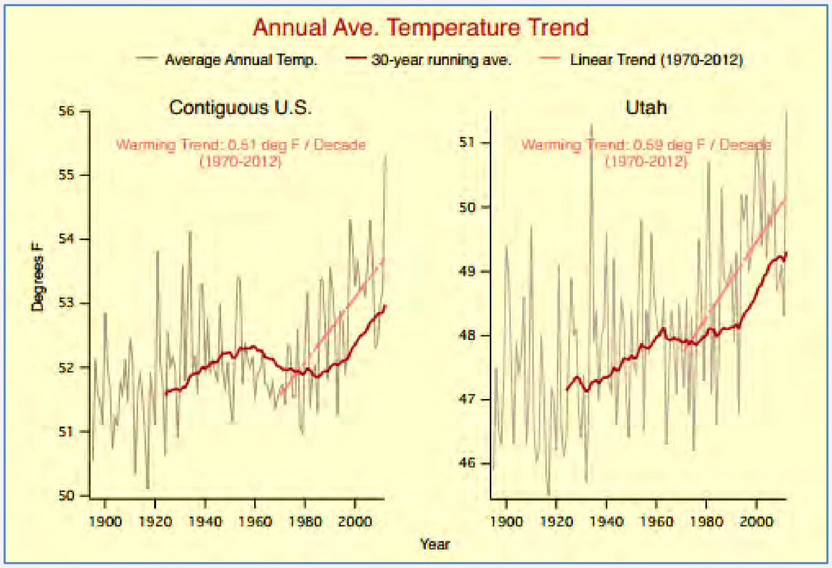
FUTURE NEEDS

There are significant efforts underway to reduce overall water consumption and to better utilize the water that becomes available as land use changes from agriculture to urban. It is not known how much impact these efforts will have on the need for additional or expanded, future water transmission facilities. However, with the projected doubling of Utah's population in the next decades, significant expansion of transmission facilities will be inevitable. The costs of these projects will be substantial. The question is, “How will they be paid for, and by whom?” It can seriously be argued that, just like highways that benefit from state-level funding, adequate water supplies are absolutely necessary to support a healthy economic development future for Utah. Since the benefits are so widespread, why not support the required funding with state-level funding? It’s at least worth considering.

ADAPTING TO A CHANING CLIMATE AND WATER SUPPLY

Utah depends upon mountain snowpack for the bulk of its water supply. If snowpack continues to decline, it will negatively impact water supplies. Furthermore, if there were a reduced water supply, then providing for an increasing population would be difficult, extremely difficult. There are ways, but implementing them requires effort and funding.

The Utah Climate Center at Utah State University has closely monitored Utah climate for many decades, and developed some consensus estimates of climate futures for our state[1]. The Center reports increases in average temperature over this century-plus period for Utah, characteristic of the entire state. Utah's average temperature has been gradually increasing since the last part of the 19th Century. Temperature increases over the past couple of decades are of concern, but also are attendant changes in precipitation characteristics.



A changing feature of the past record and the future projections is that of the snow-to-precipitation ratio. This ratio has been consistently declining since the 1950s. Because our major source of urban water is the winter snowpack, as it decreases so will our urban water source. Another factor: on April 1, 2014, despite a very wet spring, Salt Lake City's precipitation deficit was 1.69-inches or 20% below normal. This was also indicative of snowpack at that time.

Just-released data from NOAA[2] verifies that our trend is continuing; 2014 had the warmest average global temperature since adequate measurements were started in the mid-1800s. According to information documented by the USEPA, “In the western part of the United States, future projections for less total annual rainfall, less snowpack in the mountains, and earlier snowmelt mean that less water will likely be available during the summer months when demand is highest.””. If our snowpack continues to be depleted as driven by temperature change factors, we will be in nothing but trouble. This is a major serious threat, and we ought to take notice.

ASCE’s recognition of published global temperature changes and consequential impacts is not an endorsement of any particular scientific forecast of future catastrophes. Rather ASCE strongly endorses the concept of being prepared for such changes, given the historic record.

(1) UTAH CLIMATE UPDATE, ISSUE 51 JANUARY 2013 - climate.usurf.usu.edu
(2) www.ncdc.noaa.gov/sotc/summary-info/global/2014/12

DAMS, CANALS & LEVEES

BACKGROUND

The condition of dams in Utah has seen strong improvements in the last two decades through a number of improvements and retrofitting. Approximately 46% of hazard dams meet current safety standards or are classified as being in satisfactory condition. Another 43% are classified as being in fair condition needing rehabilitation primarily to meet seismic and flood standards. A high-hazard dam is one where failure or mis-operation is expected to result in loss of life and may also cause significant economic losses, including damages to downstream property or critical infrastructure, environmental damage, or disruption of lifeline facilities. The state has 252 high-hazard dams, of which 198 are regulated by the state, with the remaining 54 under federal jurisdiction.

The major source of concern for Utah, in regard to water conveyance/flood management, is associated with levees and canals. Levees in the state are largely unevaluated and face evolving criteria to meet more stringent federal standards, following a series of levee crises on a national level. Canals face growing challenges from urban encroachment and an escalating transition of assets from canal companies to flood management for municipal entities. Potential canal safety hazards can be readily observed from a number of high profile failures in recent years, some resulting in fatalities.

As municipalities begin to utilize canals for flood management instead of agriculture, new challenges await in assessment and regulation. A focal point on the national stage is federal policy changes to the flood insurance program. The program will no longer subsidize flood insurance as result of escalating flood damage losses. This policy change will have a significant impact on residential and commercial insurance costs, as well as liability for public entities.

The significant number of canal miles (estimated between 5,300 to 8,000 miles) in Utah can largely be separated into two groups: urban and non-urban canals. Although the number of urban canals in the state represents the small minority of canal miles (roughly 400 miles), these canals pose the greatest financial and life-safety risks to the public. Other regions of the country, most notably California, have introduced evaluation programs for two risk groupings of levees and canals. Flood management infrastructure in urban corridors has received higher levels of investigation and assessment than reviews of non-urban levees. California has made levees a focus, because water demand and urbanization have dramatically increased the potential costs of failure, both in terms of water loss and what was once farmland, now urbanized, being converted into billions of dollars of infrastructure liability. A similar approach could be applied to canals in Utah by focusing on urban canals first and the remaining canals on a case-by-case basis.

DAMS

There are more than 900 dams in the State of Utah, 700 of which are on the National Inventory of Dams. While earthquakes and severe weather pose perennial threats to dams, Utah faces unique dam safety challenges in regards to the dam's ages, regional seismic risks near major population centers, and a continuing trend of urban growth near dam breach zones.

