REPORT CARD FOR ARIZONA INFRASTRUCTURE

2020

Arizona Section of the American Society of Civil Engineers

INFRASTRUCTUREREPORTCARD.ORG/ARIZONA

ASCE

AMERICAN SOCIETY OF CIVIL ENGINEERS

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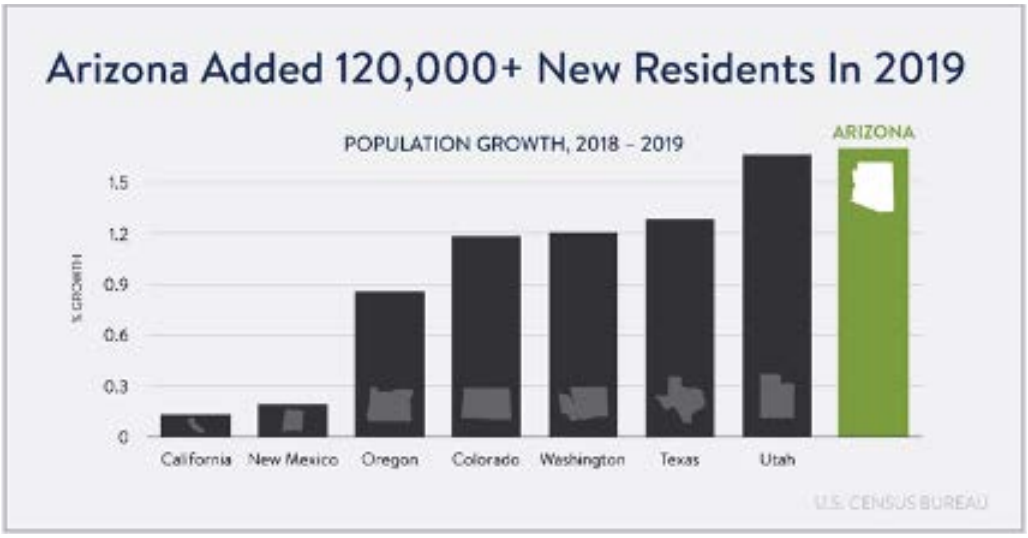
EXECUTIVE SUMMARY

Arizona's population reached 7.28 million on July 2019 and ranked third in percentage growth rate according to the US Census Bureau. Every day, Arizonans enjoy the **essential services** that infrastructure provides. These services include safe drinking water, wastewater treatment, uninterrupted utilities, reliable roads and bridges, international airports, and much more. Can you imagine living without any of these? Civil engineers focus on making sure that the people in Arizona can count on these essential services. **Infrastructure** does not only support our booming population, but also supports the tourism, goods and services that come through our state which generate **jobs** and **economic prosperity**. But just like owning a car, all infrastructure deteriorates with time and can fail prematurely without the proper maintenance. Citizens of Arizona benefit from an objective review undertaken by dozens of experts in their respective fields, just as you would take your car to a mechanic.



In 2020, local engineers with the Arizona Section of the American Society of Civil Engineers (ASCE) conducted an extensive evaluation of Arizona's infrastructure, based on publicly available databases, analysis, conversations with state and local agencies, and the 2015 Report Card as a baseline. The 2020 Arizona Infrastructure Report Card represents the second evaluation performed by the Arizona Section of ASCE and focuses on 9 categories of infrastructure; aviation, bridges, dams, drinking water, levees, rail, roads, transit and wastewater. The overall GPA for Arizona's infrastructure is a C. While some areas saw improvements, some areas saw a decline which resulted in a similar grade from 2015. This examination demonstrates that there is a **funding gap** and provides recommendations to raise the grade in each category. A strong and sustainable infrastructure is vital to the **continued growth**, **public safety**, and **quality of life**.

There is a funding gap in various sectors of infrastructure and a great example is Arizona's 1991 gas tax. Arizona hasn't raised its gas and diesel taxes in almost 30 years. This means our state's Department of Transportation is relying on a stagnant source of revenue, a challenge akin to asking someone to live off their 1993 salary in 2020. This gas tax did not account for inflation, fuel efficient cars and electric vehicles which diminishes the impact it can have on our roads today. The state and local municipalities alike have stretched limited infrastructure dollars as far as they can in maintaining and expanding their assets. Meanwhile, our population is growing, and our existing assets are aging. Immediate action is needed to maintain Arizonans' quality of life, keep our state economically competitive, and prepare us for the future.

REPORT CARD FOR ARIZONA INFRASTRUCTURE 2020

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REPORT CARD FOR ARIZONA INFRASTRUCTURE 2020

ABOUT THE INFRASTRUCTURE REPORT CARD

GRADING CRITERIA

ASCE-AZ's 2020 Report Card Committee is a group of dedicated civil and environmental engineers from Arizona, who volunteered their time to collect and analyze data, prepare, review, and revise each section, and develop the final Report Card. The committee worked with ASCE's Committee on America's Infrastructure and ASCE Infrastructure Initiative staff to provide Arizona with a snapshot of the state of our infrastructure, as it relates to us at home, and on a national basis.

The Report Card Sections are analyzed based on the following eight criteria:

CAPACITY Does the infrastructure's capacity meet current and future demands?

CONDITION What is the infrastructure's existing and near-future physical condition?

FUNDING What is the current level of funding from all levels of government for the infrastructure category as compared to the estimated funding need?

FUTURE NEED What is the cost to improve the infrastructure? Will future funding prospects address the need?

OPERATION AND MAINTENANCE What is the owners' ability to operate and maintain the infrastructure properly? Is the infrastructure in compliance with government regulations?

PUBLIC SAFETY To what extent is the public's safety jeopardized by the condition of the infrastructure and what could be the consequences of failure?

RESILIENCE What is the infrastructure system's capability to prevent or protect against significant multi-hazard threats and incidents? How able is it to quickly recover and reconstitute critical services with minimum consequences for public safety and health, the economy, and national security?

INNOVATION What new and innovative techniques, materials, technologies, and delivery methods are being implemented to improve the infrastructure?

REPORT CARD FOR ARIZONA INFRASTRUCTURE 2020

GRADING SCALE

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 are 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.

REPORT CARD FOR ARIZONA INFRASTRUCTURE 2020

COMPARISON OF **2015** AND **2020 GRADES**

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Category	**2015 Grade**	**2020 Grade**	**2017 National Grade**
Aviation	B-	B	D
Bridges	B	B+	C+
Dam	C-	C-	D
Drinking Water	C-	C-	D
Levees	C-	C-	D
Rail	C+	C	B
Roads	D+	D+	D
Transit	C+	C	D-
Wastewater	C	C-	D+

REPORT CARD FOR ARIZONA INFRASTRUCTURE 2020

2020 REPORT CARD FOR ARIZONA'S INFRASTRUCTURE

AVIATION	B
BRIDGES	B+
DAMS	C-
DRINKING WATER	C-
LEVEES	C-
RAIL	C
ROADS	D+
TRANSIT	C
WASTEWATER	C-
GPA	C

REPORT CARD FOR ARIZONA INFRASTRUCTURE 2020

SOLUTIONS TO RAISE THE GRADE

To raise Arizona's infrastructure grade, ASCE developed the following four recommendations:

1. Infrastructure is interconnected with all aspects of life in Arizona and should accommodate a growing population, enable transparent economic development, promote safe and healthy communities, and build resilience. As such, we need to develop a comprehensive, statewide asset database and an examination rubric to establish infrastructure priorities and improve coordination of asset management across all levels of agencies.

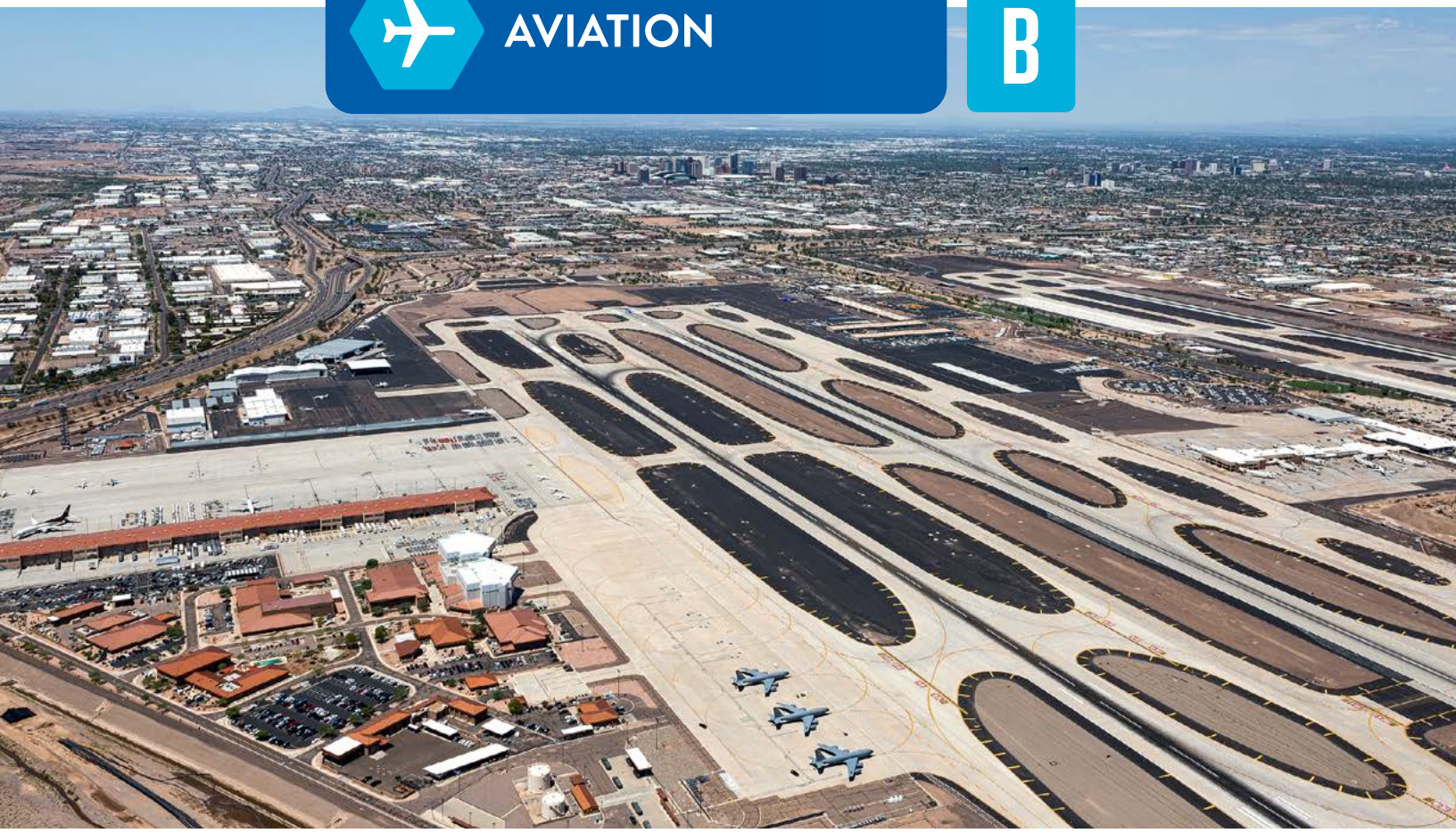
2. The current state gas tax does not keep pace with inflation and meet the needs of a growing population. Assert greater economic independence from federal funding sources through implementing additional measures such as a vehicle miles traveled charge or user fee for electric cars. Tax structures must be adjusted to keep pace with inflation and the needs of a growing population.

3. Expand public education outreach and involvement in AZ infrastructure planning to meet community priorities and identify infrastructure weaknesses. Develop outreach to highlight the current funding gap and the negative impacts experienced by Arizonans due to a lack of funding support.

4. Arizona cities are growing faster than the national average and infrastructure must responsibly accommodate that growth. Arizona engineers, lawmakers and local leaders should to accommodate Arizona's rapid growth, we must incorporate sustainability principles to mitigate irreversible impacts to the quality of life for Arizonans and the natural environment.

AVIATION

B



AVIATION
GRADE: B

EXECUTIVE SUMMARY

Aviation in Arizona is a significant economic catalyst and employs about 17% of all jobs within the state. Major investments have been made to Arizona's three largest airports, including a $700 million sky train extension and a 20-year, $38 billion Comprehensive Asset Management Plan at Phoenix Sky Harbor International Airport (PSHIA). Additional improvements include runway re-pavement and terminal renovation and expansion at Tucson International Airport and a project to improve cargo inspection at Phoenix-Mesa Gateway Airport. Between 2008 to 2018, the percentage of airports having a runway pavement condition index of 70 or better (out of 100) increased from 54% to 64%. These gains in the maintenance of the airport pavements have been made thanks to the Arizona Pavement Preservation Program (APPP) and despite an annual shortfall of approximately $284 million.

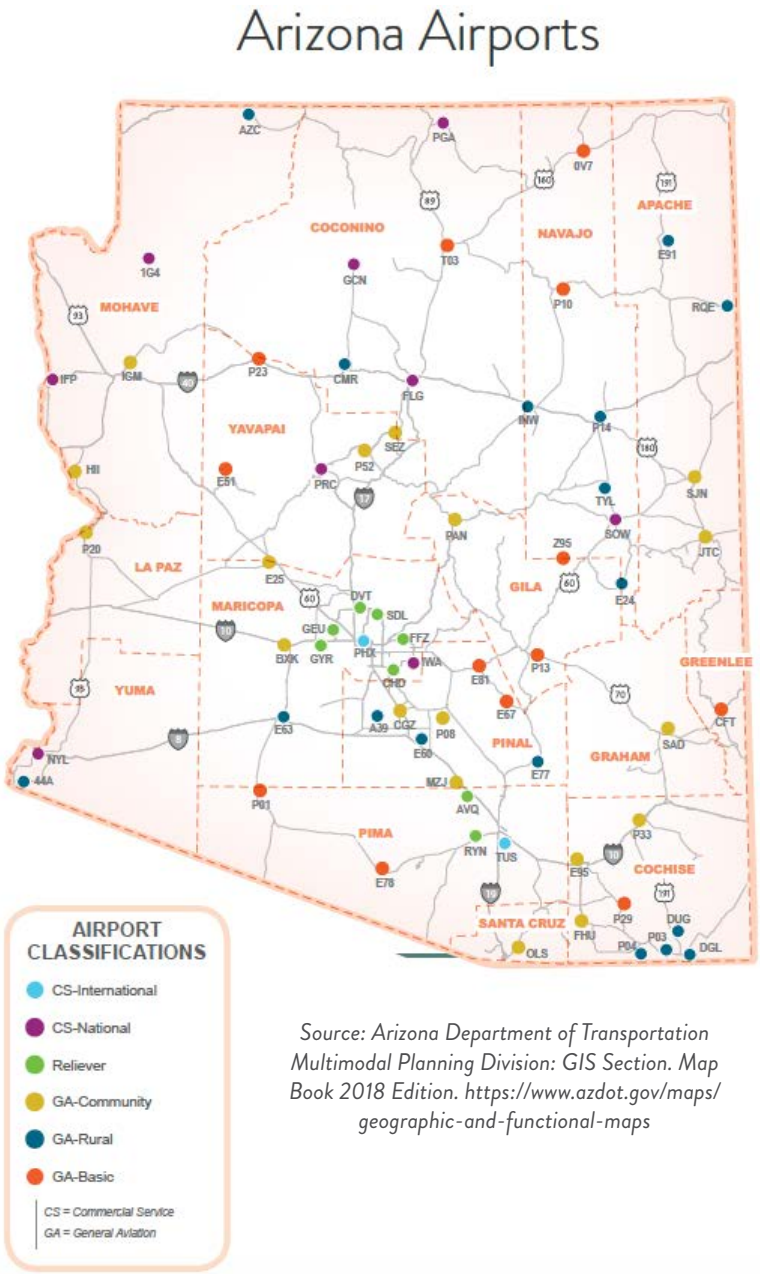
INTRODUCTION

Arizona's aviation system provides safe and effective movement of people, goods and services throughout the state connecting them to the rest of the country and the world. An efficient and well-maintained airport system is critical to the economic growth of the state. Approximately 395,000 jobs are directly or indirectly related to the aviation industry, contributing to approximately 7.6% of the state's gross domestic product. The system enhances the quality of life of Arizona's residents by accommodating business, recreational travel, health, welfare, and safety related services such as aerial firefighting activities, search and rescue missions, medical patient transport, and news reporting.

CAPACITY

The state's system consists of 83 airports that vary in size and function from large commercial service facilities to small rural general aviation airports. Arizona's largest airport, Phoenix Sky Harbor International Airport (PSHIA), is the 13th busiest airport in the country with nearly 21 million passing through its boarding gates each year (enplanements). In 2019, Phoenix Deer Valley Airport was ranked as the second busiest general aviation airport in the country, along with five other Arizona airports ranking in the top 50.

The Annual Service Volume (ASV) capacity of the airport is calculated based on airfield geometry, aircraft fleet mix, and instrument approach facilities. This capacity is compared to the actual operational demand to determine the percentage of demand that can be accommodated by the airport. The FAA recommends that additional capacity be planned when the airport reaches 60% of its capacity. According to a 2018 report by the Arizona Department of Transportation (ADOT), there are ASV capacity concerns at 10 Arizona airports, including Phoenix Sky Harbor International Airport and Tucson International Airport.



Source: Arizona Department of Transportation Multimodal Planning Division: GIS Section. Map Book 2018 Edition. https://www.azdot.gov/maps/geographic-and-functional-maps

FUNDING & FUTURE NEED

Nearly 46.3 million travelers passed through PSHIA in 2019, surpassing the previous record in 2018 when it saw just under 48 million passengers. Arizona's three largest airports have seen significant investments in the past few years. PSHIA recently completed a 20-year $38 billion Comprehensive Asset Management Plan, a $590 million modernization of terminal 3, $950 million sky train extension, and construction of the final concourse of terminal 4. Tucson International Airport completed a repaving project of the primary runway in 2017, a terminal renovation/expansion in 2019, and is beginning a safety improvement program that includes a new parallel runway. At Phoenix-Mesa Gateway Airport a U.S. Customs & Border Protection Sky Bridge program enabling American and Mexican customs agents to inspect cargo is currently under construction.

One of the most critical issues airport owners face is the limited funding to complete necessary capital improvements and maintenance at their facilities. There are a variety of funding sources; Federal Aviation Administration (FAA), state and local match; however, each year the requested funding far exceeds the available amount. The first of two primary funding sources for airports is the Passenger Facility Charge (PFC) which is a user-fee placed on passengers at commercial airports controlled by public agencies. PFCs are capped at $4.50 per flight segment with a maximum of two PFCs charged on a one-way trip or four PFCs on a round trip, for a maximum of $18 total. Airports use these fees to fund FAA-approved projects that enhance safety, security, or capacity; reduce noise; or increase air carrier competition. The second source of federal funding is the FAA Airport Improvement Program (AIP) which provides grants for planning, development, or noise compatibility projects at airports included in the National Plan of Integrated Airport Systems (NPIAS) report.

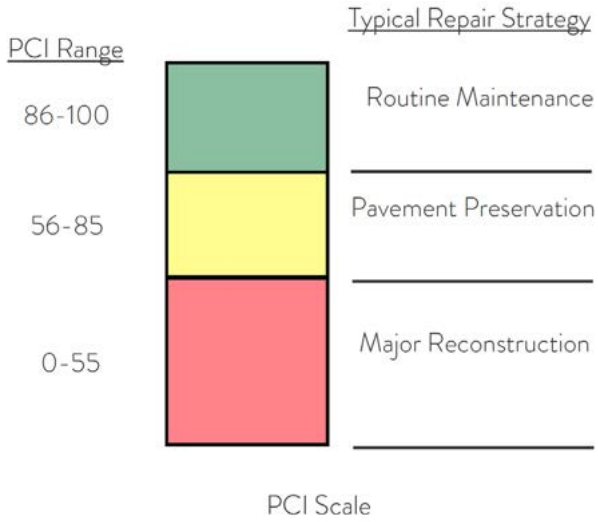
Historically, investment in Arizona's airport system has been approximately $149 million per year when all federal, state, and local sources are combined. However, the Airport Council International – North America estimated that approximately $438 million is needed annually to complete each airport's capital improvement projects, planning projects, and maintenance projects. This results in a shortfall each year of nearly $289 million. Impacted communities include rural Arizonans who remain dependent on the federal Essential Air Services program to subsidize commercial carriers continuing to serve three small airports; Page Municipal Airport, Prescott Regional Airport and Show Low Regional Airport. Lastly, during the last 20 years, over $100 million dollars were diverted away from the aviation system to other state budget items.

CONDITION AND OPERATIONS & MAINTENANCE

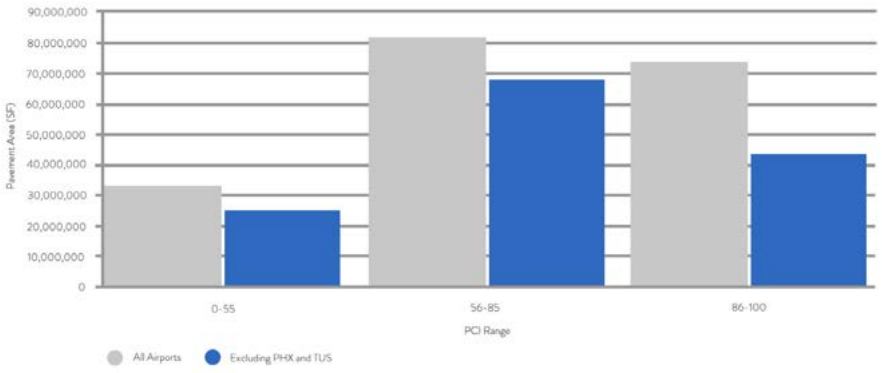
Several criteria were examined to determine the adequacy of each airport to meet the minimum requirements to support jet aircraft. Inadequate facility and service requirements of Arizona's aviation system include:

- 36% of airports do not provide instrument approaches
- 16% of airports do not include hangar spaces
- 33% of airports do not carry Jet-A Fuel
- 19% of airports do not have a 5,000-foot-long runway.

Pavement condition is vital to the safe and efficient operation of aircraft and is therefore critical for the continued operation of an aviation facility. The Pavement Condition Index (PCI) procedure is the standard used by the aviation industry to visually assess pavement condition, providing engineers with a consistent, objective, and repeatable tool to represent the overall pavement condition. During a PCI survey, visible signs of deterioration within a selected sample unit are recorded and analyzed, as are distress type, severity, and quantity. The results of a PCI evaluation provide an indication of the structural integrity and functional capabilities of the pavement. The PCI provides an objective basis for determining maintenance and repair needs as well as for establishing rehabilitation priorities in the face of constrained resources. Furthermore, the results of repeated PCI monitoring over time can be used to determine the rate of deterioration and to estimate the time at which certain rehabilitation measures can be implemented.



Between 2008 to 2018, the percentage of airports having a runway PCI ≥ 70 increased from 54% to 64%, but still falls short of the state target of 97%. The percentage of airports having a taxiway with a PCI of 70 or greater is 55% and airports with an apron PCI of 55 or greater is 64%. These gains in the maintenance of the airport pavements have been made despite the funding shortfalls and thanks to the Arizona Pavement Preservation Program (APPP). This program was established to assist in the preservation of the Arizona airport system infrastructure.



Pavement Area, SF

PCI Range	All Airports	Excluding PHX and TUS
0-55	33,128,313	25,145,231
56-85	82,095,688	67,911,915
86-100	74,078,384	43,966,337

PUBLIC SAFETY AND RESILIENCE

Arizona's aviation infrastructure links the state to the global marketplace, facilitating local, national and international commerce and military aviation which provides economic stability as well as safety in case of a disaster. The network of public-use general aviation airports provides for the needs of rural residents who are dependent on aviation for emergency medical transport, fire suppression support, air cargo, agricultural support, and business aviation.

The FAA has published standards for airport development and safety. Two standards of particular importance are related to the specific areas adjacent to runways. The Runway Safety Area (RSA) provides an unobstructed area of land adjacent to the usable runway that is suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or unintended excursion from the runway. The second area is the Runway Protection Zone (RPZ) that is an area at ground level extending beyond the end of the runway for the purpose of enhancing the safety and protection of people and property on the ground. Currently, 85% of Arizona's airports fully meet the RSA standards compared to the 59% in 2008; the state is still shy from its target of 100%. PSHIA has met the RSA standards since 2010.

Access to an airport is a very important metric in public safety. As of 2016, 93% of Arizona's population is within a 30-minute drive of an all-weather runway giving easy access in case of a disaster. Medical flights offer access to patients in need of specialized or emergency medical care, as well as transport of healthcare personnel to rural areas to provide care. Providing a network of airports to connect medical professionals with patients is an important function an aviation system can provide. 40% of Arizona's airports are capable of supporting medical operations which is slightly less than the state's performance target of 67%.

Airports with accessible fuel 24 hours per day, seven days per week allow planes to fly at non-peak hours and add a layer of safety for pilots when immediate refueling is required. 63% of Arizona's airports provide this service. The benefits of 24/7 fuel also extend to community safety and resiliency, as aircraft can refuel during times of disaster when they are needed to transport people, goods, and services. Our airports are a crucial part of our emergency plan with all the Arizona airports having a written emergency response plan.

INNOVATION

Arizona's airports have worked to deploy cutting-edge technologies and improve passenger experience. Terminal and airfield lighting systems have been modernized and solar powered energy generation has been installed at several airports to reduce energy consumption from the grid. Each airport has adapted to modern technological services, including surveillance systems, as well as terminal Wi-Fi internet availability. Each airport has an interactive website with links to administrative, operational, customer service and aviation planning documents such as Airport Layout Plans.

On Sept. 18, 2014 the Federal Aviation Administration (FAA) implemented changes in flight paths to and from PSHIA as part of its effort to streamline departures and arrivals using NextGen satellite-based navigation. NextGen is the FAA's extensive air traffic management modernization program. It operates through satellite-based navigation (RNAV) and digital communication systems which are intended to increase operational efficiencies, remove human risk factors from airspace management and reduce environmental impacts such as emissions and noise. However, with the implementation of NextGen, the FAA made significant changes (and resulting quality of life changes) without properly notifying the public or allowing the public to provide input in the airspace redesign process. The new routes resulted in lowered flight corridors over thousands of homes, historic districts, natural preserves and parks. This is a reminder that with innovation comes change and preventative measures such as extensive stakeholder outreach should be implemented to ensure success.

RECOMMENDATIONS TO RAISE THE GRADE

In the coming decades, Arizona is anticipated to experience growth outpacing the rest of the nation in key segments affecting aviation demand including population; tourism; international trade; and industries such as aerospace and defense, technology, and manufacturing.

- **Maintain airports at their current service levels:** The aviation industry is vital to Arizona's economy and serves important community functions such as medical transport and firefighting. Projected funding levels do not maintain airports at their current service levels. Adjusting the outdated federal cap on local PFCs would allow airports to improve the system's level of service and fund construction improvements to increase capacity and enhance safety.
- **Increase Federal funds for aviation infrastructure and stop diverting aviation funds away from aviation:** Changes in current policy and legislation are required to prevent diversion from the State Aviation Fund to the General fund. During the last 20 years, over $100 million dollars were diverted away from the aviation system. This reallocation of funding severely limited the ability of Arizona's airports to make crucial safety improvements, perform routine maintenance, and expand capacity.
- **Continue to monitor performance metrics to evaluate progress and need:** Evaluating the current conditions will provide data points on deterioration over time that are helpful metrics that guide policies, planning, resource allocation, and project prioritization.

SOURCES

Arizona Department of Transportation Arizona Airports Pavement Management System, www.azdot.gov/planning/airportdevelopment/development-and-planning/airport-pavement-management- system

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State of General Aviation 2019, https://download.aopa.org/hr/Report_on_General_Aviation_Trends.pdf
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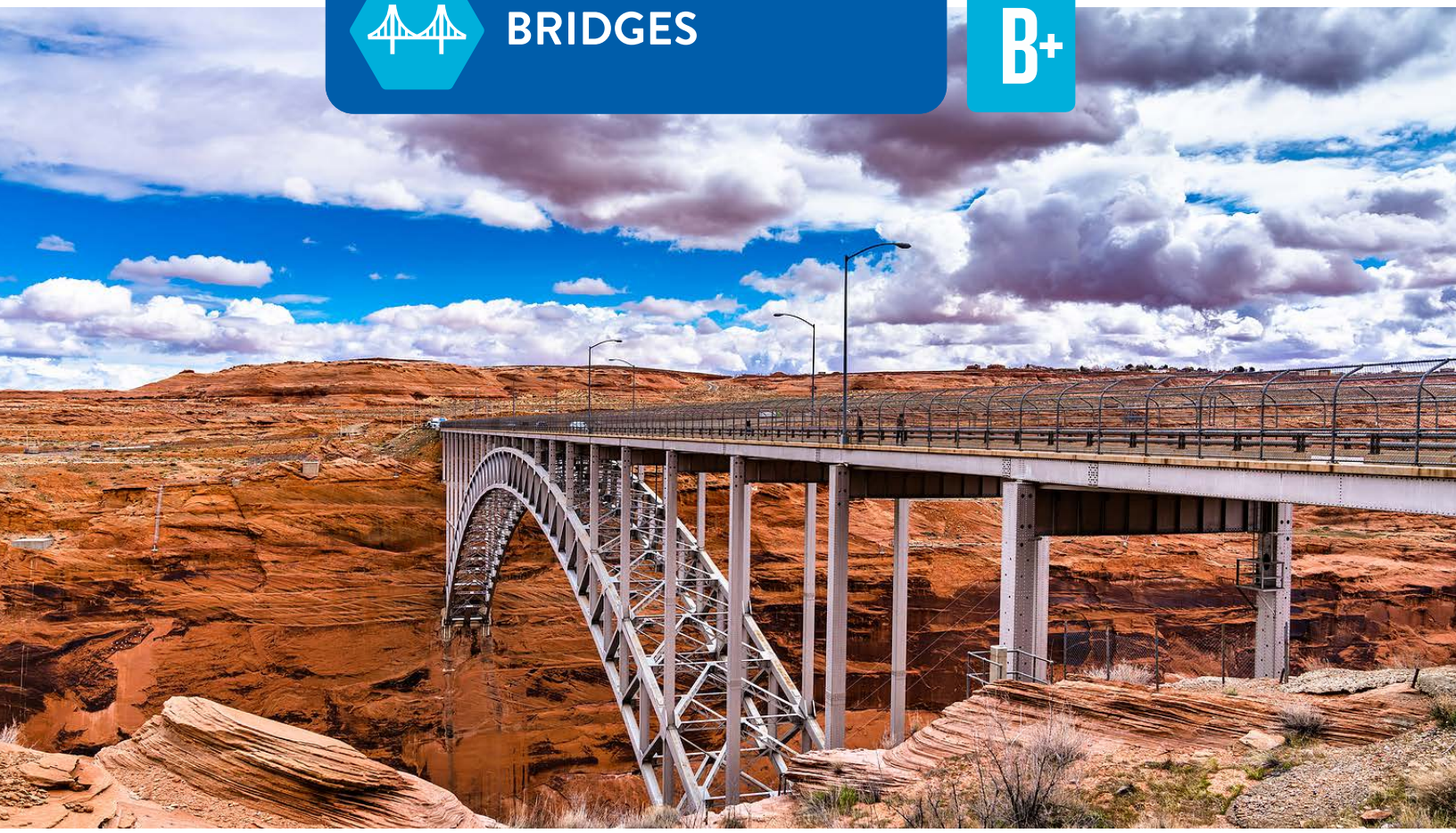
https://azdot.gov/node/5638

B+



BRIDGES
GRADE: B+

EXECUTIVE SUMMARY

Arizona's 8,320 bridges span almost 6 million square meters and service over 100 million daily crossings. The Arizona Department of Transportation (AZDOT) and other bridge owners have done an exemplary job maintaining their bridges. Just 137 – or 1.6% – bridges were classified as poor in 2019, down from 223 in 2014, and far lower than the national average of 7.5%. Currently, AZDOT has identified 1,789 bridges requiring repairs at an estimated cost of $1.5 billion. The number of bridges needing work is far less than the 2,440 in 2014, but a funding gap remains. Looking ahead, Arizona needs to plan for the future of its surface transportation network as aging bridges, a growing population, and extreme climate conditions put strain on existing bridges and revenue streams.

INTRODUCTION

Bridges are a key component of our country's infrastructure because they are critical to our economic development.

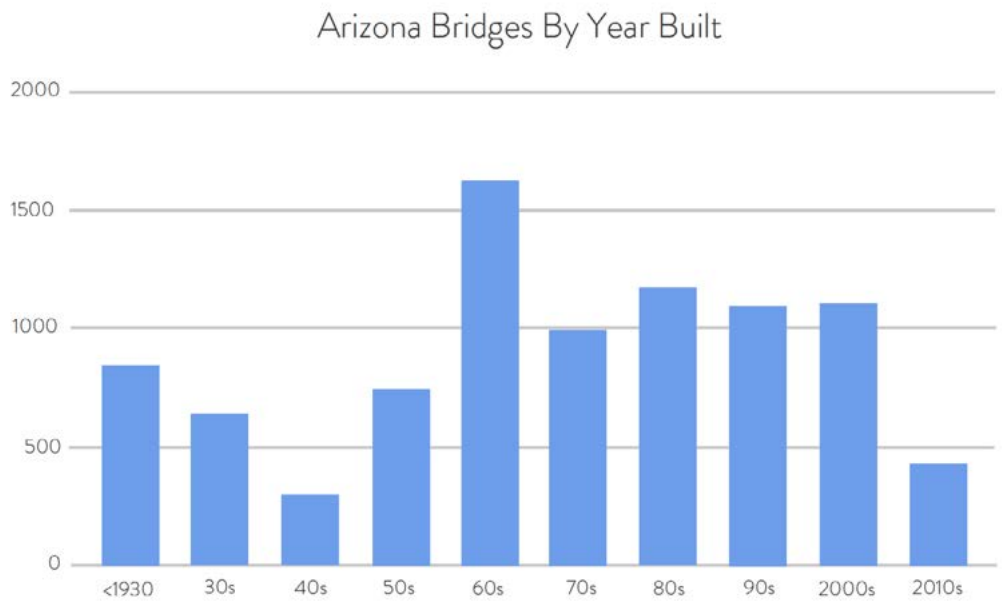
Federal law requires that most bridges' structural condition be regularly inspected by the state departments of transportation. The Federal Highway Administration (FHWA) publishes guidelines for bridge safety inspections which are followed by each state. The states then report this information—as well as other findings—on each bridge under their jurisdiction to the U.S. Department of Transportation (U.S. DOT) for inclusion in the National Bridge Inventory (NBI).

The NBI reported that Arizona's bridge inventory includes a total of 8,320 bridges spanning almost 6 million square meters and service over 100 million daily crossings.

CONDITION & CAPACITY

Until recently, bridges around the country were inspected and given a score using a rating system, with the bridges receiving the worst score being categorized as structurally deficient. Now the rating system for bridges includes good, fair, or poor. Of the 8,320 bridges in the state, 137 (1.6%) are classified as poor. A bridge receives a poor rating if any one of the following bridge components are rated less than or equal to 4 out of 9:

- Deck condition
- Superstructure condition
- Substructure condition
- Culvert condition



The number of bridges classified as poor in 2019 is down from 223 bridges classified as structurally deficient (poor in today's ratings) in 2014. The state has identified needed repairs on 1,789 bridges at an estimated cost of $1.5 billion. This compares to 2,440 bridges that needed work in 2014. Bridge owners should be applauded for addressing bridge repair needs with limited funds – Arizona is among the lowest of the 50 states in both number and overall percentage of poor bridges. However, like the infrastructure throughout much of the nation, Arizona's bridges are aging. Approximately 46% of the state's bridges were constructed prior to the 1970s while only 17% have been constructed since 2000. Without preemptive action, Arizona's bridges will continue to age and consequently increase the costs required for maintenance, repairs, and replacements.