As dams approach the end of their design lives, the downstream demand and development increases- current low risk dams are gradually becoming high risk dams through urban encroachment. At the same time, as the risks associated with dam failures increase, their necessity becomes even more critical. The western region continues to receive pressure to provide stable water resources amidst challenges associated with drought and climatic changes. Neighboring states are undertaking ambitious and expansive efforts to meet future water demand through a renaissance in dam construction. There are more than 900 dams in this state of Utah with approximately 106 not currently rated or in need of rehabilitation to meet current standards. Of these 900 dams, 252 are considered high hazard (198 managed by the state with 54 under federal jurisdiction). Approximately 46% of high hazards dams meet current safety standards and are classified as being in satisfactory condition with another 43% being classified as in fair condition needing rehabilitation to meet current seismic and flood standards. Impressively 100% of the state regulated dams have emergency action plans in place.

The State of Utah Department of Water resources has been remarkably successful in improving the status and reliability of dam infrastructure, year after year, even in spite of an effective reduction in funding, as a result of no significant increases in funding to correspond with construction cost inflation. This lack of dam rehabilitation funding is a key consideration in the status of dam infrastructure, as the program is in need of additional support to complete work in progress and support additional dams transitioning to high hazard classification as a result of urban encroachment.

The Utah Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. These dams are assigned to one of three general classifications: high, moderate, and low. High hazard dams are classified as such because of their risk for possible loss of life in a failure event. Moderate hazard dams are associated with significant property loss in a breach event. Low hazard dams are expected to pose no significant property loss in a dam failure. Due to increasing water demands by municipalities and irrigation districts, dam construction continues at a steady pace with current replacement values estimated at over $1.5 billion. Approximately 46% of hazard dams meet current safety standards or are classified as being in fair to satisfactory condition. Another 43% are classified as being in fair condition, needing rehabilitation, primarily to comply with current seismic and flood standards. The assessment condition for high hazard dams regulated by the state is as follows:

- Satisfactory – 92 – meet current safety standards
- Fair – 85 – need upgrade to meet long-term design events
- Poor – 6 – Known deficiencies, need rehabilitation for short term design
- Unsatisfactory – 0
- Not Rated – 15 – Evaluation of condition assessment not complete

A key component of managing risk associated with Dams is an Emergency Action Plan (EAP). The EAP is a formal plan that identifies potential emergency conditions and provides a prescriptive procedure to minimize property damage and loss of life in a catastrophic event. Utah's Dam Safety Program has six full-time employees, with each overseeing more than 95 dams on average. In-spite of limited resources, 100% of state regulated dams have emergency action plans in place (197 of 198 of Utah's high-risk regulated and 156 out of 194 moderate hazard dams have EAP's. Low risk dams do not require EAPs. Utah's Dam Safety Program has an annual budget of $770,600. Due to budget reductions, the Program's budget for FY2013 has been reduced to $709,100.

The following is a summary of significant dam failures:

- Santa Clara Failure (September 2012). As a result of having an emergency action plan in place, downstream residents were evacuated with no injuries. Had no EAP been in place, this could have been a more disastrous failure. Estimated damages associated with the failure were $3.7 million.
- Quail Creek Dam (December 1988) failed due to extensive foundation seepage. The failure caused approximately $12 million in damage; fortunately no lives were lost.
- Trial Lake Dam (1986) failed from piping due to organics (roots, etc.) along the foundation. The Bureau of Reclamation rebuilt the dam and the Army Corps of Engineers mitigated the damaged river channel.
- DMAD Dam (1983) failed and a person was killed trying to cross the flooding river on a suspended wire. To reduce the risk of overtopping the Gunnison Bend Dam was proactively breached.
- Little Deer Creek dam (June 1963) failed on its first filling, due to extensive foundation seepage. The catastrophic failure resulted in Utah's first dam failure fatality, Bradley Galen Brown, a four-year-old boy.

Utah provides funding of approximately $3.8 million per year for dam rehabilitation projects. This program has been in effect for about 15 years. During that time, 33 dams have been rehabilitated to meet current safety standards. An additional six dams have been partially rehabilitated, but need another phase of rehabilitation to complete the work. 91 dams are in need of rehabilitation to meet current standards. As the condition assessment evaluations of the 15 not rated dams are completed, additional repair needs could be added to the list. Dam rehabilitation funding is in need of additional support to complete work in progress; no significant increases have occurred to compensate for inflation impacts on rehabilitation costs. (Are there any cost estimates available for identified needs? If so, consider adding to section.)

CANALS

It is estimated that there are between 5,300 to 8000 miles of canals in Utah, which exist without any regulatory programs. Most of these canals pre-date modern construction (over 100-years in age) and face continued pressure from urban encroachment, transitioning many of them into high risk assets. Canals are largely self-regulated by approximately 1,400 canal companies, which are operated with diminishing funding and resources as the densely populated portions of the state transition from agrarian to urban centers. There is virtually no public information available on canals, and very little is known about their condition, status, and/or potential risk. Canals face significant changes in management and ownership as urbanization causes them to evolve from water conveyance for canal districts to flood management conduits for municipalities. State and municipal risk exposure in the case of failure is relatively unknown in regards to legal precedent as this transition continues to occur.

During the 2010 legislative session, a law was passed (House Bill 60, House Bill 298 as well as Utah Code: 73-10-33), which required canal ownership to develop canal safety management plans. Through the legislative process the HB-60 was amended to require canal/irrigation districts to develop canal safety plans, but doesn't require submittal of them to the state, unless they receive state funding for improvements (i.e., most are not required to be submitted for public record). These management plans are required to be confirmed in existence to the state by summer of 2013. House Bill 290 was passed and requires that all canal companies have centerline of canal alignment mapped so that municipality development is set-back a minimum of 100-ft from canal runs. Further important legislative foresight and action includes House Bill 370, passed in 2014, that requires the state engineer to inventory and maintain a list of all open, human-made water conveyance systems in the state. In spite of these legislative actions, no significant state funding has been made available for state entities, water districts, or canal companies to develop plans and perform necessary assessments.

Canals face significant changes in management and ownership as urban encroachment causes them to evolve from water conveyance for canal districts to flood management conduits for municipalities. State and municipal risk exposure in the case of failure is relatively unknown in regards to legal precedent through this transition.

The following is a summary of significant recent canals failures:

- North Jordan Canal Failure - Murray (2013). The City participated in paying for some of the canal repairs.
- Mendon Canal Failure (Exact Year Unknown)
- Provo Canal Failure (Exact Year Unknown)
- Draper Irrigation Canal Failure (Early 2000's)
- Logan Northern Canal (Logan-Hyde Park) Canal Failure (July 2009): Three Dead with $1.25 million dollar settlement
- Davis/Weber Canal – the largest in state's history (July 1999 and April 2006)
- Vernal Canal Failure (Exact Year Unknown)

The largest impacts of canal hazards are at crossings, particularly if they were not constructed properly. As a minimum, all proposed crossings should be engineered, and existing crossings should be better evaluated for hazard impacts. A number of successful mitigation projects have occurred recently and include the Logan–Hyde Park Canal Inclusion and Provo Reservoir (Murdock) Canal Enclosure Project - roughly 20-25 miles of canal. The latter was the largest state funded project in history.

Rough estimates for canal evaluation costs are in the range of $1- to 1.5 million dollars for a full assessment of urban canals in the state. An observational study would be on the order of $500,000. Yearly maintenance is carried out by canal companies (or districts), with very limited state funding. Maintenance costs vary significantly from company to company. The Bureau of Reclamation recently completed a similar study of its urban canals across the west, in order to address many of the similar challenges facing the State of Utah. (Is there any annual O&M cost information available from the districts? If, so, please consider adding.)

Levees

FEMA estimates that 72 miles (assuming 51 miles are public, private, individual) of existing levees will require assessment in the immediate future within the State of Utah. After recent failures of flood protection systems, such as from Hurricane Katrina, an increased focus on levee evaluation is occurring around the country. Information regarding the condition of the majority of the levees across the state is largely unknown. Evaluation criteria for levees are still evolving at the federal level, with a potential for significant increases in flood protection requirements and insurance costs to home and property owners. Only limited information is known regarding the state of levees in Utah, with estimated evaluation/assessment costs on the order of $1 million. However, rapid assessments could be done for much less, depending on proximities to urban and non-urban infrastructure.

The Army Corps of Engineers is currently tracking roughly 21 miles of levees within the state of Utah as part of the National Levee Database and of these federally tracked levees. Of these levees 19½ miles are considered unacceptable and only 1½ are considered minimally acceptable. As recently as 2011, serious flooding has been observed as a result of inadequate levees in Weber County. A number of proposed improvements have been initiated as part of the Weber County Emergency Watershed Protection Project through a grant awarded through the NRCS Emergency Watershed Protection program to assist in flood management improvements.

As a result of historic flood recurrence and resultant increases in flood management demands from urban encroachment, financial losses and flood impacts are continually setting new records. Home and property owners are seeing the first-hand impacts of these risks through increased insurance premiums, changes in risk underwriting and in relief support from federal and local entities. Given the historical impacts of an extended wet cycle, as seen in the early 80s, another such period could be financially devastating to the State of Utah, as a result of continued development along and near flood management resources. Dams, levees, and canals form the backbone of flood management and conveyance throughout the state and their systemic performance is critical in ensuring Utah's water future.

WASTEWATER & STORMWATER

INTRODUCTION

Wastewater infrastructure is a term used to describe the entire wastewater treatment system. In general it includes the system of pipes and pumps that collects used water and carries it to a treatment facility, which is a combination of physical, chemical and biological processes to clean the water before release into the environment.

AGING INFRASTRUCTURE

Generally, the municipal wastewater treatment plants in Utah are meeting baseline technology limits, yet a growing number are at risk of slipping away from installed treatment capacity as their infrastructure ages beyond its expected useful life. Numerous treatment plants are approaching or have exceeded their expected 30-year useful and efficient operating life. In addition, there is significant deterioration of sewage collection systems that are 60-70 years old and beyond their expected useful life. There is an increasing trend in Utah of antiquated sewage collection and treatment systems. Wastewater agencies have not kept up with repair and replacement let alone accounting for changing regulations and population growth. Aging infrastructure has progressively translated into declining water quality.

STORMWATER

Water quality declines are often caused by nutrient loading from stormwater runoff. Urban stormwater is a major contributor to dissolved oxygen depletion in the lower Jordan River. Non-point source pollution related to agriculture has always been a source of water quality impairment and is only recently being addressed by regulators and legislators in a meaningful way. The control of stormwater is a necessary component of water quality protection.

The CWA also mandates pollution reduction to address stormwater discharges from construction sites as well as all urbanized municipalities. The Salt Lake City area is a major contributor of stormwater pollution and is facing the task of reducing nutrient and organic loading to the Jordan River from the local storm drains and streams that eventually enter the Great Salt Lake. The cost of stormwater

CLEAN WATER ACT

In 1972, Congress enacted the Clean Water Act (CWA) to protect the nation’s waters. For the past 40 years Utah has been required to comply with these mandates, and the result has been greatly improved water quality. A fundamental aspect of the CWA is the permit system for treatment facilities that are based on the best available technology and water quality based standards. Best available technology limits are established in Utah, but in general water quality based standards have lagged behind. There is now a push to establish criteria that would result in water quality based standards for the waters of the State. This process will then allocate the amount of pollutant reduction needed direct and non-point/stormwater discharges. The cost of facilities to meet new water quality based standards and current best available technology standards to reduce nutrient pollution will be costly.

compliance with CWA regulations is difficult to determine at this time; projections range from $3 to $25 per person.

CONDITION

Aging infrastructure is the unanimous top concern by utility managers around the country and in Utah as determined by a recent national survey. Within the category of aging infrastructure rehabilitation and replacement of buried assets represents the greatest concern. While Utah's pipelines are younger than in many other parts of the country, the severity of the problem is increasing and spending has not kept pace with the need. For generations the spending gap has continued to widen.

Although most of Utah's publicly owned treatment works (POTWs) are operating within hydraulic and treatment design capacities for current permit conditions they are aging and approaching functional obsolescence. In addition, the issue of nutrients being discharged has not been addressed and in most cases treatment plants will require costly improvements to remove nitrogen and thus will shortly lack functional adequacy. The 2010 Utah POTW Nutrient Removal Cost Impact Study provides clues to the functional adequacy of POTWs by way of the significant capital cost of meeting nutrient regulations. Capital costs to meet the strictest nutrient regulations are well over $1 billion on a statewide basis. Even a moderate level of nutrient reduction will cost hundreds of millions to implement. Utah is definitely "behind the curve" with respect to addressing the future of wastewater infrastructure.

CAPACITY

Many Utah wastewater facilities are in reasonable shape with respect to treatment capacity if nutrients regulations are excluded from the discussion. New capacity has recently been brought on-line in all the counties of the Wasatch Front. However, Salt Lake City, South Davis Sewer District, Provo City and Logan City are the exceptions and are facing between $500,000,000 to $1,000,000,000 in combined capital costs to meet nutrient limits and for repair and replacement to their treatment plants. The Logan City lagoon system, which has been ruled inadequate by the State, is facing $150,000,000 to convert its facility to a mechanical process that will treat nutrients. In some measure Logan City has avoided the issue they face by continuing to allow a leaky sewer collection system to send millions of gallons of groundwater into their plant that otherwise should not contribute to the size of the facility.