OPERATION & MAINTENANCE

The ADOT Bridge Group is responsible for maintenance of most of the state's bridges, which it accomplishes through the ADOT Bridge Preservation Program. The program has subprograms for replacement and rehabilitation, inspection and repair (including emergency repairs), scour, and deck rehabilitation. Committees and personnel from the Bridge Group determine how to allocate resources based on the results of bridge inspections. Most of the subprograms were seeking additional funding, citing the following concerns:

- The state bridge inventory is steadily increasing with the expansion and upgrade of the highway system. However, funding levels remain the same.
- Frequency and severity of collision damage to bridges are on the rise due to higher volume of truck traffic and movement of over height vehicles.
- Older bridges are undergoing more frequent failure of deck joints, bearings, barriers, and decks. The demand for repair projects is far exceeding the current level of funding, resulting in backlog and delayed completion of bridge repairs. These postponed repairs only get more expensive as time goes on.
- The increasing usage of deicing chemicals in the northern part of the state has been accompanied by the need for increasing attention to bridge deck maintenance and repair work.
- In addition to the de-icing of the bridge decks, which accelerates the unavoidable deterioration of structural elements due to age, many decks are reaching their design life and require rehabilitation or replacement.
- Less conservative past design practices and improper construction methods have also contributed to the problem.

The Arizona Department of Transportation (ADOT) bridge preservation program is essential in preserving and maintaining the state's bridge inventory. The program's objective is to restore and maintain the structural integrity of a bridge, ensuring the state's safe and efficient transportation system.

FUNDING & FUTURE NEED

Funding for bridge construction and maintenance projects in Arizona comes from several sources including federal and state fuel taxes, sales taxes, and vehicle registration taxes and fees. The Federal Transit Administration (FTA) allocates money to each state DOT to finance construction, operation and maintenance of public transportation systems. The financing includes many different types of funding sources, including federal and non-federal grants, cooperative agreements, and other revenue sources. Federal funds provide about 64% of annual Arizona DOT capital outlays for highway & bridge projects.

The state of Arizona taxes motor fuels and collects additional money from a variety of fees. These collections include gasoline and use-fuel taxes, motor-carrier taxes, vehicle-license taxes, motor vehicle registration fees and other miscellaneous fees. These revenues are deposited in the Arizona Highway User Revenue Fund (HURF) and are then distributed to the cities, towns and counties and to the State Highway Fund. These taxes represent a primary source of revenues available to the state for highway construction, improvements, and other related expenses. Arizona's projected transportation budget for FY2019/2020 includes over $413 million from HURF. It is important to note that these estimates were determined before COVID-19 measures impacted the volume of users and associated revenue collection from the gas tax.

The state Vehicle License Tax (VLT) is another source of funding for transportation projects in Arizona. It is currently set at $2.80 or $2.89 per $100 for new and used vehicles, respectively. Unlike HURF, the use of VLT is not dedicated to fund transportation related projects or improvements.

The state gasoline tax in Arizona has remained unchanged since 1991 at 18 cents per gallon, and it is among the lowest compared with other states with the nationwide average approximately 31 cents per gallon. Similarly, the federal gasoline tax has remained unchanged since 1993 at 18.4 cents per gallon. Gasoline taxes in Arizona do not increase with inflation, reducing their effective purchasing power each year.

Currently, Arizona needs $1.4 billion dollars to cover the needed repairs on 1,789 bridges. The proposed bridge work is described in the table below.

Type of Work	Number	Cost (millions)	Daily Crossings	Area (sq. meters)
Bridge replacement	1,325	$1,178	21,610,698	766,653
Widening and rehabilitation	245	$87	4,830,891	83,746
Rehabilitation	88	$123	848,447	118,795
Deck rehabilitation/ replacement	12	$8	134,850	7,762
Other work	119	$62	3,616,120	57,912
Total	**1,789**	**$1,458**	**31,041,006**	**1,034,867**

In the State Transportation Improvement Plan, ADOT has programmed the following amounts for bridge repair and maintenance over the next four years, however the total amount shown below is not enough to cover the $1.4 billion dollar cost required for repairs:

Type of Work	Number	Federal Funds	State Funds	Local Funds
New Construction	3	$1,168,691	$5,300,000	$25,172,000
Bridge Replacement	15	$134,740,000	$23,775,000	$20,400,000
Bridge Preventative Maintenance	8	$29,641,000	$0	$0
Bridge Rehabilitation	93	$415,190,006	$299,000	$65,000,000
Total	**159**	**$580,739,697**	**$29,374,000**	**$110,572,000**

RESILIENCE & INNOVATION

ADOT has a Sustainable Transportation Program to help manage the monetary, social, and environmental costs of infrastructure over its entire lifespan. These programs use a wide variety of methods to improve sustainability including conducting life cycle cost analysis, utilizing recyclable materials, minimizing construction costs, and implementing policies to reduce environmental impacts of construction and maintenance. There is also a Resilience Program that works to mitigate the effects of extreme weather by incorporating extreme weather and climate adaptation into the design engineering process.

In addition to sustainability and resilience initiatives, ADOT also encourages the use of innovative construction methods, where appropriate, to reduce costs. Accelerated Bridge Construction (ABC) is one method that can be used to update infrastructure while minimizing costs and impacts to the public. ABC can include methods such as replacing a bridge by building the new bridge adjacent to the old one and then shifting the roadway after completion, allowing traffic to continue using the old bridge until the new one is finished, or by building the new bridge offsite and then moving it to replace the old bridge in a much shorter time than is typical for conventional construction methods. For instance, the construction schedule of bridge projects in the state of Arizona is being improved by using innovative design and construction techniques. A recent example of this is ADOT's I-40 bridge project. The bridge abutments are being built by using a geosynthetic reinforced soil-integrated bridge system in which the layers of fill are alternated while being reinforced with a synthetic material. By employing this technique, the construction schedule was significantly improved.

On this same project, the deck will be constructed using a polyester polymer concrete that can be placed and cured in days instead of weeks. This deck provides a similar performance with lower maintenance costs when compared to traditional concrete bridge decks. Employing new materials with lower maintenance cost will allow limited budgets to cover more maintenance in the future.

RECOMMENDATIONS TO RAISE THE GRADE

All things considered, ADOT has done good work addressing bridges in poor condition and keeping the percentage below the national average. Now Arizona needs to plan for the future. Aging bridges and a growing population mean that it will only get more difficult to keep bridges in good shape with current funding levels. To improve the grade and prevent an eventual crisis, our recommendations include:

- Index motor fuel taxes, both federal and state, to inflation. This will help to maintain the purchasing power of these dedicated transportation funds.
- Encourage the federal government to provide additional funding sources for the Highway Trust Fund and/or raise the federal gas tax.
- Reduce fee diversions from motor vehicle taxes and user fees paid to non-transportation uses.
- Employ innovative solutions and resilient building technologies to replace, repair and maintain existing infrastructure.

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DAMS

C-

DAMS
GRADE: C

EXECUTIVE SUMMARY

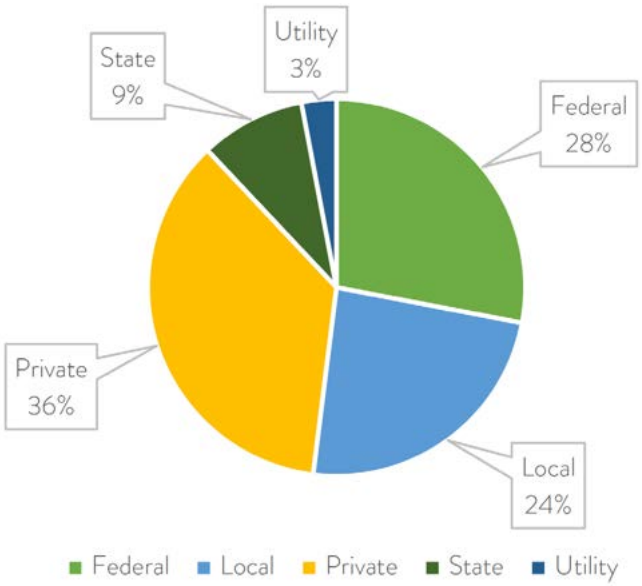
Of the 384 dams in Arizona, 257 are state regulated dams and 127 federally or otherwise regulated. There are 164 dams in Arizona with a high hazard rating. It is important that high hazard dams are regularly inspected and the condition of these structures is known in order to protect public safety. In Arizona, 95% of dams with a high hazard potential have a condition assessment rating, and more than half of those have a satisfactory rating. Additionally, Emergency Action Plans have been prepared for approximately 95% of the state regulated high hazard dams, which is well above the national average. In Arizona, the responsibility for the safe operation and maintenance of dams lies with the dam owners. Arizona's dam safety state budget is less than $1 million annually. These funds are only available to conduct inspections and manage the Dam Safety Program for the inventoried and state regulated dams. The Association of State Dam Safety Officials (ASDSO) estimates that rehabilitation of non-federal dams in Arizona will cost $316 million (based on 2012 data).

CONDITION & CAPACITY

Water is a critical resource throughout the Southwestern United States, particularly in Arizona. Dams are a vital component in managing this resource, whether to provide drinking water and irrigation, control flood waters, or generate power. A prominent example, Glen Canyon Dam, is located near the border of Arizona and Utah. Originally constructed from 1957 to 1963 by the Bureau of Reclamation for the purpose of flood control, water storage, and to generate hydroelectric power, the dam also provides extensive recreational benefits. It is part of a larger system of dams along the Colorado River, which include Hoover Dam and Parker Dam, that control the storage and distribution of water throughout the Southwest.

According to the 2018 U.S. Army Corps of Engineers National Inventory of Dams (NID) and the Arizona Department of Water Resources (ADWR), there are 257 state regulated dams and 127 federally/other regulated dams for a total of 384 dams in Arizona. This total includes eight dams under state regulation, designated with Protected Critical Infrastructure Information (PCII) status, and therefore accompanied by minimal publicly available data. Seventy two percent of dams are of earthen construction and the primary uses are flood control, irrigation, and fish and wildlife ponds. Flood control is the highest primary use with 27% of all dams utilized for this purpose. Other dam uses include hydroelectric, debris control, mine tailings impoundment, water supply, recreation, and fire protection, to name a few.

FIGURE 1: DAM OWNERSHIP



Federally owned dams and privately-owned dams, with 108 and 136 respectively, comprise the majority of dams in Arizona, with the State owning less than 10% of all dams. Dam ownership is summarized in Figure 1. The federal dams are managed by several agencies including the Army Corps of Engineers, Bureau of Reclamation, U.S. Forest Service, Bureau of Land Management, Mine Safety and Health Administration, and the Bureau of Indian Affairs. State regulated dams are under the jurisdiction of the ADWR. ADWR and federal owners/regulators report dam information to the NID, including dam height, construction, total storage, owner, and hazard rating. The Hazard Rating quantifies the potential for downstream damage in the event a failure occurs. Hazard ratings are updated based upon development and changes in downstream population as these factors affect the impact of a potential dam failure. There are four levels of hazard rating in Arizona:

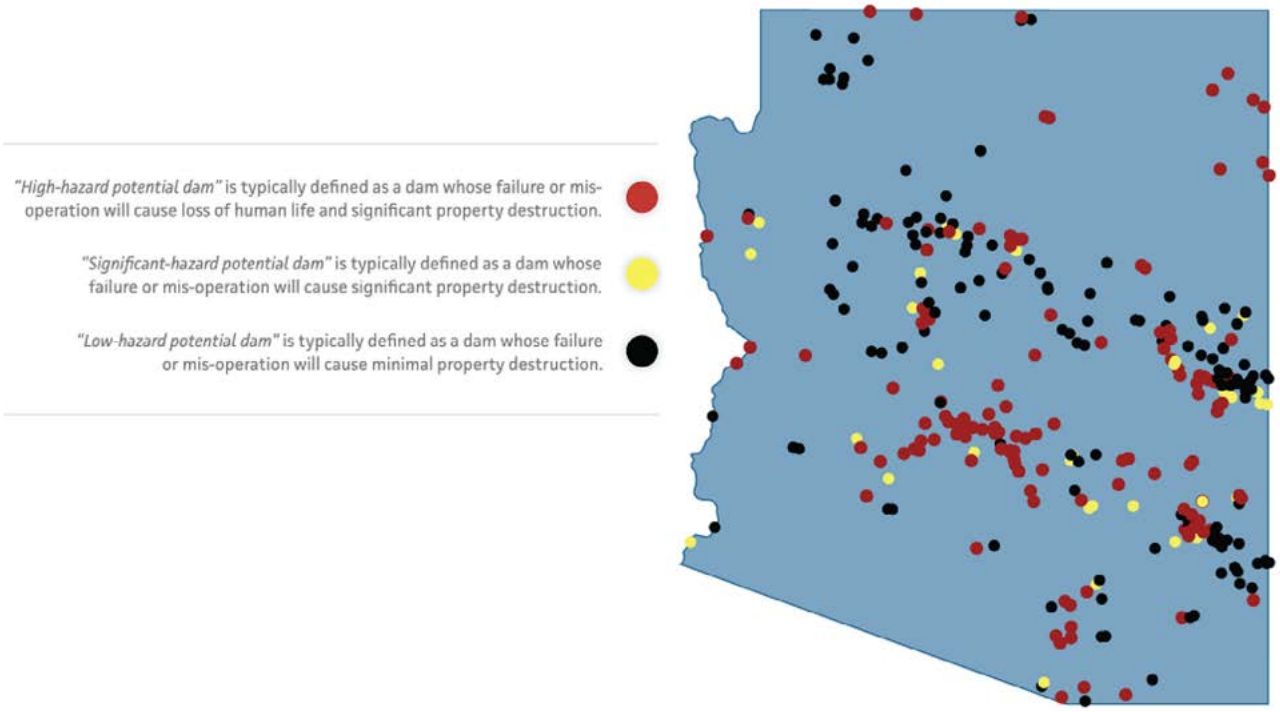
High Hazard Potential: Failure or improper operation of a dam would be likely to cause loss of human life because of residential, commercial, or industrial development. Intangible losses may be major and potentially impossible to mitigate, critical lifeline services may be significantly disrupted, and property losses may be extensive. Arizona Administrative Code (A.A.C.) R12-15-1206.B.2.d.

Significant Hazard Potential: Failure or improper operation of a dam would be unlikely to result in loss of human life but may cause significant or high economic loss, intangible damage requiring major mitigation, and disruption or impact on lifeline facilities. Property losses would occur in a predominantly rural or agricultural area with a transient population but significant infrastructure. A.A.C. R12-15-1206.B.2.c.

Low Hazard Potential: Failure or improper operation of a dam would be unlikely to result in loss of human life, but would produce low economic and intangible losses, and result in no disruption of lifeline services that require more than cosmetic repair. Property losses would be limited to rural or agricultural property, including equipment and isolated buildings. A.A.C. R12-15-1206.B.2.b.

Very Low Hazard Potential: Failure or improper operation of a dam would be unlikely to result in loss of human life and would produce no lifeline losses and very low economic and intangible losses. Losses would be limited to the 100-year floodplain or property owned or controlled by the dam owner under long-term lease. A.A.C. R12-15-1206.B.2.a.

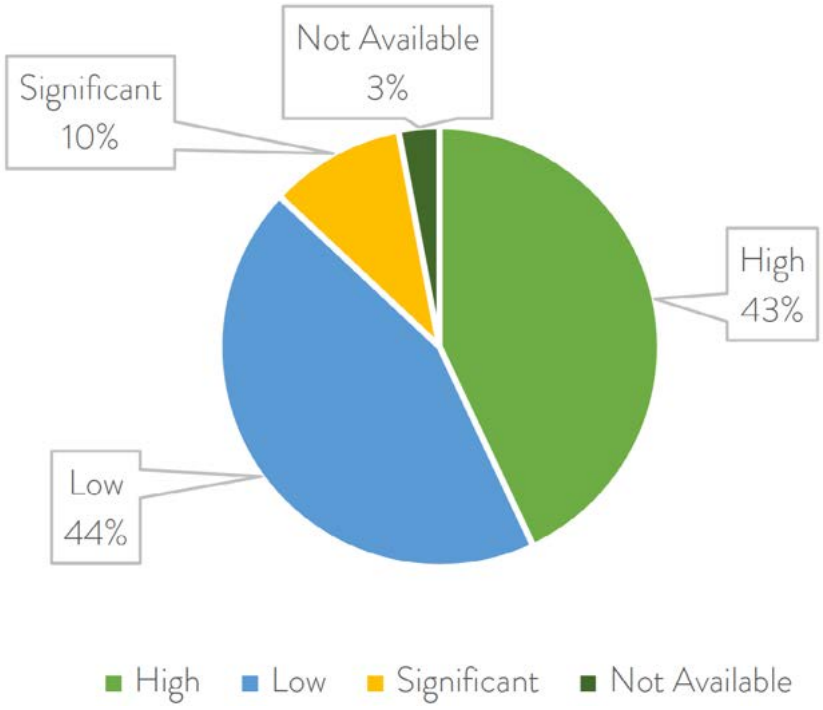
FIGURE 2: DAM LOCATION BY HAZARD POTENTIAL



https://nid-test.sec.usace.army.mil/ords/f?p=105:113:1681701399273::NO:::

Figure 2 shows dam location in Arizona based on hazard rating. There are 164 dams in Arizona with a high hazard rating, 38 with a significant hazard rating, 168 with a low hazard rating, and the remaining 14 dams are categorized as undetermined or not available. Figure 3 indicates percentage of dams in Arizona based on hazard classification.