The Central Valley WRF, Salt Lake City, South Davis Sewer District, Provo City and others all have water treatments that will not remove nitrogen, and these facilities are approaching the end of their useful lives. These facilities alone contribute 30-40% of the wastewater generated in the State and represent a significant impact on the wastewater infrastructure needs.

Many smaller and rural communities such as Park City/Western Summit County, Cedar City and St. George have made investments to meet growth and address strict nutrient limits. The small lagoon systems in Utah can be said to operate on the edge without excess capacity for any growth and could not meet any measure of nutrient limits. These communities routinely ask for low cost loans and grants (if they can get them) from the State Water Quality Board to bail them out of situations created by lack of investment in their buried and treatment infrastructure.

OPERATION AND MAINTENANCE ISSUES

Operation and maintenance is and has long been a significant issue facing wastewater utility managers. Factors include the aging workforce, lack of skilled workers entering the marketplace, continuing regulations, disengaged consumers, and rates (set by "low first cost" minded government leaders) that do not reflect the actual full cost of wastewater service. Many older wastewater treatment systems were originally funded by federal grants, low interest rates, and state revolving fund money which all contribute to inadequate O & M. Sewer rates that were set at lower than actual cost when facilities were new, have over decades become inadequate and are now coming due. Rates now must increase significantly to accommodate the actual cost of service.

ENVIRONMENTAL AND SAFETY ISSUES

Issues that impact the environment and safety are emerging and have not been adequately addressed due to lack of permanent and adequate funding mechanisms. The exfiltration of wastewater from leaking sewers represents a new issue that is linked to drought conditions. Drought can cause groundwater levels to drop allowing wastewater to leak out of sewers (exfiltrate), degrading groundwater quality.

Also, there is a need to supplement drinking water supplies in arid climates and non-traditional sources of purified water including wastewater recycling are being considered. Wastewater as a source of water to augment drinking water supplies is not likely soon in Utah. First of all, Utah does not have a regulatory framework to facilitate such use. If such direct reuse of treated wastewater were to become a reality, it would be subject to strict regulation and rigorous public outreach and it would be very costly. There are major environmental impacts from untreated storm water, snowmelt in urban and mineral source settings and non-point pollution from agricultural and industrial sources. The cost of controlling pollutants from these sources is unknown but could be significant.

CONSTRUCTION ISSUES

Construction practices have improved over the life of the infrastructure that is in place. Tied to construction practices are design standards and the emphasis on compliance with engineering designs. Buried assets are the most vulnerable due to lack of understanding of impacts of corrosion, settlement over time, root encroachment, landslides and other geotechnical influences. What the above facts tell us is that much of our aging wastewater infrastructure should be scheduled for replacement sooner than later.

Treatment works have additional challenges in that wastewater being treated can be toxic, corrosive to concrete, metals, mechanical and electrical equipment and instruments. Additionally, wastewater vapors can combine with air and water to create chemicals such as hydrogen sulfide that act to corrode almost any of the facilities they come in contact with. As industry standards, knowledge and technology have improved over the years, these construction issues have been largely controlled. The aging facilities must be replaced with the latest and best value components and methods before critical facilities experience massive and catastrophic failure. Replacing the massive infrastructure investment with state-of-the-art construction materials, means and methods is essential to not only the well-being of our citizens but to the economic advantage that Utah desperately seeks and claims on the national stage; it must be accelerated.

CHANGING REGULATIONS

Utah has not fully kept pace with the intent of the Clean Water Act with respect to controlling harmful nutrients that affect water quality, health and quality of life. Although the Wasatch Front is a unique environmental setting (discharges mostly enter the highly managed Jordan River), some level of nutrient reduction from discharges into receiving waters is clearly demonstrated based on well-founded science as well as the mandates of national political and environmental realities. Implementing technology-based discharge limits to reduce nutrients is currently working its way through the regulatory and legislative process, based largely on pressure from EPA and third-party environmental agendas.

A proposed surcharge on wastewater treatment facilities to pay for reducing non-point source/stormwater pollution has been introduced into the regulatory process. The POTW community is supportive of the surcharge, however, some large water purveyors are not and the outcome is uncertain. The nutrient pollution coming from rural agricultural settings must be addressed, and methods of providing permanent funding for improvements must be put in place.

CHANGING FUTURE

Two of the future wastewater challenges that are emerging include pharmaceutical and personal care products (PPCPs) and water shortages. These challenges present opportunities that can be solved by creative thinking where a perceived problem can be turned into a viable resource. The high level of treatment needed to address PPCPs requires the same technologies that can create purified water to supplement secondary (non-potable) water supplies. More attention is needed to address the potential challenges and benefits.

Utility managers and trustees are now placing renewed emphasis on asset management and business analytics. New understanding by political and citizen decision makers on prioritizing expenditures offers hope for lower-cost (best value) solutions to treatment and water quality challenges. However, meeting future infrastructure needs can only be achieved through creative and committed partnerships at all levels of government, and by fully engaging the citizens that live and play in Utah. It is critical that the wastewater industry work closely with the public and legislature to develop permanent funding programs. If there is sufficient political will, we can make significant progress toward ensuring that the Utah wastewater infrastructure is brought to a level of service that is befitting of a State that recognizes the benefits of maintaining infrastructure systems that fully support a top tier economy and superior quality of life.

SOLID WASTE

SUMMARY

Waste management in Utah, is monitored and permitted based on the content and nature of the materials and by who generates the waste—industries or households. In 2012, Utah households generated about 2.34 million tons of solid waste, including 260,000 tons of recycling and compost (11%). This lags behind a national average of 37% waste generated that is recycled and composted. With a population of about 2.8 million people, that's 4.57 lbs of waste per person, and only 0.5 lbs/person/day is recycled. Utah per capita generation is above the national average (4.4 lbs/person/day), and below the national recycling rate (1.5 lbs/person/day)[1]. In 2012, there were 107 permitted solid waste landfills, 22 compost facilities, 4 incinerators receiving municipal, industrial and medical waste and 11 recycling facilities. Generally, disposal is relatively close and with the construction of transfer stations, accessible. Unfortunately, the State of Utah, Division of Solid and Hazardous has not published a Statewide Solid Waste Plan Update since 2007, and data represented in the plan is simply too dated to use to assess the state's solid waste management.

Type of Waste	National % generated	National% recycled[2]	UT 2010% generated[3]
Paper and paperboard	28	53	40
Yard trimmings and food waste	28	24	32
Plastics	13	3	12
Metals	9	9	6
Glass	5	4	3
Wood	6	3	7
Other	11	5	

Source: U.S. EPA and Utah DEQ, 2010.

2013 Non-Hazardous Solid Waste Disposal for Utah Regulated Facilities[4]

Landfill Facilities	Municipal Tons	Industrial Tons	C/D Tons	Total Tons	Recycling Tons	Number
Class I Facilities (>20T/day)	1,507,247	39,617	90,338	1,637,203	19,698	21
Class II Facilities (<20T/day)	24,904	3,601	13,259	41,765	425	10
Class III Facilities (industrial)		746,577		746,577	6,995	26
Class IV Facilities (C & D)			200,001	200,001	5,885	31

Class V Facilities (private)	548,905	498,485	1,798	1,049,187	0	11
Class VI Facilities (private C & D)			439,895	439,895	4,996	8
TOTALS	2,081,057	1,288,280	745,291	4,114,627	38,616	107
Other Facilities	**Municipal Tons**	**Industrial Tons**	**Other**	**Total Tons**	**Recycling Tons**	**Number**
Incinerator	124,121	18,541	6,765		0	4
Land Spreading				45,500		6
Recycling				89,900		11
Transfer Stations	1,067,900	17,100	136,300		101,100	17

CAPACITY

Utah has over 100 permitted landfills and capacity for future expansion at most of the facilities. It is estimated that 4 landfills are land limited, and this is less than 5% of the total number of landfills, resulting in a high score for capacity. Relatively low tipping fees, do not encourage recycling and low recycling (including composting) resulted in below average score for recycling or municipal solid waste (MSW) diversion. In the 2007 Utah Solid Waste Plan, it was specifically noted that the higher solid waste generation number and lower recycling rates in Utah maybe an area to focus on in the future.

INNOVATION

It is estimated that to divert 297,000 tons per year of targeted organics need initial capital investment of $5.7 million and to maximize processing of recyclables require ongoing investment of $2.9 million per year. Utah has recently passed legislation for public education related to e-waste recycling and initiated a mercury switch removal program. Utah is one of 38 states with landfill bans for whole waste tires and recycled over 2 million tires during 2013 at 5 facilities; however, no existing tire piles were cleaned up during the same time frame.

FUTURE

Resilience is defined as the ability of the industry to provide services in the case of infrastructure catastrophes. The key attributes reviewed are safety, sustainability and operational certainty during natural disasters and resulting disaster management. With regard to solid waste in Utah, with the number and access of disposal facilities, Utah's resilience was considered sufficient.

HAZARDOUS WASTE

SUMMARY

Hazardous waste management in Utah is monitored and permitted based on the content and nature of the materials and by who generates the waste—large and small waste generating industries or households. The Division has published a statewide Hazardous waste Generation and Management Report for 2011 that was utilized to compare with national EPA data.

Utah Division of Solid and Hazardous Waste reports that waste generation in Utah is cyclical, often related to local and national economic cycles. Demand for management facilities is trending downward due to completion of historic waste sites, improvement in manufacturing, product substitution and an increase in recycling of waste products. With the large number of facilities in Utah and the downward trending of generation numbers, the score for RCRA waste generation and management is given an above average score.

GENERATION

Utah Resource Conservation and Recovery Act (RCRA) regulated facilities are trending downward in the amount of waste being generated. In the reporting year 2011-2012, Utah solid and hazardous waste reported a decrease of about 18% of waste generated. This is a continued trend, since 2007 there has been a decrease of over 35,000 tons. The top 3 regulated industries produce 74% of the waste and are classified as national security and international affairs, iron and steel mills and waste treatment and disposal. In 2011 Utah ranked 33rd in the nation in the quantity of waste generated, Utah generates about 1% of the total waste nationally. Utah also ranks 33rd in the number of regulated waste generators.

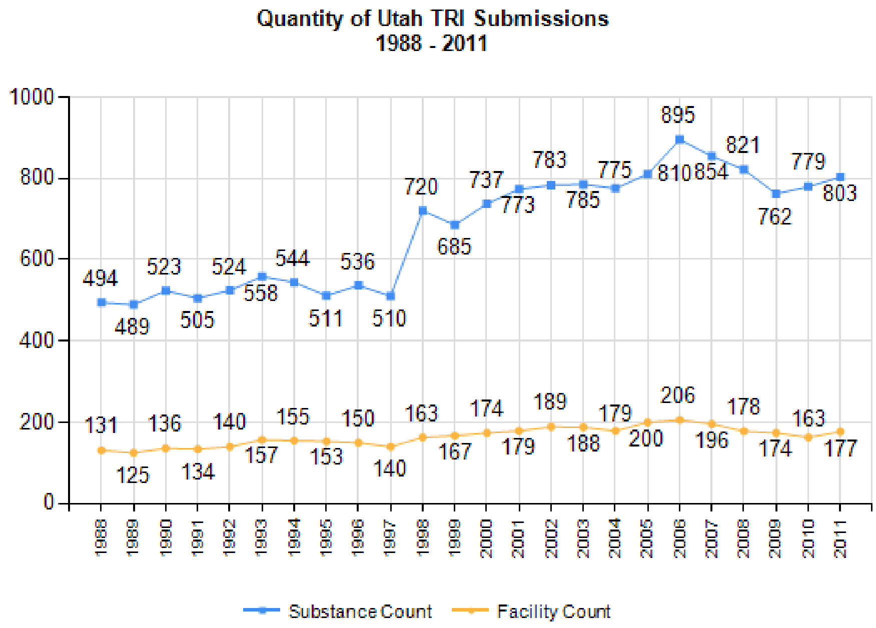
MANAGEMENT

Utah manages RCRA generated waste with 55% going to landfill/impound facilities; 43% going to incinerators and 2% to other facilities. There are 15 permitted hazardous waste facilities in the state. The State of Utah ranks 27th in the nation, in the amount of waste that is managed in the state, with about 46 % of the waste managed in Utah imported from other states.

Toxic releases to the environment are regulated and reported through the Toxic Release Inventory under the Community Right-to-Know Act and the State Emergency Response Commission. The reported data may include only a relatively small portion of all chemical releases of significance and is reported and published annually by the State Division of Environmental Response and Remediaton6. For the reporting year ending in July 2012, Utah reported 177 facilities filed 803 chemical submissions. Of the facilities reporting, about 70% are located in Weber, Davis, Salt Lake and Utah counties, collectively referred to as the Wasatch Front. Reported releases have increased over the three years.

	2011, Million pounds	2010, Million pounds	2009, Million pounds
Air	11.45	8.5	6.9
Land	183 M	165	161.
Water	0.492	0.102	0.101
TOTAL	**194**	**173**	**168**

The figure below, from the 2011 TRI report, shows an increasing trend in facility and chemical submission counts over the past 23 years. Utah's population increased from an estimated 1.7 million to 2.8 million over the same time period.