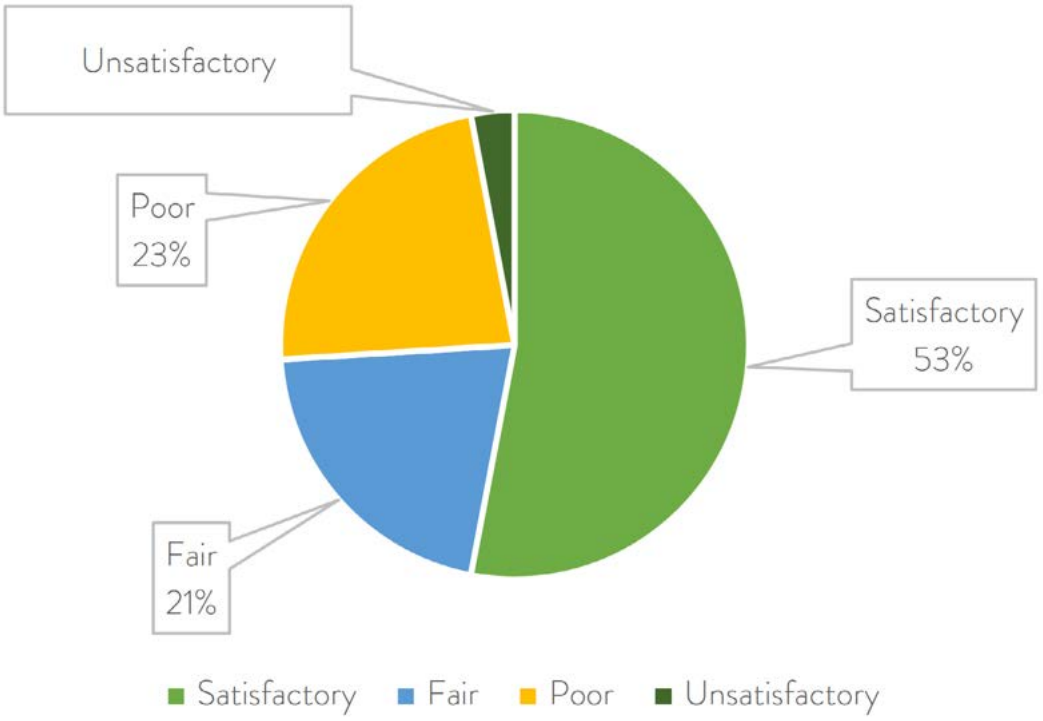
FIGURE 3: HAZARD CLASSIFICATION



Most dams have a 50-year design life. In Arizona the average age of a state jurisdictional dam is over 64 years and Federal/other regulated dams have an average age of 68 years old (median ages of 58 and 64 respectively). As of 2017, the average age of dams nationwide was 56 years. The oldest dam in Arizona is 139 years old. Regular inspection and rehabilitation/maintenance are critical components to ensure the ongoing safe operation of existing dams.

The ADWR Dam Safety program is tasked to inspect and rate the condition of state jurisdictional dams. The frequency of inspection depends on the downstream potential hazard rating. The NID provides information on the condition rating of dams. Ninety five percent of dams in the state with a high hazard potential have a condition assessment rating. As shown in Figure 4, 53% of high hazard rated dams have a satisfactory rating, 21% of high hazard dams rate as fair, 23% rate poor and 3% rate as unsatisfactory.

FIGURE 4: CONDITION OF HIGH HAZARD DAMS



OPERATION & MAINTENANCE AND PUBLIC SAFETY

In Arizona the responsibility for safe operation and maintenance (O&M) of dams is the responsibility of the dam owners. When conducting inspections of state jurisdictional dams, ADWR looks for all adverse conditions, including those resulting from inadequate O&M. Some dam owners have the financial resources to perform needed maintenance, others do not. Proper O&M influences the safety of these structures.

Emergency Action Plans (EAPs) identify conditions at a specific dam and outline pre-planned actions to be followed to help prevent loss of life and minimize property damage should a failure occur. The EAP also specifies actions for the owners to take regarding moderating or mitigating potential issues at their dam. State officials work with local entities and dam owners to prepare new and update existing EAPs. Of the 108 state jurisdictional high hazard potential dams in Arizona, approximately 95% have EAPs in place.

Arizona's dam safety budget is less than $1 million annually. These funds are only available to conduct inspection and manage the Dam Safety Program for the inventoried and state regulated dams. Arizona's dam safety program employs 5.9 full-time staff members (FTE), which puts Arizona above the national average for state regulated high hazard potential dams per FTE. Arizona's dam safety state budget per state regulated dam and per high hazard dam are also above the national average.

FUNDING & FUTURE NEED

While a majority of Arizona's dams have a satisfactory rating, the 2019 ASDSO report, *The Cost Of Rehabilitating Our Nation's Dams*, estimates that rehabilitation of non-federal dams in Arizona will cost $316 million (2012 data from ASDSO report).

The ADWR has limited funding available through the Dam Repair Fund. Funding for this program comes from monies appropriated by the state legislature, dam safety inspection fees, filing fees, and principal and interest collected from dam repair loans These monies are used to make emergency repairs if dam owners are unable or unwilling to take action on a timely basis. The Dam Repair Fund is also used to provide grants and loans to owners of high hazard potential dams to analyze and rehabilitate or repair dams that are designated as unsafe, or have safety deficiencies, but are not considered emergency repairs. Some federal funding is available from the United States Department of Agriculture (U.S.D.A) Natural Resources Conservation Service (NRCS) for rehabilitating aging dams that are reaching the end of their design life. Additionally, Congress recently funded for the first time - and the Federal Emergency Management Agency (FEMA) recently implemented - the High Hazard Potential Dam Rehabilitation Program, which provides grants to non-federal high hazard potential dams for repair, rehabilitation, or removal; however, the $10 million in federal funds is nowhere near adequate to fully address the needs of all high hazard potential dams in the nation. Without additional funding opportunities to help dam owners inspect and maintain their facilities, the possibility of a dam failure continues to exist. The most recent dam failure in Arizona was the Tempe Town Lake Dam which occurred on July 20, 2010. Fortunately, no lives were lost and minimal property damage occurred. The cost of the replacement dam completed in 2016 was $45 million. Tempe Town Lake and Dam serves as flood control, economic development center, and a recreation venue.

FIGURE 5: TEMPE TOWN LAKE DAM FAILURE, JULY 20, 2010

http://cookiecadman.blogspot.com/2010/07/tempe-town-lake.html

RESILIENCE

The 2018 State of Arizona Hazard Mitigation Plan notes that while future climate conditions are unknown, the trend shows an increase in the average temperature throughout Arizona. Referencing the 2014 National Climate Assessment Report, the Plan notes anticipated reduction in average annual precipitation and streamflow volumes, potentially more frequent winter flooding, and possibly increasing the severity of overall flooding conditions for watersheds upstream of dams because of the potential for reduced vegetation due to increases in drought and post-wildfire flooding. The Plan includes a hazard mitigation action item to collaborate with the State Climatologist and others to discuss and analyze the impacts of future climate change.

INNOVATION

Some dam owners have implemented newer technologies to increase dam safety. Some flood control dams are being monitored with flood sensing systems. Interferometric Synthetic Aperture Radar (InSAR) is being used by some dam owners to efficiently map changes in ground elevation over large areas utilizing satellites. Ground elevation deformation occurs due to groundwater extraction and natural hazards. ADWR is evaluating the potential use of drones for safety inspections. ADWR is also implementing a low-cost flood inundation mapping project using the DSAT/DSS-WISE (Decision Support System for Water Infrastructure Security) software. This will increase the number of dams having flood inundation limits which will be helpful to state, county, and local agencies.

RECOMMENDATIONS TO RAISE THE GRADE

- **Develop Emergency Action Plans for all High and Significant Hazard Dams that currently don't have EAPs by 2024.**
- **Increase funding for repair of deficient dams and maintenance of aging dams, including full funding for federal dam repair programs such as the High Hazard Potential Rehabilitation Program.**
- **Education and risk awareness should be an important aspect of Arizona's dam safety program. Dam owners and operators need to be aware of Arizona's dam safety laws and regulations.**
- **Encourage improved land use planning at the local level by considering the ways that dams impact local areas downstream.**
- **Evaluate impact of climate change on dams.**

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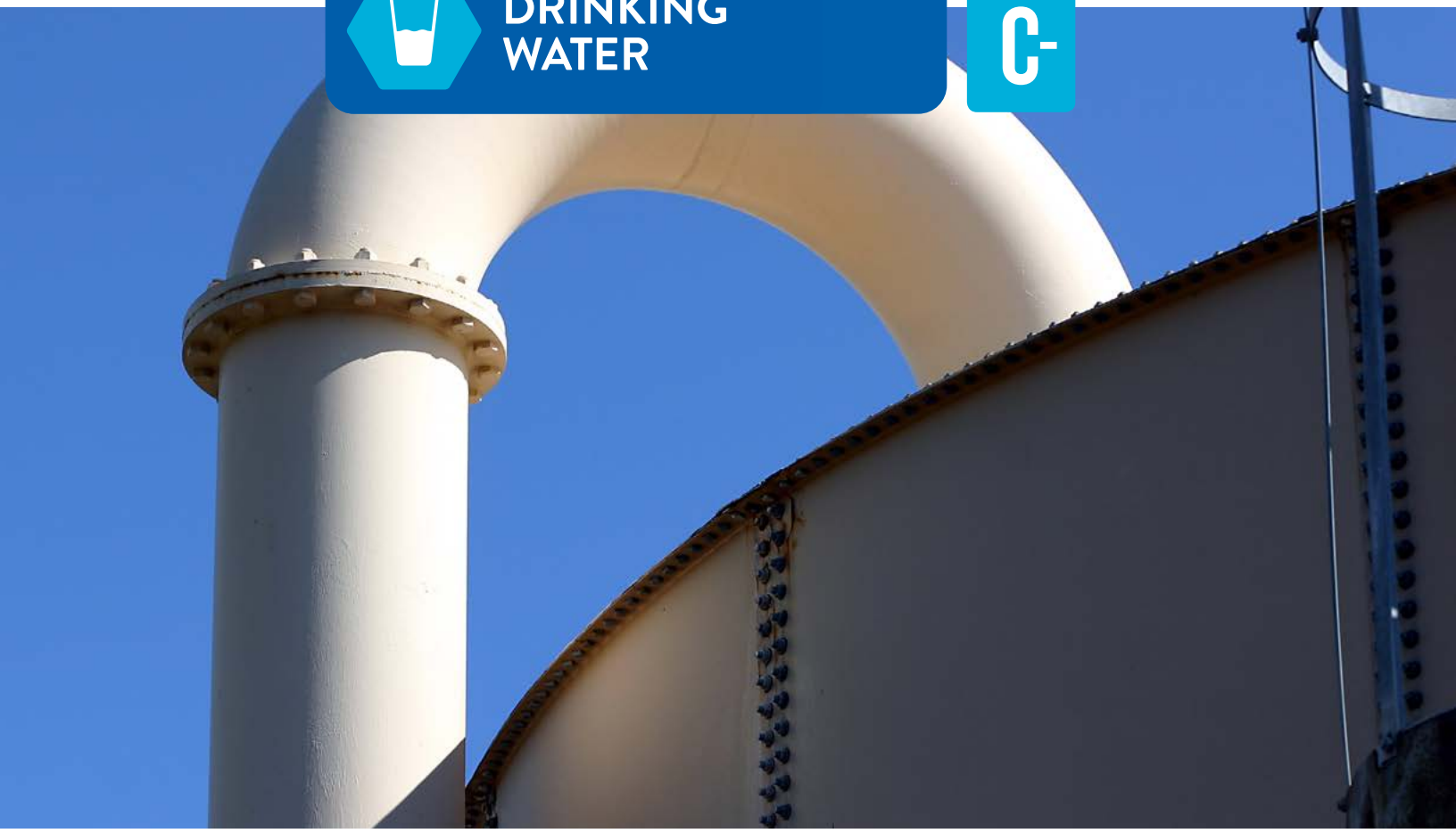


DRINKING WATER
GRADE: C-

EXECUTIVE SUMMARY

Drinking water infrastructure in Arizona moves and stores water for industries and the state's population. Much of the water mains were built around 30 years ago, and as they age, implementing asset management practices to extend the lifespan of these assets is advised. The price for water across the state of Arizona is relatively low compared to other parts of the country and compared to the price for other less essential consumer goods. The average bill in 2015 was $43.69, and only increased 6% to $46.09 by 2017. Some utilities decline to raise rates at all, resulting in deferred maintenance. Out of 421 water rate structures with a known effective date, 46% have not updated their rates in the last five years, and 20% have not updated rates in the last 15 years. Appropriate water rates are essential to support the infrastructure we need to treat and distribute safe drinking water.

REPORT CARD FOR ARIZONA INFRASTRUCTURE 2020

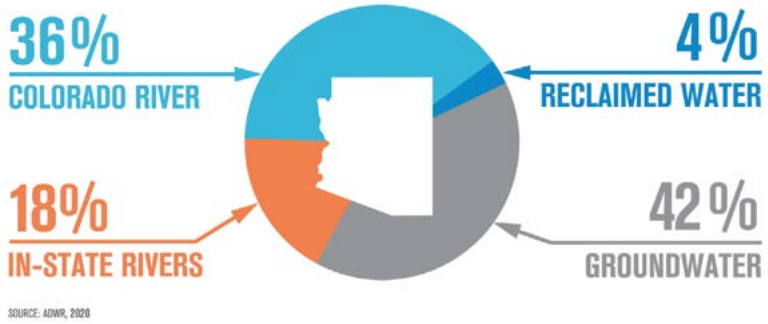
INTRODUCTION

Under the Environmental Quality Act of 1986, the Arizona State Legislature created the Arizona Department of Environmental Quality (ADEQ) in 1987 as the state's cabinet-level environmental agency. ADEQ carries out several core functions pertaining to drinking water: planning, permitting, compliance management, monitoring, assessment, cleanups, and outreach. For instance, ADEQ helps measure and report on drinking water quality through mandatory scheduled tests of all public water systems for a wide variety of potential contaminants.

CAPACITY

Over the last decade and a half, the Southwest has experienced significant drought conditions. These conditions can lead to changes in our state's water supply. Fortunately, Arizona has developed a diverse portfolio of water supply sources and management strategies which serve as the foundation of our State's robust drinking water system. This diversity allows Arizona to more effectively manage water resources, withstand the effects of existing drought conditions, and provide options in planning for the state's future economic growth.

SOURCES OF WATER FOR ARIZONA

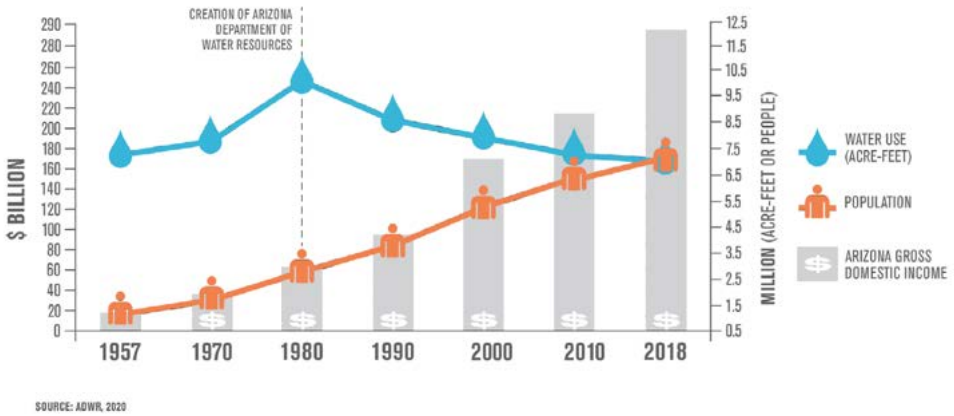


In 2017, while the average American used 64,240 gallons per year, Arizona was making efforts to reduce its water usage, doing so to a point that the average Arizonan consumed 52,925 gallons per day. Arizona's water use can be divided into three categories: municipal, industrial, and agricultural.

ARIZONA'S WATER USE BY SECTOR

Arizona's population has grown steadily over the last 5 years at about 1.5% growth; since 2015, the population has increased by more than 500,000 people. While a growing population has meant an increased demand for water, significant investments in water conservation, infrastructure, and the reuse of water have resulted in total water use essentially remaining the same over the last 50 years.

ARIZONA'S WATER MANAGEMENT



SOURCE: ADWR, 2020

Arizona has stored nearly 3 trillion gallons of water underground for future use. That is the equivalent to serving the city of Phoenix for 30 years.

CONDITION

On the morning of February 7th, 2018, a 36-inch water pipe within the City of Chandler's drinking water distribution system burst, immediately flooding Price Road and 101 and 202 interchange ramps. To shut the water off and reduce the damage, Chandler's water staff had to close 21 water valves. The city spent nearly $1 million to repair the break in the pipe, assess the condition of the surrounding pipes, and install new equipment to ensure the pipe could be shut down more quickly and alleviate the damage of another potential break. This was one break in Chandler's 3,176 miles of drinking water distribution lines from two water treatment plants and 30 wells. However, it is emblematic of the larger challenge facing the state's utility owners.

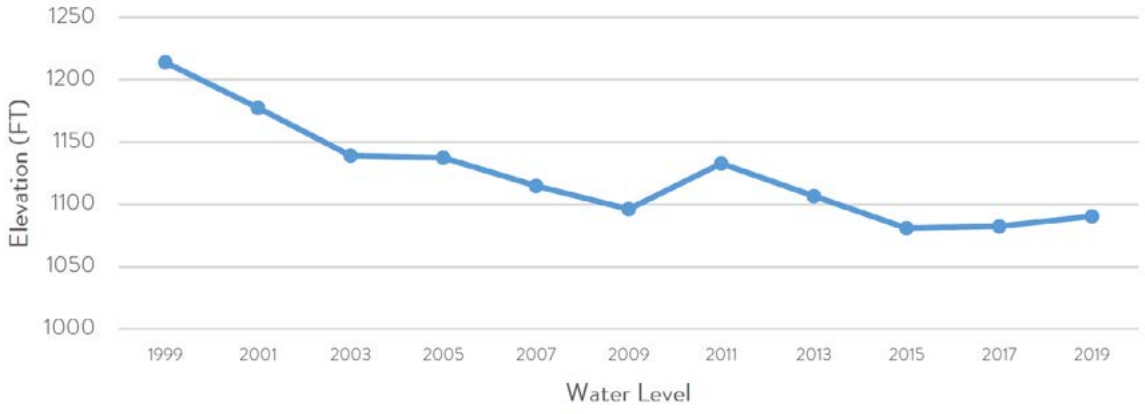
Much of Arizona's water infrastructure is over 30 years old. This is not near the end of its life cycle but presents the state's water utilities with the perfect opportunity to implement asset management so they can get the maximum life from their systems. More than 2,600 miles of transmission and distribution mains are currently in need of rehabilitation or replacement. Subsequent breaks can cause street and property damage and leaks waste valuable treated water. Additionally, water storage steel tanks need to be sandblasted and recoated to prevent rust and deterioration and mechanical equipment such as pumps and motors are in need of rehabilitation or replacement.