There are 13 active sites in Utah on the superfund National Priorities List (NPL) and managed under the State Division of Emergency Response and Remediation. The NPL identifies sites that have known releases of hazardous substances or pollutants and allows EPA to prioritize sites that may warrant further investigation or cleanup activities. There are 3 new sites proposed for the NPL due to historic mining operations, and there are 5 sites deleted from the NPL. Five active sites are federal facilities.[7] Utah has no sites with unfunded new construction for 2012.

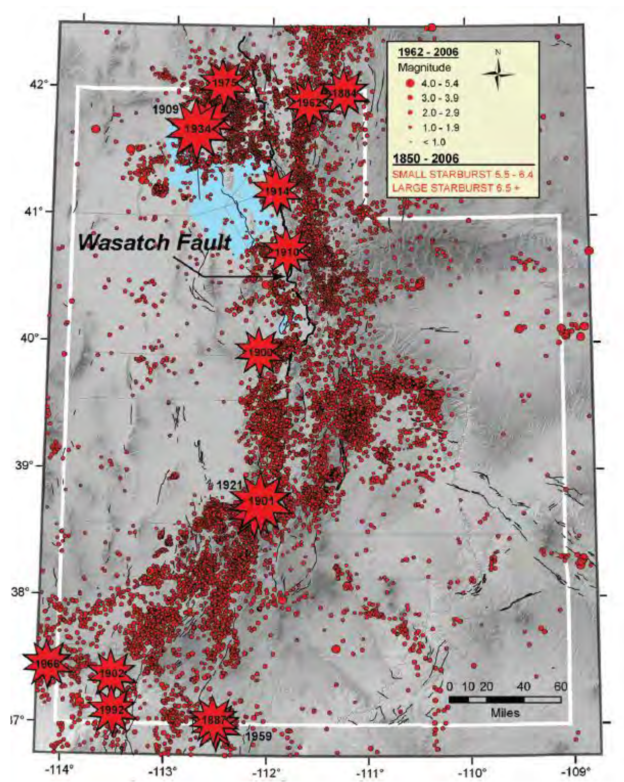
Under Utah Voluntary Cleanup (VCP) and Brownfields Program, 79 sites are identified; of which 41 sites have certificate of completion representing a completed response action. 13 sites have planned or completed response actions for 2012/2013.

PLANNING TO REBOUND:

EARTHQUAKE HAZARDS ALONG THE WASATCH FAULT

ABOUT EARTHQUAKES AND UTAH

The State of Utah is a part of the Intermountain Seismic Belt (ISB), which is a zone of pronounced seismicity, up to 120 miles wide and 800 miles long and one of the most seismically active areas in the interior western U.S. The ISB extends from Arizona, through Utah and Idaho, and into northwest Montana. The Wasatch Fault is one of the longest and most active normal faults in the world. The Wasatch Front region experiences approximately 700 earthquakes each year, however, many of these temblors are less than 3.0 on the Richter Magnitude scale and are not felt. Geologic studies show that on average, a magnitude 6.5 to 7.5 earthquake occurs somewhere along the central (most active) part of the Wasatch fault about every 250 to 300 years. When other active faults and fault segments in Utah are added in, the frequency of major potentially devastating earthquakes in the state is probably at least twice this rate. The last devastating earthquake the Utah Geological Survey has been able to document occurred about 300 years ago on the Nephi segment of the Wasatch fault. Utah is seismically active – damaging earthquakes have occurred in the past, and will occur again in the future. Since pioneer settlement in 1847, Utah has experienced 16 damaging earthquakes greater than magnitude 5.5. Furthermore, geologic studies show that Utah has more than 200 active faults that have the potential to generate even larger, magnitude 6.5 to 7.5 earthquakes (30 to 1000 times larger).



Fault Location, Surface Fault Rupture, and Tectonic Subsidence (Putting Down Roots in Earthquake Country 2008)

The Wasatch front is particularly susceptible to seismic hazards because of local geologic conditions (e.g., soft lake deposits), areas of shallow ground water subject to liquefaction, and the Great Salt Lake, Utah Lake, and high mountain reservoirs up narrow canyons from major population centers. Additionally, more than 80% of Utah's population is located in earthquake prone zones. Although Utah has historically been a leader in establishing and following modern building codes, seismic risks were not widely understood in Utah until the mid-1970's. It is estimated that roughly 185,000 buildings along the front are particularly susceptible to significant failure or collapse given their historic construction in unreinforced masonry (e.g., brick) (FEMA 2012). The greatest earthquake hazard in Utah is found along the Wasatch Front where population centers are localized. It is believed that the maximum size earthquake capable of being generated by Utah faults is magnitude 7.5.

The figure above provides an overview of the recorded earthquake events in the State of Utah since a seismic network was established up to 2006.

The Wasatch Fault is roughly 240 miles long, extending from Malad City, Idaho to Fayette, Utah. The fault represents a major geologic break where the mountain block, to the east, is rising relative to the valley floors. The fault is broken into ten segments, each about 25 miles in length, which likely behave independently. These segments are named after the major metropolitan areas they intersect (e.g., Brigham City Segment, Weber Segment, Salt Lake City Segment, Provo Segment, etc.). The fault traverses through broad swaths of residential housing, commercial developments, transportation networks, and critical lifelines (e.g., water, gas, oil, power, and medical care facilities).

Large earthquakes produce significant movement and displacement, which may propagate to the surface. These displacements and ruptures are particularly devastating to buried utilities. Significant sections of the fault have been traced across communities throughout the Wasatch Front with mapped vertical displacements from past earthquakes from one side of the fault to another of between 3 to 10-ft. However, vertical displacements at the surface along the fault for individual earthquakes can range up to about 20-ft (Utah Natural Hazards Handbook 2008).

Map showing the Wasatch Fault (red line) and other identified faults (black lines), which may are capable of generating large earthquake events (Putting Down Roots in Earthquake Country 2008).)

Fault displacement and rupture are particularly problematic for critical buried utilities, which create hazards in two forms 1) incidental release (e.g., toxic chemicals and fire) and 2) severing critical infrastructure and separate communities from invaluable resources, such as water, needed for immediate care and recovery.

Although fault segments represent the most significant hazard to adjacent housing and infrastructure, the impacts of the earthquake will be felt regionally through associated seismic hazards.

GROUND SHAKING

Earthquake induced strong ground shaking is considered to be the greatest seismic hazard for it's far-reaching impact beyond the fault zones. Ground shaking is the result of seismic waves generated by a fault rupture in the subsurface. The lateral or horizontal component of the waves is primarily responsible for damage to structures as older infrastructure was designed to primarily resist downward vertical loads. Intense ground shaking has a pronounced influence on inadequate or unreinforced structures that pre-date modern building codes; this impact varies largely based on local geologic conditions. Shaking can lead to partial failure or total collapse and is a leading contributor to serious injury or death during an earthquake.