FUTURE NEED AND RESILIENCE

The Colorado River system, which supplies 36% of Arizona's total water use, has experienced extensive drought conditions for the past 19 years. This has resulted in Lake Mead dropping to historically low reservoir levels. Most recent projections show a probability of immediate water shortage as soon as 2020, although expected shortage volumes are relatively small compared to Arizona's total Colorado River allocation. While this is cause for concern, these conditions along with the challenges associated with increasingly extreme weather events have been anticipated. Arizona has been proactively building resilience and implementing innovative water management strategies to secure dependable water infrastructure and supplies. Arizona has focused on renewable water supplies such as state rivers, natural recharge into groundwater aquifers, and treated wastewater.

For instance, in 2019, Arizona Governor Doug Ducey announced the Governor's Water Augmentation, Innovation and Conservation Council to help ensure the certainty and vitality of Arizona's water supply long into the future.

WATER ELEVATION OF LAKE MEAD (DATA: U.S. BUREAU OF RECLAMATION)



Source: U.S. Bureau of Reclamation (Elevation Reported at the End of Calendar Year)

The Groundwater Management Act ensured that new development in this fast-growing state would prove an assured water supply capable of sustaining its residents for at least 100 years. A study shows that by 2024, about 383,000 homes statewide are expected to pump groundwater as a result of development in areas where the Central Arizona Project does not service. The potential exists for a huge gap between the amount of water that is available for replenishing aquifers and the amount that new development will need over the next century. Various fees and assessments imposed on homeowners living in these areas have escalated. The annual charge assessed on homes to pay for water supplies, water rights purchases and administrative costs, for instance, jumped in the Tucson area from $188 an acre-foot per home in 2000 to $738 in 2019. It's expected to hit $775 by the mid-2020s. One of the major problems with replenishing aquifers is that in some cases the water is replenished elsewhere and not where the water is being pumped out, resulting in falling water tables. This can trigger land subsidence, or settlement of the ground that can cause earth fissures. Over pumping groundwater threatens collapse of the aquifer which would worsen groundwater quality.

O&M AND FUNDING

A portion of every water bill goes toward maintaining and repairing the existing water lines. A survey conducted by the Water Infrastructure Finance Authority (WIFA) shows an increase of the average water and wastewater rates. For WIFA's benchmark of water usage at 7,500 gallons per month, the average bill in 2015 was $43.69. In 2017, the average bill was $46.09, a $2.40 or approximately 6% increase over a two-year period. The price for water across the state of Arizona is relatively low compared to other parts of the country and compared to the price for other less essential consumer goods. At around half a cent per gallon from the tap, it is astoundingly cheaper than a gallon of gas, yet clean water is critical to sustaining life.

Pressure to maintain low rates has many utilities running at a deficit and/or deferring necessary operational and capital improvements. Arizona's drinking water infrastructure faces a $15 billion dollar deficit. Out of 421 water rate structures with a known effective date, 46% have not updated their rates in the last 5 years, and 20% have not updated rates in the last 15 years. Appropriate water rates are essential to support the infrastructure we need to treat and distribute safe drinking water. Utilities must consider all aspects of pricing to determine if their rates are set to truly reflect their costs.

The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA) established the WIFIA program, a federal credit program administered by EPA for eligible water and wastewater infrastructure projects. The city of Phoenix was selected by the EPA to apply for a WIFIA loan of $49 million for the Water Main Replacement Program that will replace over 150,000 linear feet of water distribution mains annually. The purpose of this program is to prevent costly, harmful water main breaks and interruptions in service often caused by failing infrastructure.

Another source of funding is the drinking water revolving fund programs from the U.S. Environmental Protection Agency (EPA) which has awarded more than $693 million to Arizona's clean water and drinking water revolving fund programs since their inception in 1988 and 1996, respectively. These funds support Arizona's efforts to address an estimated $16 billion worth of water infrastructure needs. In 2018 the EPA awarded more than $30.8 million to Arizona for drinking water and wastewater infrastructure improvements. According to the EPA, these funds are supplemented with state funding sources, which provide low-interest loans for wastewater and drinking water infrastructure projects.

The Drinking Water State Revolving Fund (DWSRF) received almost $20 million to improve public water systems including the City of Safford and the Tierra Buena Water Company. The Arizona DWSRF Loan Program funds publicly and privately-owned community water systems and nonprofit non-community water systems. Eligible projects include treatment, transmission and distribution, source, storage, consolidation, and creation of new systems. Projects for acquiring land or refinancing debt obligations of publicly owned systems may also be eligible. The program also places an emphasis on small and disadvantaged communities and on programs that address compliance and health advisories, as well as prevention and sustainability as tools for ensuring safe drinking water.

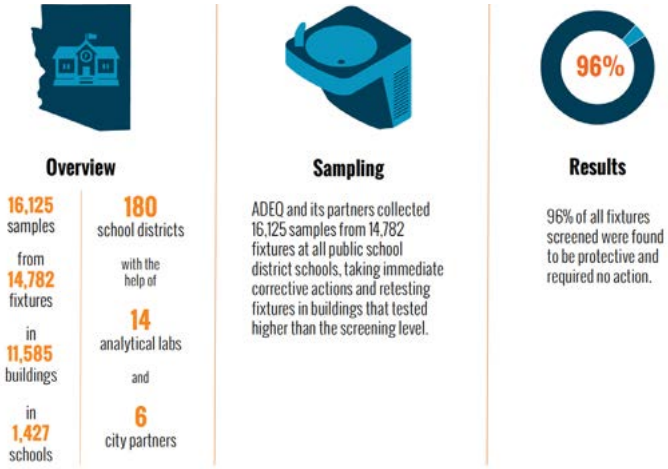
PUBLIC SAFETY AND RESILIENCE

Since the public health crisis in Flint, Michigan where many children were exposed to high levels of lead in drinking water, many areas of the country have demanded better testing for lead in their homes and communities. Young children, infants, and fetuses are particularly vulnerable to lead because the physical and behavioral effects occur at lower exposure levels to these populations. A dose of lead that would have little effect on an adult can have a significant effect on a child. In children, low levels of lead exposure have been linked to

damage to the central and peripheral nervous system, learning disabilities, shorter stature, impaired hearing, and impaired formation and function of blood cells. In pregnant women, lead can have serious effects such as reducing growth of the fetus and premature birth. In adults, lead can lead to cardiovascular deficiencies, increased blood pressure and incidence of hypertension, decreased kidney function, and reproductive problems in both men and women. The ADEQ conducted a screening program to test for lead in Arizona's public schools' drinking water and a report was published in December 2017. The report stated that rather than the water, the fixtures and piping were the source of lead for the small number of confirmed elevated levels found.

Subsequently, the Arizona School Facilities took on the task of addressing the identified fixtures and piping with an estimated repair cost of $400,000. The study also demonstrated that school buildings constructed before 1989 (older buildings) had a higher number of lead level exceedances due to protective construction standards that came into effect in 1987. As of the date of the report, Arizona was one of only four states that has completed any statewide lead screening program for school drinking water.

ADEQ SAMPLING PROGRAM SUMMARY



The Environmental Working Group (EWG) drinking water quality report for Arizona shows results of utilities that accumulated the most violation points between October 2015 to September 2018:

The Safe Water Drinking Act is a federal law passed in the 1970s that sets quality standards for the systems that provide Americans with drinking water. The Environmental Protection Agency uses a weighted point system to track violations of the law, including contaminants and treatment. This metric measures the number of violation points against public water systems per 1,000 residents served in each state. Based on this metric, drinking water in Arizona ranked 33rd in the nation.

INNOVATION

The U.S. Environmental Protection Agency (EPA) recognized 30 clean water and 25 drinking water infrastructure projects for excellence within the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) programs. Among those recognized is the innovative water reuse project in the Town of Marana in Southern Arizona. These exemplary projects showcase water quality improvements and public health protections that can be achieved when the federal government, states, municipalities, and local utilities work together.

RECOMMENDATIONS TO RAISE THE GRADE

Arizona's Drinking Water Infrastructure faces a $15 billion dollar deficit which leaves a gap in funding. The EPA's SRF helps but is not enough.

- **Protect groundwater in urban, rural areas** - Groundwater supplies about 40% of Arizona's annual water use, that is why we need to update groundwater management plans to make sure we're balancing and safely replenishing what's being taken out of our aquifers.
- **Overhaul the 1980 Groundwater Management Act** - The aquifers will suffer permanent damage if a policy does not guide the state into an environmentally sustainable use of our natural water sources.
- **Reassess water rates** - water rates have increased exponentially in recent years and the state needs fees that both ensure affordability for low income communities, so that they don't bear the disproportionate burden of rate increases, but also adequately maintain and repair existing systems.
- **Test any drinking water fixture in public school buildings** - water fixtures constructed before 1989 that have not been tested before could be exposing our children to lead. Develop a strategy to address the fixtures and piping with confirmed elevated levels of lead in drinking water.
- **Asset management** – encourage municipalities to adopt asset management technologies aimed at reducing waste and deferred maintenance costs.
- **Funding for resilient infrastructure** – Increase funding and programs that mitigate challenges to drinking water infrastructure and sources including climate related threats.

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https://www.epa.gov/waterdata

American Waterworks Association

Water Environment Federation

Tap Into Quality

Partnership for Safe Drinking Water

Water For People

Central Arizona Project

Arizona Department of Environmental Quality

Environmental Database

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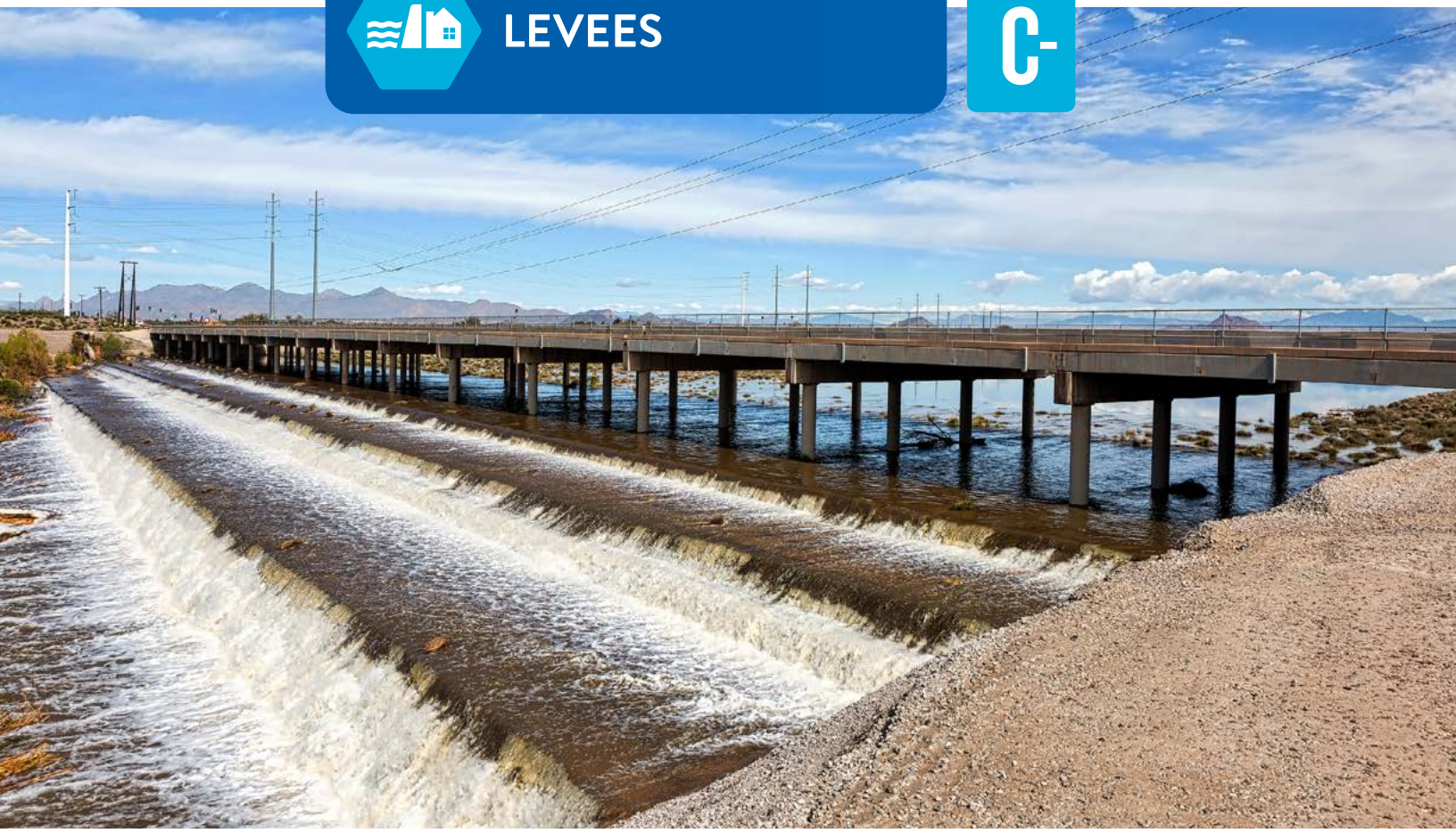
LEVEES

C-



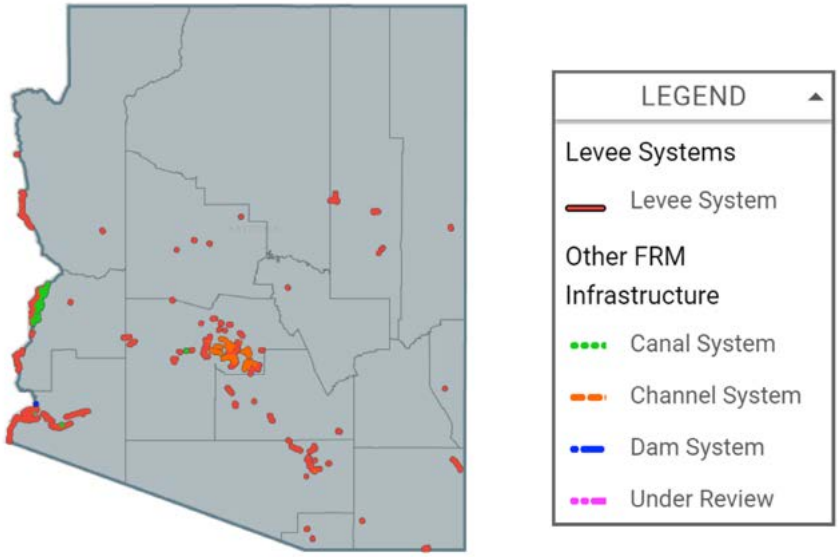
LEVEES
GRADE: C-

EXECUTIVE SUMMARY

Levees are critical to Arizona, protecting 345,000 people and close to $60 billion in property. Local flood districts typically perform the necessary operation and maintenance of these structures to ensure public safety of communities. While most levees in Arizona have been inventoried in the National Levee Database, just the 8% of them that are within the jurisdiction of the US Army Corps of Engineers have been screened for condition analysis. The average age of a levee in Arizona is 41 years old. It is likely that only a small percentage of levee owners in the state have adequate funding to address the estimated $10 to $20 million needed per year for repairs, upkeep, and upgrades as the levees continue to age and are burdened by impacts from development and changing runoff-rainfall characteristics.

INTRODUCTION

Levees have allowed Arizona to increase developable land and to protect existing populations and structures from flooding. Levees are usually artificial structures composed of earthen, cement stabilized aggregate (CSA), roller compacted concrete (RCC) embankments, structural concrete, or steel walls. According to the National Levee Database, there are 159 levee systems including 387 miles of levees in Arizona that protect 345,000 people, $58.8 billion in property and 112,000 structures from flooding. It is paramount to maintain these structures to prevent failures.



CAPACITY & CONDITION

The National Levee Database (NLD) was developed by the United States Army Corps of Engineers (USACE) with the purpose to inventory, review and assess critical information for levees, with a particular focus on levees not currently identified to be within USACE authority. There are 25 levees that are within USACE authority and 306 that are in authority of other jurisdictions. Along with identifying the levees, a Levee Safety Action Classification (LSAC) value was given to each levee studied. The LSAC provides state and local officials with a risk-based value to determine mitigation priorities. Some of the levee systems that protect major cities are listed below.

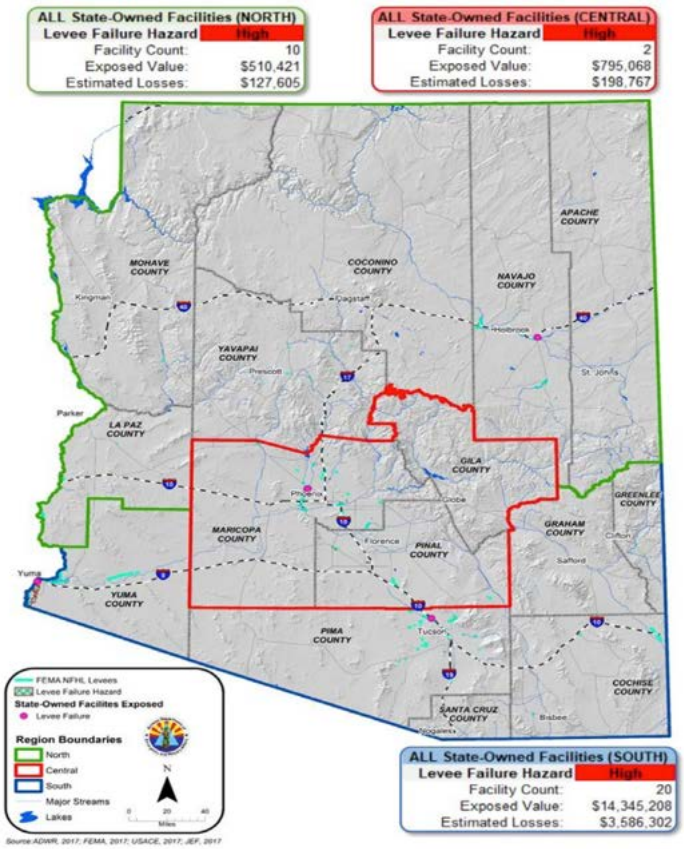
Levee System	City	Population	Property Value ($, Billion)
Indian Bend Wash 4	Scottsdale	24,700	$2.8
Tucson Diversion Channel 6	Tucson	17,800	$1.9
Indian Bend Wash 1	Scottsdale	6,800	$0.3

Source: National Levee Database

The NLD now includes a list of most levee systems in Arizona. However, as seen in the graph below, 91% of the levees in the database have not been screened due, in part, to a lack of collaboration between the NLD and levee owners. Failing to assess the levees' risk poses a threat to people in areas protected by levees; they remain without critical information to inform scheduling the infrastructure's maintenance or rehabilitation.

The Federal Emergency Management Agency (FEMA) maintains a database of FEMA accredited levees as a part of the National Flood Hazard Layer (NFHL). Areas of reduced flood risk protected by a levee, are specially designated as such on FEMA maps and in the NFHL database. These special FEMA zones are considered a "best available" data source for mapping potential levee failure zones. The NLD also contains a data layer that shows the leveed areas for most of the USACE authority levees; however, the NFHL dataset is more comprehensive. This may change once the USACE completes the inventory and review process, and future updates should query the NLD as a possible source for defining levee failure hazard areas.

The map below shows a statewide depiction of FEMA accredited levees and the reduced flood risk zones (or leveed areas) that are protected by the levees.



The 2018 State of Arizona Hazard Mitigation Plan identifies the following areas of concern:

North Region

The North Region is the second-most vulnerable state region when considering the history of events, the exposure estimates, and number of local plans that included levee failure in their risk assessment. The Winslow Levee experienced two flooding instances in the recent past. First was an overtopping failure in 1993. This flooded 204 parcels and damaged 140 structures. The second was a piping failure at the end of 2003. Other levees along or near the Little Colorado River in Navajo County have a history of failure risk, and especially in and around the City of Winslow. There is also a possibility of significant post-wildfire flooding that could significantly overwhelm existing capacities. Local hazard mitigation plans for the North Region identified a total of 24 assets with a total replacement value of $118.3 million. Total potential losses to local CFI for levee failure inundation were estimated at $29.6 million.

Central Region

Among the three state regions, the Central Region has the most significant vulnerability when considering the history of events, the exposure estimates, and number of local plans that included dam and/or levee failure in their risk assessment. Alternately, the Central Region arguably has the greatest amount of resources for active dam and levee maintenance and repair, as well as modeling and mapping of hazard areas. Local hazard mitigation plans for the Central Region identified a total of 113 assets with a total replacement value of $143.0 million.

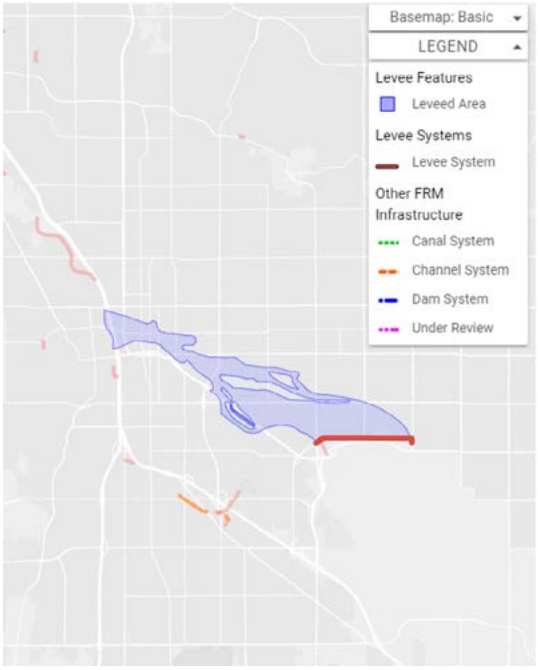
Southern Region

The South Region is the least vulnerable state region when considering the history of events, the exposure estimates, and number of local plans that included dam and/or levee failure in their risk assessment. Local hazard mitigation plans for the South Region identified a total of four assets with a total replacement value of $1 million. Total potential losses to local CFI for levee failure inundation were estimated at $200,000.

PUBLIC SAFETY

One of the levees identified in the National Levee Database as a "moderate" risk is the "Tucson Diversion Channel 6" which protects 19,849 people, 6,805 structures and $1.94 billion in property value. The levee has a limited loading history with a maximum loading of 32% of its height in 2007 and an estimated overtopping frequency is approximately 1 in 200.

NLD - TUCSON DIVERSION CHANNEL 6 LEVEED AREA



Levees do not eliminate flood risk but can provide critical time for local emergency management officials to evacuate residents safely. It is important to communicate accurate and timely information about the risk of living and working behind levees. Communicating risk-related issues and safety concerns is paramount, supports USACE efforts, and can facilitate local decisions aimed at reducing risk.

Flooding associated with levee failures can result in injuries and loss of life to the general public located within the inundation zone. Fatalities are usually due to drowning. Another very disruptive effect is when this hazard leads to isolation or evacuation. The evacuation alone can cause considerable trauma and stress for those affected, not to mention those who must find shelter for their pets and livestock. Long-term recovery will take months if not years, and in some cases permanent relocation may be required. The speed of emergency response, efficiency, and communication are key factors in maintaining public confidence during and after a flood event. The effects of flooding are destructive and disruptive to jurisdictions and often continue after the immediate event has passed. Power outages are likely, and travel may be hindered due to flood waters, debris, and blocked roads. Some government functions may be reduced or lost during a significant flood event. Public employees may be removed from normal duties to help in the response and recovery efforts, putting some less critical government operations on hold. Public facilities may be impacted by the flooding, causing services to be relocated or suspended until the agency can recover.

OPERATION & MAINTENANCE

In most cases, for levees other than those designed and constructed by the USACE in Arizona, non-Federal sponsors have the responsibility of operations and maintenance. Non-Federal sponsors are typically a community or a Flood Control District. In some cases, the jurisdiction is transferred from the entity that constructed the infrastructure (i.e. the USACE) to a County Flood Control District for ongoing operation and maintenance.

Arizona Department of Water Resources (ADWR) serves as the state's lead agency for levee safety. By participating in the USACE National Levee Database inventory project and coordinating with FEMA through the Cooperating Technical Partnership (CTP) program, ADWR is able to coordinate federal and local agencies to better inspect, maintain, and track levees within our communities. However, this interaction does not always translate into practice.

Flood Districts are responsible for the majority of the operations and maintenance of our levees today. For example, Pima County Regional Flood Control District projects play a vital role in protecting Pima County residents from flooding and erosion hazards. The Engineering Division delineates existing flood and erosion hazards to assist the Floodplain Management Division and undertakes activities intended to reduce flooding and erosion by designing and constructing improvements that will safely convey floodwaters and protect channel banks from erosion. These projects address regional flood and erosion control needs in incorporated and unincorporated areas of Pima County, in areas with repetitive flood damages, as well as to reduce the potential for future flood damages. For example, major work has been done and continues to focus on improvements along the Santa Cruz River and in Arroyo Chico to control drainage and repetitive flooding in the urban core of Tucson and South Tucson.

RESILIENCE AND INNOVATION

The primary climate change impacts to levees are related to potential changes in the way precipitation and resultant flood patterns may vary and the potential for increased wildfire activity. The National Climate Assessment (NCA) report notes that one of the anticipated impacts of climate change for the Southwest is a reduction in average annual precipitation and streamflow volumes. The report and supporting documents also indicate that winter storm intensities are anticipated to increase, which may lead to increased event-based flooding. The NCA report also notes that winter precipitation will be less in the form of snow and more frequently rain, which may indicate more frequent winter flooding. The overall flooding conditions for watersheds upstream of levee facilities could also be exacerbated by the potential for reduced vegetation due to increases in drought or post-wildfire flooding conditions.

The resilience of Arizona's levees is impacted by development and local land use change. The phenomenon known as "development creep" happens when development begins to encroach into the leveed areas, increasing the exposure of population and infrastructure to the risk of post failure inundation. Furthermore, potential changes in watershed rainfall-runoff characteristics due to the addition of significant impervious areas can translate into increased runoff volumes that may exceed or challenge the design capacities of the levee structures.

It is difficult to confidently say that Arizona's levees are resilient to the changing climate since 278 levees have not been screened. More data is needed to be able to properly assess the resilience Arizona's levees. Furthermore, innovation is lacking in our approach to inspections and much less in our levee technologies.

FUNDING AND FUTURE NEED

ADWR's floodplain management program is partially funded by FEMA's Community Assistance Program (CAP). One of the main objectives of the CAP is to assure that jurisdictions adopt and enforce floodplain management regulations in accordance with requirements of the National Flood Insurance Program (NFIP) and the Arizona Revised Statutes (ARS).

Without a Levee Safety Action Classification for all the levees in Arizona, it is difficult to quantify the cost of the repairs, inspections, and relevant operation and maintenance (O&M) activities. According to the NLD, most levee systems in the state are non-USACE levees, which means that the levee owner is responsible for all or most of the costs of O&M, repair, and/or rehab of the levee. As a result, there is no centralized database for the local jurisdiction to provide costs to operate and maintain the levees in our state.

The USACE pays 75-100% of repairs if the levee system is in USACE's programs and funding is available. Following the methodology used by the Kansas chapter of the American Society of Civil Engineers' 2013 Infrastructure Report Card Committee for estimating the cost of repairs, levee repairs can be up to $50,000 per levee mile for minor repairs and upkeep and up to several million dollars per mile for upgrades or repairs following a levee failure. There are approximately 387 miles of levee in the state, and nearly all will require maintenance in the next 20 years. Assuming an average improvement cost of $500,000 to $1 million per levee mile, the resulting funding deficit is likely $194 million to $387 million over the next 20 years, or approximately $10 to $20 million per year. It is likely that only a small percentage of levees in the state have adequate funding for long-term repairs that will be required as the levees continue to age.

The National Levee Safety Program includes funding for the nation's inventory of levees (the National Levee Database), so if the program were fully funded at its authorized at $79 million/year, it would provide $30 million/year (USACE funding) for levee rehabilitation.

RECOMMENDATIONS TO RAISE THE GRADE

Leadership is required on state and federal levels to coordinate levee maintenance and repairs, and to identify needed improvement to hold back major floods. Innovative methods of communication and synchronization of activities between levee districts are needed.

- **Jurisdictions who own and maintain the levees must work together with the Arizona Department of Water Resources (DWR), FEMA and USACE to complete the National Levee Database for both federal and nonfederal levees. An important step is to fully fund The National Levee Safety Program.**
- **Allocate proper funding to rehabilitate levees and increase maintenance funding to upkeep our aging levees.**
- **Improve public safety awareness by communicating the risks associated with levee failures and the inability to assess a risk due to a lack of data.**

SOURCES

U.S. Army Corps of Engineers Levee Portfolio Report "A Summary of Risks and Benefits Associated with the USACE Levee Portfolio" March 2018

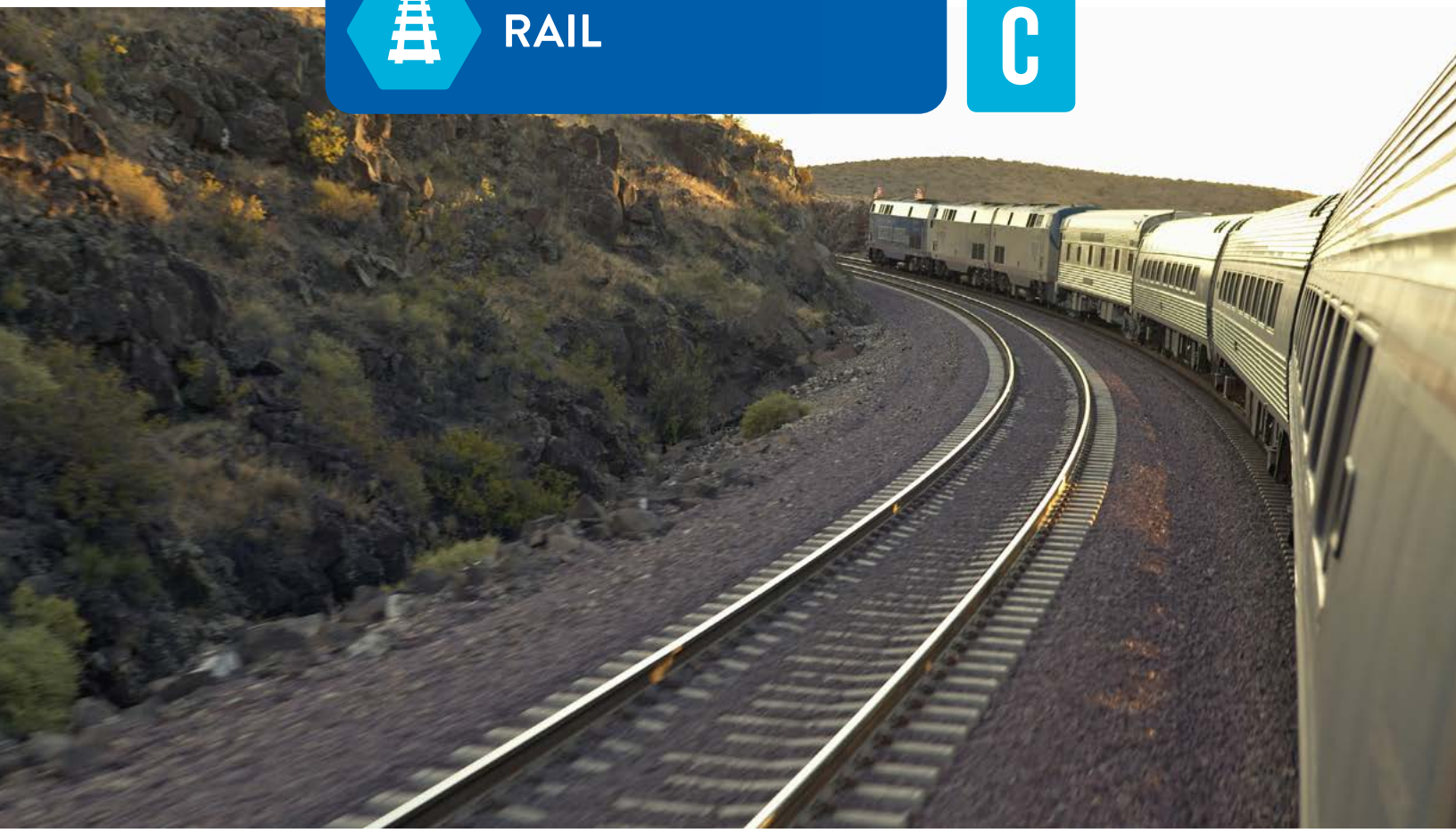
National Levee Database
https://levees.sec.usace.army.mil/#/

2018 State of Arizona Hazard Mitigation Plan
https://dema.az.gov/sites/default/files/publications/EM-PLN_State_Mit_Plan_2018.pdf

AZ Department of Water Resources US Army Corps of Engineers, National Levee Safety, http://www.usace.army.mil/NationalLevee-Safety/

RAIL

C



RAIL
GRADE: C

EXECUTIVE SUMMARY

Arizona rail infrastructure is comprised of two Class I railroads, eight Class III/short line railroads, Amtrak for passenger rail services, and two small tourist railroads. Most rail freight traffic in the state is through-traffic, meaning it continues to other nearby major ports. There has been a decline in passenger rail usage statewide, while freight rail continues to grow beyond the current capacity. Investment in additional passenger rail options, and upgrades to existing freight rail should be the priority moving forward.

CONDITION & CAPACITY

Passenger Rail

There are three Amtrak routes that service Arizona: Sunset Limited, Texas Eagle, and Southwest Chief. Combined, there was a 5% decrease in ridership from 2017 to 2018.

Amtrak's Sunset Limited route traverses 1,995 miles between New Orleans, Tucson, and Los Angeles. The Sunset Limited route crosses the southern tier of Arizona on the Sunset Route of the Union Pacific (UP) Railroad with stations in Benson, Tucson, Maricopa, and Yuma. It is limited to one trip per day in one direction (Thrice weekly, 6-days per week service) and has bypassed the capital city of Phoenix since June 1996. However, in 2017 Amtrak began operation a thruway shuttle service in Maricopa that connects passengers to Phoenix and Tempe. This route is often delayed due to single track rail lines and competition with freight trains, and as of 2018 had an on-time percentage (OTP) of 30.3%.

Amtrak's Texas Eagle route traverses 2,429 miles between Chicago, San Antonio, Tucson, and Los Angeles. However, only the route from Chicago to San Antonio has daily round-trip service. The remainder of the route from San Antonio to Los Angeles transports passengers three times per week, connecting the cars to the Sunset Limited route, which results in a 2-5-hour layover for train car coupling. Thus, this route has an OTP of 39.7%.

Amtrak's Southwest Chief route travels 2,256 miles between Chicago, Flagstaff, and Los Angeles. It crosses the north-central tier of Arizona on the Transcontinental 'Transcon' Route of the BNSF Railway. There are three stations in Arizona served by the Southwest Chief: Winslow, Flagstaff, and Kingman. It features daily round-trip service and has an OTP of 47.0%.