SUBSIDENCE: SOIL LIQUEFACTION, LATERAL SPREAD AND SENSITIVE CLAYS

The phenomenon of soil liquefaction occurs when saturated sandy soils are subjected to strong shaking, inducing high pore water pressure, and causing the soils to behave similar to a liquid; effectively acting like quicksand. The transition to the liquid condition can cause significant losses of strength in foundations, embankments and slopes leading to failure. Significant settlements, from a few inches to a few feet, are associated with liquefaction as loose particles re-orient from seismic displacement. Lightweight, buoyant structures (e.g., buried storage tanks, sewer/water basins and pipes) may rise to the ground surface in areas of significant liquefaction. Many below ground structures are permanently displaced and this movement can lead to breaking of utilities over extensive lengths. Additionally, the settlement of the ground may lead to groundwater displacement, flooding into new low-lying areas, and overtopping of settled dams, levees, and canals.

Lateral spreading is largely related to the effects of liquefaction along relatively flat grades, gradual slopes, or free faces such as vertical faces of steep banks. Surficial soil layers above liquefied zones move laterally and break into sections during sliding. Significant displacements lead to cracking and rupture of the ground surface. The movement associated with lateral spreading may pull apart buildings, roads, pipelines, and utilities over extensive distances.

Similar to liquefaction, soft fine-grained deposits, such as Lake Bonneville deposits, are susceptible to collapse when disturbed by vibration. Significant strength loss, leading to potential failures, have been observed and documented in zones of disturbed fine-grained materials. These fine-grained Lake Bonneville deposits are found in the valley basins and are distributed along the Wasatch Front.

LANDSLIDES, ROCK FALLS, AND EARTHQUAKE TRIGGERED AVALANCHES

Landslides, rock falls and avalanches can all be induced by earthquakes. Landslides and rock falls may occur over a wide area in earthquakes larger than magnitude 6.0, but are typically within only a few miles of the earthquake source in small earthquakes (magnitude 4.0 to 5.0). Rock falls create significant hazards and may occur at distances from 50 (magnitude 6.0 earthquake) to 175 miles (magnitude 7.5) away from the earthquake epicenter (Hazards Handbook 2008).

FLOODING – TECTONIC SUBSIDENCE/TILTING, SEICHES, DAM, CANAL AND LEVEE FAILURES

Surface faulting along the Wasatch Front may result in dropping and tilting of the valley floor as the mountain benches separate from eastern valley edges. Translation of the valley floor could possibly result in the Great Salt Lake and Utah Lake shifting eastward and permanently flooding low-lying shoreline areas in Utah, Salt Lake, Weber, and Box Elder counties. Flooding may also take place as ground subsidence occurs, lowering the ground surface below the shallow valley water tables. The distribution of water storage and transport structures (pipelines, canals, etc.) from high mountain elevations to the valleys creates a significant hazard for flooding, mudslides, and potable water disruption. Failure of water structures will cause floodwater to surge down mountain canyons to valleys, exceeding flood control capacities and creating devastation, in both loss of life and property.

EARTHQUAKE RISK AND ESTIMATED LOSSES

Earthquake risk relates probability of occurrence to losses, both in terms of life and costs. The financial liabilities associated with earthquake damage can be catastrophic for communities. The damage in housing and critical infrastructure creates an immediate challenge, however, long-term loss of jobs and general infrastructure create financial liabilities that can last decades.

The Federal Emergency Management Agency (FEMA) uses the HAZUS-MH methodology and software program with GIS data to estimate potential losses associated with earthquakes, hurricanes, and floods. In conjunction with the successful Great Utah ShakeOut earthquake awareness program, results for major seismic events are provided to estimate approximate costs, severe casualties, and displaced households. A summary of earthquake hazard costs and loses associated with segmental earthquake events by geographic region can be seen at “The Great Utah Shakeout” website, and here are the damage estimates

DAMAGE ESTIMATES FOR THE CORE METRO AREA EVENTS IN UTAH (IN BILLIONS OF DOLLARS)				
Seismic Event Location	**Ogden Earthquake Scenario**	**Salt Lake City Segment**	**Provo Segment**	**Washington Earthquake**
Event Magnitude	**6.5**	**7.0**	**7.2**	**65**
Total Estimated Losses - Transportation & Utilities	**$66.6**	**$33.3**	**$69.9**	**$55.8**

Source: www.shakeout.org/utah

The HAZUS-MH summaries provide these costs, casualties, and household displacement relative to key infrastructure, such as Transportation System Lifelines, Utility System Lifelines, and Building Related Economic Losses. The following areas are of particular concern in regards to potential losses:

- **Utah Schools** – in a seismic event schools will provide shelter to one of the most vulnerable demographics, children. Schools that meet seismic code requirements will provide shelter and community support in earthquake recovery as well as significantly reducing demands on emergency response teams.
- **Critical Utility Pipelines** – Salt Lake is a central hub for pipelines across the west and contains a wide variety of hazardous chemicals. Recently constructed pipelines are designed in accordance with modern practices and should fair well, however, older lines could create serious hazards. Critical pipelines will demand resources for repair to reduce chemical releases, fire hazards, restore heat during a winter event, and provide potable water. These critical pipelines often cross multiple faults between source and final destination, which could require miles of repair. A single break along a major line, such as a municipal aqueduct, could disrupt supply for the majority of the state.

- **Unreinforced masonry (mostly brick) buildings (commercial/residential)** – Traditional building design practices for more than 100 years provided minimal response to seismic demands. Over time, the portfolio of older unreinforced brick building liabilities is reduced as buildings are replaced or retrofitted. However, geographic concentrations of unreinforced masonry buildings (mostly older brick homes) will create catastrophic damage in large sections of cities that will be liabilities for emergency response and re-construction due to a lack of earthquake insurance.

Competitive demands for funding and an apparently never ending need of financing for mitigation/replacement of infrastructure create notable challenges on where to focus valuable resources. Numerous organizations such as Utah Seismic Safety Council (USSC), Structural Engineers Association of Utah (SEAU), American Society of Civil Engineers (ASCE), Utah Liquefaction Advisory Group (ULAG), Earthquake Engineering Research Institute (EERI), Utah Geologic Association (UGA), American Public Works Association (APWA), and Association of Environmental and Engineering Geologists (AEG) can be utilized as resources to develop and prioritize funding mechanisms across a broad range of infrastructure.