Freight Rail

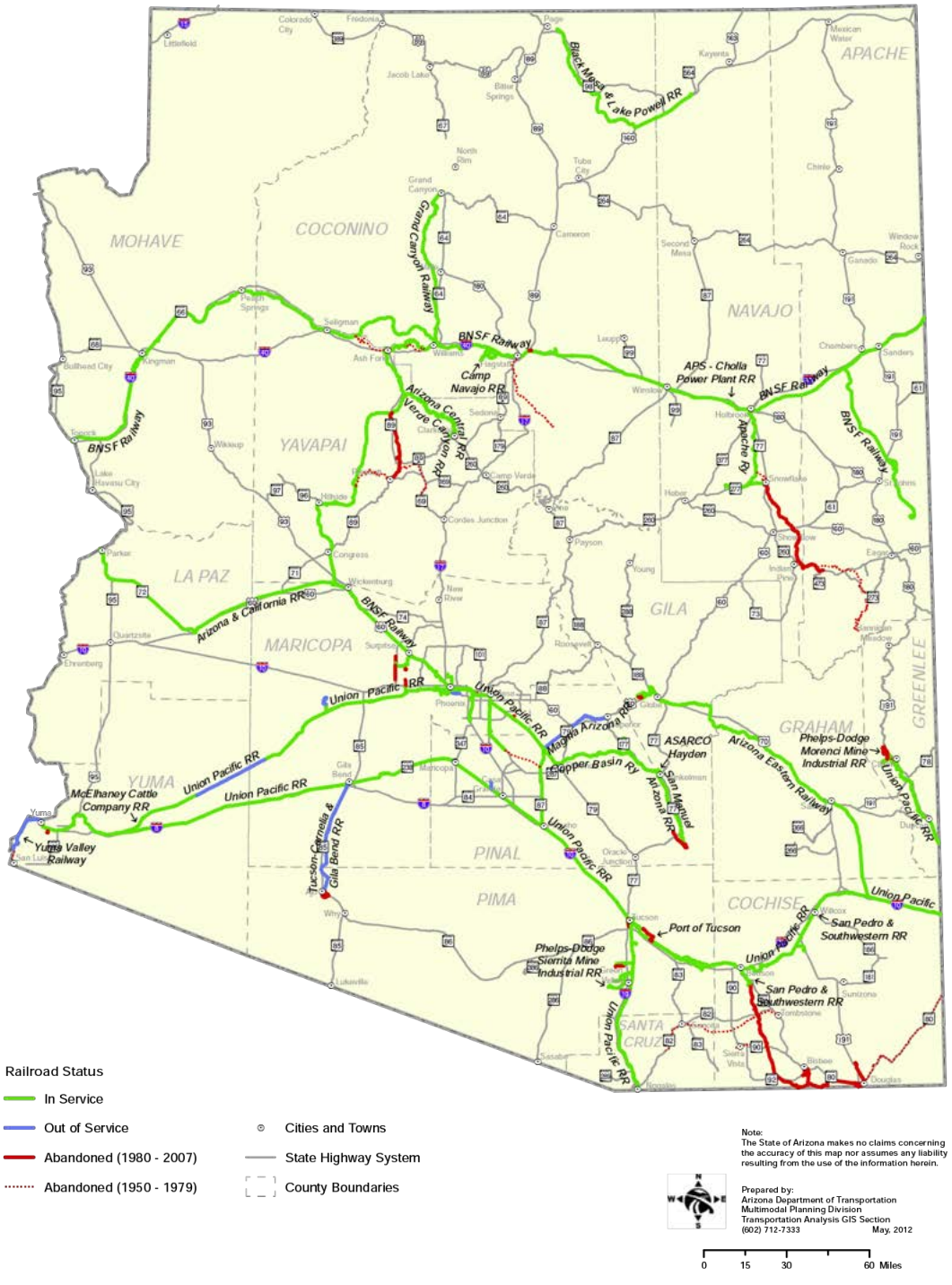
U.S. freight railroads are privately owned and are categorized into three classes based on the distance served and earnings: large Class I railroads, regional/Class II railroads, and short line/Class III railroads. Arizona's freight rail system is made up of Class I railroads and short line/Class III railroads.

The two Class Is operating in Arizona are BNSF and UP, which own and operate a combined 1,465 miles in the state. Union Pacific recently completed double tracking the Sunset Mainline through Arizona and is in the process of planning new regional facilities near Eloy and Phoenix. These infrastructure improvements add capacity. BNSF is also in the planning process for new regional facilities near Phoenix and Flagstaff.

The Class III railroads in Arizona are: Arizona Eastern Railway (AZER), San Manuel Arizona Railroad Company (SMARRCO), Copper Basin Railway (CBR), Apache Railway (APA), Arizona and California Railroad (ARZC), Black Mesa and Lake Powell Railroad (BKLM), Magma Arizona Railroad (MAA), and San Pedro and Southwestern Railroad (SPSR).

Over 75% of all rail freight is through traffic, so it continues through the state to major hubs like the Ports of Los Angeles and Long Beach, Chicago, or Dallas. The remaining percentage of freight is either within the state, outgoing, or incoming to Arizona. A major weakness for freight rail is the limited capacity on the U.S.-Mexico border, and the need for additional rail infrastructure can only be fixed by private companies, not local and state transportation departments.

FIGURE 1: EXISTING ARIZONA RAILROADS



Source: Arizona - State Rail Plan (2011)

FUNDING

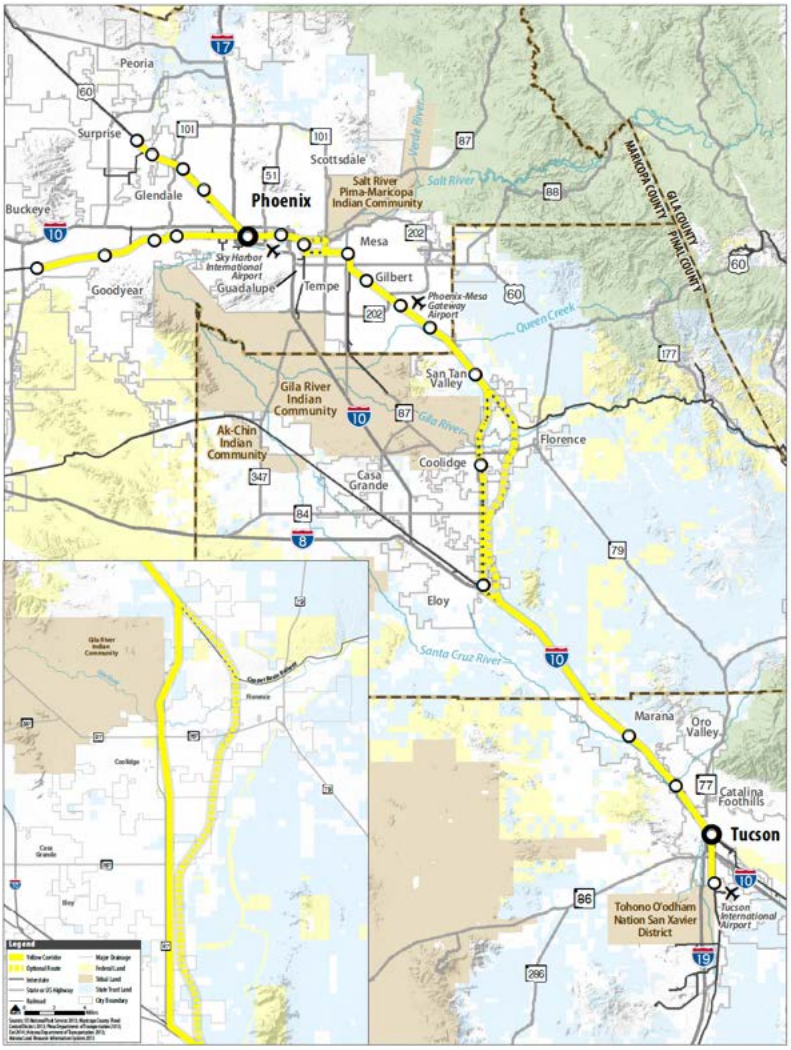
Funding for Amtrak comes from the federal government, state agencies, and user fees (i.e. tickets). State and federal funds also go toward grade-rail separations which help keep passengers and the public safe. ADOT has $116.8 million over five years apportioned from the FAST Act National Freight Program. Six freight projects will be addressed. One of which, the US 191 Cochise Railroad Overpass, is related to freight rail. This project is authorized for 2021 at $16.5 million. ADOT has an additional $14.2 million over five years from the FAST Act Railway-Highway Crossings Program.

Class I railroads fund and finance their own capital and maintenance needs. In 2016, Union Pacific reported spending just under $38 million to improve its rail infrastructure specifically in Arizona, including a $17.6 million investment to replace 180,099 railroad ties on the track between Yuma and Casa Grande and $5.1 million investment to replace 25,756 railroad ties and almost 3 miles of curve rail on the line between Vail, Arizona, and El Paso, Texas. In 2019, BNSF pledged $2.47 billion nationwide for maintenance, including replacing rail and installing railroad ties; $760 million will go towards expansion and efficiency projects for the Southern California-Chicago and Pacific Northwest-Upper Midwest lines.

FUTURE NEED

ADOT has been studying passenger rail service between Phoenix and Tucson, Arizona's two largest cities, since 2011. In September 2015, a Draft Tier 1 Environmental Impact Statement (EIS) was released to address the rail system's future need. After technical evaluations and consultations with the public and various agencies, the EIS consisted of two "build" alternatives, and one "no-build" alternative. ADOT and the Federal Railroad Administration (FRA) completed the Tier 1 EIS and signed the Record of Decision (ROD) in December 2016, selecting the Phoenix to Tucson Alternative shown below. In the Tier 2 EIS, this alternative will be further analyzed, but there is currently no construction schedule or planned funding for the project.

FIGURE 2: PASSENGER RAIL STUDY - PHOENIX TO TUCSON ALTERNATIVE



Source: ADOT website, https://www.azdot.gov/planning/transportation-studies/PassengerRail/overview

Phoenix Metropolitan Area

In 2018, MAG (Maricopa Association of Governments) released an update to the 2010 Regional Commuter Rail System Study, which analyzed commuter rail corridors in the region based on updated demographics, ridership, operations, and more.

The study focused on two corridors that cross the metropolitan area from east to west and north to south, with both lines intersecting in the downtown area. If constructed, both lines have a combined forecast of 20,975 boardings in 2040. Although it would cost upwards of $2.5 billion to build both commuter rail lines, with at least $10 million in operations and maintenance per year, the strong ridership forecasts mean the cost is on par with comparable rail systems nationwide, and actually lower than average O&M cost per passenger. However, these costs do not include right-of-way purchases or operating rights payments to freight railroads.

Southern Arizona

The Pima Association of Governments (PAG) released the 2045 Regional Mobility and Accessibility Plan in 2016, which includes a focus on regional rail projects as well as freight rail. Union Pacific Railroad operates a freight line, averaging 45-50 trains per day, across Southern Arizona with a sub line that connects to Sonora, Mexico. The Plan addresses the improvement of freight rail infrastructure, specifically projects around the Port of Tucson in the future. Within the City of Tucson, the Plan identified a number of projects focused on railroad grade separation. However, at this time, only a handful of planned projects have funding.

The PAG 2045 Regional Mobility and Accessibility Plan focuses on both freight and commuter rail options. The plan recognizes the need for an expansion and investment in both types of rail infrastructure in Pima County's future.

OPERATION & MAINTENANCE AND PUBLIC SAFETY

Privately-owned freight railroads are responsible for the operation and maintenance of their track and signal systems. Capital investments by the freight railroads include bridge, signal, ballast, track, and drainage improvements. In general, Class I railroads spend about 40 cents of every dollar of revenue on capital expenditures and infrastructure maintenance. Because Amtrak operates on private freight rail lines, their operation and maintenance costs primarily relate to station and personnel expenditures. Several of Arizona's stations have been rehabilitated in recent years and/or have benefitted from funds, like BNSF's $2.47 billion for maintenance in 2019, that also contribute to the public safety of rail systems.

A major public safety concern in regard to railroads is collisions at grade crossings, which accounts for 95% of all rail-related fatalities and injuries. In Arizona alone there are a total of 695 railroad crossings, with 331 Union Pacific crossings, 150 BNSF crossings, and 214 for other railroads. On a positive note, only 1% of all railroad crossings in Arizona do not have any signs or signals.

Arizona receives an average of $2.3 million in Section 130 funds (Highway-Rail Crossings Program) per year for grade crossings improvements. On the private side, BNSF invests approximately $117 million each year for grade-crossing maintenance, improvements, and safety programs; they also have one of the lowest rates of highway-railroad crossing collisions, declining 70% between 1995 and 2018. Union Pacific partners with communities through UP CARES to educate the public about rail safety, along with investing in infrastructure replacement. However, even though a majority of the railroad crossings have warning signs or signals, and there is continuing investment from the private railroads, the collision rate has stayed about the same for the past few years.

TABLE 1: ARIZONA RAILROAD ACCIDENT AND INCIDENT DATA, REPORTED BY RAILROADS

Year	Total Accidents	With Fatalities	With Injuries
2016	23	0	1
2017	11	0	1
2018	23	2	1
2019	26	1	1
2020	4 (through March 31, 2020)	0	0

Source: FRA Accident Data

TABLE 2: ARIZONA RAILROAD ACCIDENT AND INCIDENT DATA - TRAIN ACCIDENTS, GRADE CROSSING INCIDENTS, CASUALTIES, OTHER INCIDENTS, AND OPERATIONAL DATA

Year	Total Accidents	With Fatalities	With Injuries
2016	122	16	80
2017	118	15	82
2018	101	14	59
2019	122	19	74
2020	23	4	14

Source: FRA Accident Data

RESILIENCE AND INNOVATION

Rails-to-Trails is a not-for-profit organization with a focus on connecting communities to the outdoors via once-used railroad corridors. The program converts former rail lines into multi-use trails throughout the nation, bringing transformative health and environmental benefits to communities. Within Arizona, there are 13 total rail-trails totaling 73 miles, with potential for 13 additional miles of rail-trails.

In order to meet the future needs of freight rail and passenger rail within the state of Arizona, there needs to be a focus on mobility (a typically difficult to measure metric) as well as sustainability-related goals such as social, environmental, and economic benefits in order to create a rail system that better serves the state's communities. Lastly, as frequency of extreme weather events, droughts, and wildfires increase, the rail sector must evolve and incorporate these challenges into infrastructure designs, O&M, and planning to ensure resilience of the system to meet Arizona's needs.

RECOMMENDATIONS TO RAISE THE GRADE

To raise the rail grade, the Arizona Section of the American Society of Civil Engineers recommends the following actions:

- **Updated Statewide Rail Plan**
- **Continue to implement safety improvements and educate on railroad safety**
- **Invest in private freight improvements for additional capacity**
- **Improve passenger rail services and plan for future passenger rail in and between major cities**

SOURCES

Arizona - State Rail Plan (2011)

ADOT Passenger Rail Study (2011-2014)

Amtrak FY2018 Company Profile

Amtrak Fact Sheet, Fiscal Year 2017, State of Arizona

MAG – Commuter Rail System Study Update (2018)

MAG - 2040 Regional Transportation Plan (2017)

MAG Regional Freight Transportation Plan (2017)

Federal Railroad Administration (FRA) – www.fra.dot.gov

ADOT Long Range Transportation Plan (2018)

ADOT Transportation in Arizona (2016)

Arizona State Freight Plan (2017)

ADOT – Multimodal Planning Dept. - Transit Programs and Grants, www.azdot.gov/planning/TransitProgramsandGrants

National Transit Database (NTD)

PAG 2045 Regional Mobility and Accessibility Plan

FHWA FAST Act

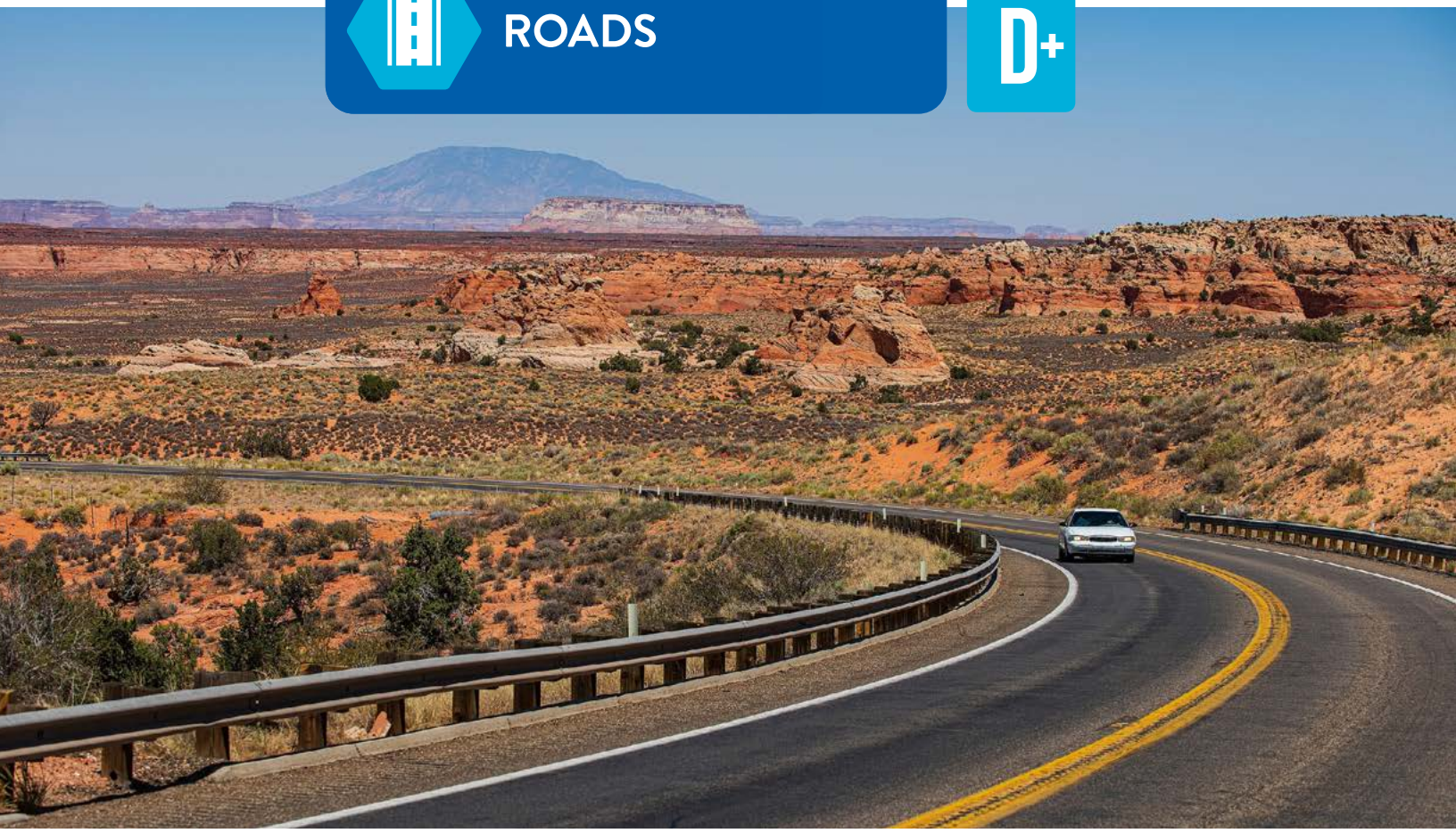
Association of American Railroads - Freight Railroad Capacity and Investment