PLANNING FOR THE FUTURE:

A COORDINATED INFRASTRUCTURE MASTER PLANNING PROCESS

The Utah's Dam Safety Program and the Unified Transportation Plan have utilized an approach of comprehensive evaluation, estimation of risk-based needs, and overview by an authority composed of diverse interests. These same qualities would be very effective for an Infrastructure Planning Process in selecting the best coordinated courses of action – and expenditure – thereby maximizing the benefits to Utah's citizens.

Further, an Infrastructure Master Planning Process would analyze and prepare for serious natural challenges and threats, such as major earthquake events and climate changes – especially as these changes affect precipitation events and temperatures. It is not possible to predict the duration or possible increase of challenging climate conditions like drought or seismic events like earthquakes, but we know they unequivocally will affect our infrastructure. Thus, they too must be addressed in a realistic Infrastructure Master Plan as part of developing resilient communities and lifeline systems.

STRUCTURE

The major elements of a Coordinated Infrastructure Master Plan would, first of all, consider the full range of infrastructure elements including:

1. Water – Storage, Transmission and Distribution
2. Highways, Roads and Bridges (state and local)
3. Wastewater – Collection, Treatment, and Reclamation, Reuse and Disposal
4. Storm Water Management and Quality Control
5. Solid and Hazardous Waste
6. Transit – Its Role in Urban Transportation, and Equitable Funding
7. Dams, Canals and Levees – Systematic Monitoring, Maintenance and Funding

TEAM

Because of the complex nature of the set of infrastructure problems and solutions, it will be imperative that the conduct of the Infrastructure Planning Project be assigned to a multi-disciplined group of technical specialists. Given the variety of subjects, this group should include the following:

- Civil Engineers
- Geotechnical Engineers, Geologists, and Seismologists
- Professional Planners, e.g. Land Use
- Resilience Professionals, e.g. Natural Hazards Specialists, seismologists geologists
- Fiscal/Financial Planners, including Accountants
- Lawyers and Governance Experts
- Legislative Professionals
- Those with Broad Municipal Experience
- Demographers with Utah experience
- Experienced Public Information/Public Relations Personnel

Moreover, the Management Group for this endeavor must have had experience in directing complex and comprehensive efforts. We anticipate that an essentially unlimited number of issues will surface during the conduct of the process. In fact, such should be encouraged so that the results are truly comprehensive and address our key infrastructure challenges for the coming decades in a vastly more populated and crowded Utah.

Regarding governance, we recommend a State-Level Commission, including representatives of:

- The Utah State Legislature
- The Governor's Office/State Agencies
- The Utah League of Cities and Towns
- The Utah Association of Counties
- Major Infrastructure Organizations
- The State's Chambers of Commerce
- Area-Wide Planning Agencies, such as The Wasatch Front Council of Governments
- American Society of Civil Engineers
- Experienced Non-Profit Comprehensive Planning Organizations, e.g., Envision Utah
- Citizen Groups

OUTPUTS

The major output from the Infrastructure Planning Process would be the development of a matrix of infrastructure needs for the next 20 year period, with special focus on the next five years, including:

1. Necessary Repairs, Renovations and Replacements
2. Systems Expansions to meet Growth Requirements
3. The resultant Infrastructure Master Plan should maximize the use of existing Local Infrastructure Master Plans. Further, it should:
4. Provide for financial assistance to smaller communities that may lack technical expertise or adequate financial reserves
5. Emphasize coordination between same-service agencies that exist within the same general geographic area.

Among the most difficult, yet absolutely necessary, results of the Infrastructure Master Plan should be a definition of appropriate operational financing alternatives for the future, including:

1. Direct user fees
2. Broad-based funding, such as property or consumption taxes
3. Legislative designations, such as sales tax percentages

TIME FRAMEWORK

Time is a valuable asset, so expeditious conduct and completion of the Infrastructure Planning Project is highly desirable. However, given the critical nature of this endeavor, sufficient time must be allowed so that creditable and equitable results are obtained. A reasonable time may be 30 months from start to finish with definitive progress reports issued at 6-month intervals, and a detailed Annual Report, so that information can be shared and all infrastructure groups can be addressed adequately, and so that equitable response time is allotted to address individual/organizational concerns.

METHODOLOGY

Using an easily understood school report card format, each of the 10 categories of infrastructure covered in the Report Card were assessed using rigorous grading criteria and the most recent aggregate data sources to provide a comprehensive assessment of Utah's infrastructure assets.

GRADING SCALE

To develop the Report Card grades, a quantitative and qualitative approach to each of the eight fundamental criteria is used to arrive at each of the 10 category grades. These grades are averaged to create a grade point average (G.P.A.) for Utah's infrastructure overall.

A **EXCEPTIONAL: FIT FOR THE FUTURE**
The infrastructure in the system or network is generally in excellent condition, typically new or recently rehabilitated, and meets capacity needs for the future. A few elements show signs of general deterioration that require attention. Facilities meet modern standards for functionality and resilient to withstand most disasters and severe weather events.

B **GOOD: ADEQUATE FOR NOW**
The infrastructure in the system or network is in good to excellent condition; some elements show signs of general deterioration that require attention. A few elements exhibit significant deficiencies. Safe and reliable with minimal capacity issues and minimal risk.

C **MEDIOCRE: REQUIRES ATTENTION**
The infrastructure in the system or network is in fair to good condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies in conditions and functionality, with increasing vulnerability to risk.

D **POOR: AT RISK**
The infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of significant concern with strong risk of failure.

F **FAILING/CRITICAL: UNFIT FOR PURPOSE**
The infrastructure in the system is in unacceptable condition with widespread advanced signs of deterioration. Many of the components of the system exhibit signs of imminent failure.

GRADING CRITERIA

ASCE's grades are assigned according to the following eight key criteria:

- **Capacity** – Evaluate the infrastructure's capacity to meet current and future demands.
- **Condition** – Evaluate the infrastructure's existing or near future physical condition.
- **Funding** – Evaluate the current level of funding (from all levels of government) for the infrastructure category and compare it to the estimated funding need.
- **Future Need** – Evaluate the cost to improve the infrastructure and determine if future funding prospects will be able to meet the need.

- **Operation and Maintenance** – Evaluate the owners' ability to operate and maintain the infrastructure properly and determine that the infrastructure is in compliance with government regulations.
- **Public Safety** – Evaluate to what extent the public's safety is jeopardized by the condition of the infrastructure and what the consequences of failure may be.
- **Resilience** – Evaluate the infrastructure system's capability to prevent or protect against significant multihazard threats and incidents and the ability to expeditiously recover and reconstitute critical services with minimum damage to public safety and health, the economy, and national security.
- **Innovation** – Evaluate the implementation and strategic use of innovative techniques and delivery methods.

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