BNSF

Rails to Trails

ROADS

D+



ROADS
GRADE: D+

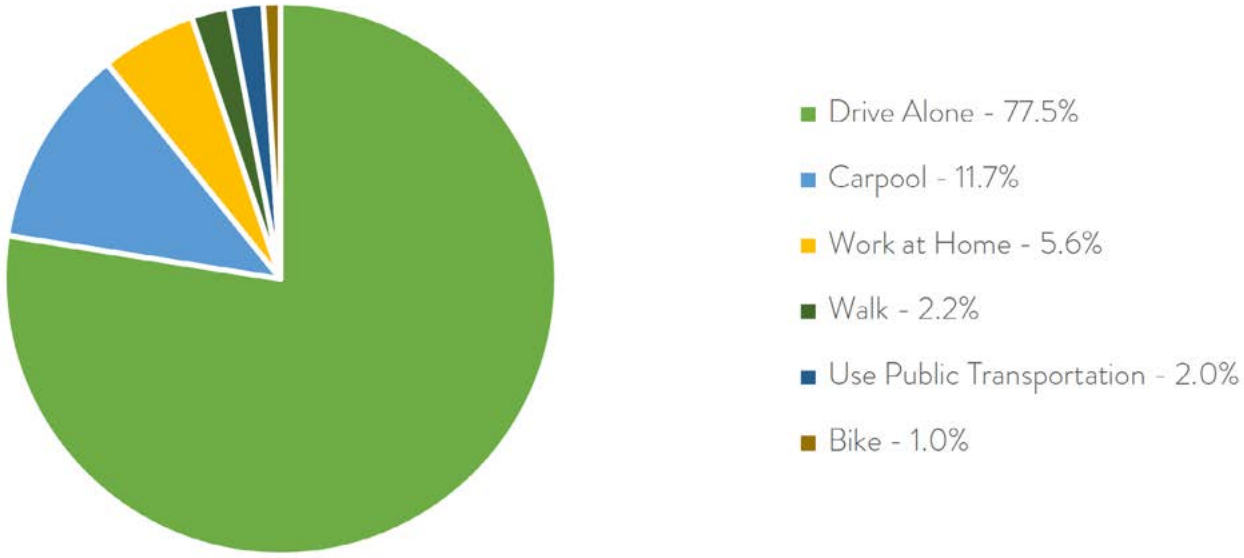
EXECUTIVE SUMMARY

Arizona's road infrastructure is critical to the state's economic success. Arizona's population, 6.6 million people, is using more than 66,000 miles of public roads, each traveling an average of 36.4 miles per day. Residents and visitors exert a significant demand on the state's roadways, so the local, state, and federal funding cannot adequately keep up with the expansion, modernization, and preservation required for safe and well-maintained roadway infrastructure. More money could be allocated to infrastructure by raising the gas tax and voting in favor of transportation initiatives. For Arizonans, the repair costs attributed to poorly maintained roads and bridges is reported to be more than three times what the cost of an increased gas tax would be.

CONDITION & CAPACITY

Arizonans are highly dependent on motor vehicles. Data shows 89.2% of people drive alone or carpool to get to work; 5.2% walk, use public transportation, or bike, while the remainder work from home. Vehicle travel on Arizona's highways increased by 32% from 2000-2017, while vehicle travel increased nationally by 17%. Similarly, Arizona's population has grown by 37% from 2000-2017, while the United States' population grew by 15%.

All of these factors place stress on Arizona's roadway network. In 2018, 43% of Arizona's major roads were in poor or mediocre condition. Driving on poorly maintained roads costs Arizona drivers $3 billion a year in extra vehicle repairs and operating costs. The cost per motorist has risen to $576, which is $258 higher than in 2015. 40% of Arizona's urban interstates experience congestion during peak hours. Across the U.S., traffic congestion costs American motorists $170 billion a year in wasted time and fuel costs. In 2015, this cost was reported as $121 billion a year.



FUNDING AND FUTURE NEED

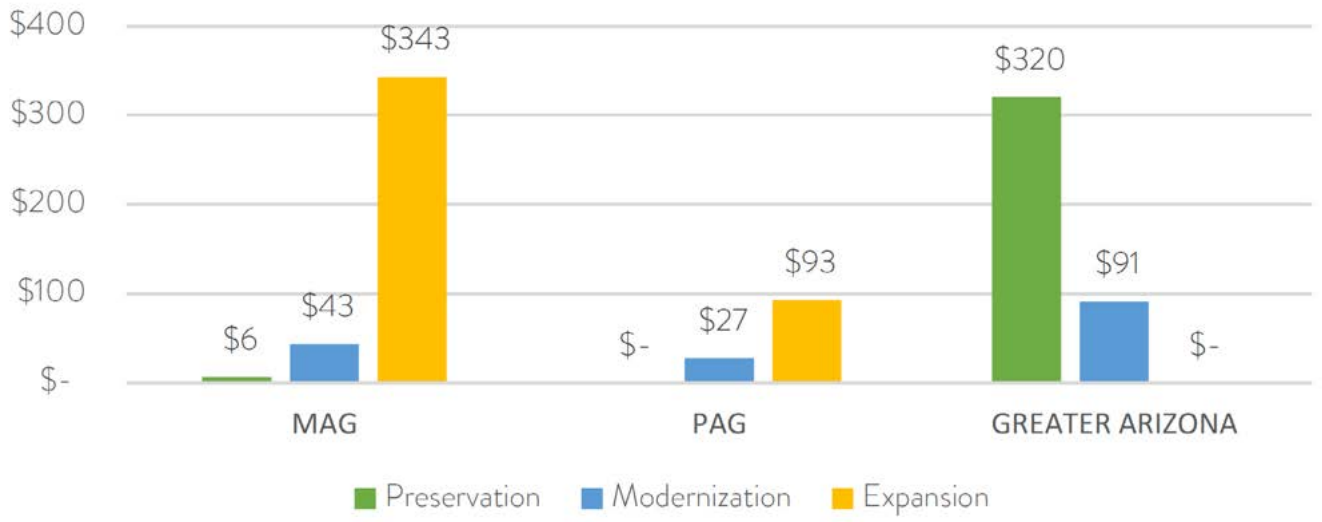
Expected Funding and Allocation

According to Arizona Department of Transportation's (ADOT) Long Range Transportation Plan for 2016-2040, Arizona's 25-year statewide federal, state and local investment needs total $98.3 billion. Operations and maintenance account for $8.7 billion of that total. The State Highway User Revenue Fund (HURF), county transportation excise tax, and federal funding programs are expected to provide $31.1 billion for ADOT funding. After accounting for operations and maintenance and supporting local transit agencies, $22.8 billion should be available for highway capital spending, yielding just over $30 billion as the expected 25-year gap for capital funding.

The total average annual highway capital spending is expected to be $923 million. ADOT's recommended investment choice allocates money to three major investment types:

- Preservation – Spending to keep pavement smooth and maintain bridges on the state highway system.
- Modernization – Non-capacity spending that improves safety and operations of the existing state highway system through activities such as adding shoulders and implementing smart road technologies.
- Expansion – Improvements that add capacity to the state highway system through new roads, adding lanes to existing highways and constructing new interchanges.

Due to ADOT's anticipated budget shortfall, the 2016-2040 Long-Range Transportation Plan preferred to allocate statewide funding to preservation and modernization only. However, with cooperation from ADOT, the Maricopa Association of Governments (MAG) and the Pima Association of Governments (PAG), which serve the greater Phoenix and Tucson metropolitan areas, respectively, decided to allocate their portion of the money through planning processes and voter-approved plans. Due to voter approved initiatives, a large portion of their money must go to expansion.



Population Growth and Increased Demand on Arizona Roads

The population, number of registered vehicles, number of licensed drivers, annual vehicle miles traveled and number of vehicles per household have all trended upward from 2012-2015. Additionally, Arizona is projected to add over 165,000 jobs from 2018-2020. At the same time, the roadway system is deteriorating and the need for improvements is significantly exceeding the amount of state and federal funding available. If completing the needed roadway improvements were possible, it could stimulate short-term and long-term economic growth by creating jobs, reducing travel delays and minimizing transportation costs.

Limited Revenue Sources

In December 2015, the Fixing America's Surface Transportation (FAST) Act was signed into law to provide funding for surface transportation infrastructure planning and investment. It authorized $305 billion from 2016-2020 for highway, safety, public transportation, rail, research, and technology programs, allocating $775 million to Arizona per year on average. This allowed state and local governments to move forward with important transportation projects knowing they will have a committed amount of federal funds.

With FAST Act funding expiring in 2020, it fails to provide a permanent source of revenue for the federal Highway Trust Fund. The federal Highway Trust Fund is supposed to be mostly financed by the federal gas tax but its balance is quickly decreasing due to inflation, improved fuel efficiency, increased use of electric vehicles, and travelers choosing alternative modes of transportation. According to the Congressional Budget Office, the Highway Trust Fund is projected to have a deficit of $74.5 billion by 2025 and possibly a $97 billion deficit by 2026.

Arizona's Highway User Revenue Fund (HURF) collects taxes and fees on fuel, registration and operation of motor vehicles. The funds are distributed to the cities, towns, counties, and the State Highway Fund and are a primary source of revenue for Arizona's highway construction and improvement expenses.

Other revenue sources include a half-cent sales tax that has been approved for PAG and MAG's respective Regional Transit Authorities, but these are not permanent and will need to be reapproved by voters.

Increasing the Gas Tax to Improve Roads

The Arizona gas tax is 18 cents per gallon, but diesel fuel is taxed at two rates. Heavy vehicles are taxed at 26 cents per gallon but light class vehicles and exempt vehicles (such as school buses, government and non-profit vehicles) are taxed at 18 cents per gallon. The federal gas tax is an additional 18.4 cents per gallon and was last raised in 1993. The Arizona gas tax was last increased in 1991. Arizona has the 5th lowest gas tax in the country.

In 2018, the General Contractors Association of New York, Inc. published an article stating that 49 of the 50 states pay significantly more each year in vehicle operating and repair costs due to poor road and bridge conditions than they would if Congress increased the gas tax by 25 cents and the money was dedicated to rebuilding the nation's failing transportation infrastructure. The cost per household of a 25-cent increase in the gas tax is reportedly $281 in Arizona. As of March 2020, the vehicle operating costs per household from roads in poor condition is estimated to be $576 per driver.

OPERATIONS AND MAINTENANCE

The Arizona Department of Transportation (ADOT) is responsible for maintaining, operating and improving all 18,488 miles of the state highway system which carries 50% of the total traffic and almost 90% of all heavy truck traffic.

ADOT makes it clear that the TSMO's purview does not include routine road maintenance. Its strategies for asset management include implementation of technological advancements and recurring roadway system analyses to enhance or improve efficiency, access to information, and public safety. As of March 2016, ADOT has put into operation the Transportation Systems Management and Operations (TSMO) set of strategies intended to improve the existing infrastructure by employing systems, services, and projects to maintain the capacity and improve the reliability and safety of Arizona's transportation system.

PUBLIC SAFETY

There were 982 traffic fatalities in 2019 in Arizona. In 2018, Arizona's traffic fatality rate was 1.53 per 100 million vehicle miles of travel, which is higher than the national average of 1.13 and higher than the 2015 reported rate of 1.40.

Roadway features are estimated to be a contributing factor in one-third of traffic fatalities. When this is the case, it costs Arizona motorists $2.1 billion per year in medical costs, lost productivity, travel delays, workplace costs, insurance costs and legal costs.

Arizona has the third highest fatality rate and places 16th in most fatalities involving drivers who are 65 and older. Due to the rapidly growing number of older Americans, Arizona needs to provide safer roads, safer vehicles, and more transportation options to keep up with their transportation needs.

In January 2017, ADOT, the Department of Public Safety and the Governor's Office of Highway Safety created four safety corridors. Special signs, targeted public outreach and increased enforcement in these areas are intended to reduce crashes, injuries and fatalities. Meanwhile, Phoenix and Tucson have begun to implement Complete Street policies that will provide additional infrastructure such as sidewalks, separation for pedestrians from vehicular traffic, and bike lanes to encourage active transportation and increase connectivity.

RESILIENCE AND INNOVATION

Despite budget shortfalls, ADOT is continuing work on several transportation related projects to include technological and innovative advancements. These advancements include modifying existing highway sensors to detect wrong-way vehicles and alert authorities and other drivers. New sensors may be placed along the highway to alert drivers on the overhead message boards when dust creates dangerous driving conditions between Tucson and Phoenix.

Additionally, ADOT has embraced autonomous vehicles by being a member of the Arizona Self-Driving Vehicle Oversight Committee and participating in conversations with auto manufacturers, technology companies, and other states to determine how best to implement self-driving vehicles safely and effectively. ADOT has a procedure in place that requires notification or certification when vehicles are intended to be tested with or without a driver. In 2015 Governor Ducey made Arizona the first state to provide an executive order that supported the testing and operation of autonomous vehicles. More than 600 test vehicles have been on the state's roads with over a dozen companies testing their vehicles or technology.

ADOT also participates in the Federal Highway Administrations' Every Day Counts Initiative which is designed to identify innovative opportunities to reduce the time it takes to design and construct highway projects. The Arizona Council for Transportation Innovation (ACTI) was created in 2012 to meet the initiative's requirements and expedite the safety and protection of the environment by developing ways to accelerate the highway improvement process.

RECOMMENDATIONS TO RAISE THE GRADE

- **Raise the federal and state gas tax to provide dependable funding for infrastructure maintenance, expansion and innovation!**
- **Pass bonds or additional sales tax measures for transportation improvement programs!**
- **Prioritize maintenance of public roads to provide a safer and dependable road network!**
- **Increase public and political awareness of the importance of maintenance and preservation of the existing transportation system!**
- **Encourage and expand public transportation opportunities to reduce the wear and tear on the public road system!**

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TRIP, Arizona Transportation by the Numbers, www.tripnet.org, (March 2020)

USDOT Federal Highway Administration, Highway Statistics (2017 & 2018)

USDOT Federal Highway Administration, Fixing America's Surface Transportation Act (2019)

USDOT Federal Highway Administration, State by State Apportionment Tables (2015)

USDOT Bureau of Transportation Statistics, Arizona: Transportation by the Numbers (2016)

USDOT National Highway Traffic Safety Administration, Traffic Safety Facts: Arizona (2013-2017)

TRANSIT

C

TRANSIT
GRADE: C

EXECUTIVE SUMMARY

For every dollar invested in public transportation, approximately four dollars in economic returns are generated. An investment in transit is an investment in our community. Arizona has begun its commitment to public transportation, including pursuing and acquiring several grants, however more can and should be done to ensure all Arizonans have efficient and reliable access to transit. Arizona legislators can accomplish this by raising the gas tax (which has not been raised in nearly 30 years). Furthermore, Arizona should continue to foster and encourage innovative solutions to reaching transit and assisting users complete their last mile. One option to improve this is to allow more electric scooters throughout the state with adequate regulations.

Public transportation contributes to a healthier environment by improving air quality and reducing oil consumption; this is important in Arizona where air quality often ranks in the bottom half of the country and Arizona cities are spread out. Taking bus or light rail can free up time and attention when someone else is driving; this is important for young and old transit users alike, who are seeking alternatives to driving themselves across the state.

However, transit is only as effective as its accessibility. Reducing traffic congestion, increasing mobility, and saving money begins at transit users' ability to easily and quickly access transit. While Arizona can be proud of the progress made to make public transportation a viable option, more can be done to expand services and improve first-mile/last-mile connections to public transportation.

CAPACITY AND CONDITION

There are a multitude of existing public transit programs, such as: local and express buses, light rails, streetcars, neighborhood circulators and shuttles, rural connector buses, dial-a-ride, and vanpools. However, a large proportion of the state's population does not have reasonable access to public transit. Arizona has local and regional transit systems in 13 of the state's 15 counties with a total of five urbanized and 22 rural transit systems. Nine of these counties are in rural Arizona and provide essential services to residents throughout the state. Arizona's transit systems, though, are mainly focused in the four largest urbanized areas: Phoenix metro area, Tucson, Flagstaff, and Yuma. These urban areas feature varying degrees of dedicated local transit funding, governing authority over regional transit, and regional funding sources.

In Arizona, about 13% percent of the workforce do not drive themselves to work and instead use other means such as carpooling, bus, or light rail to commute to work. Transit agencies in Arizona are constantly working to provide services to different users and communities including park and ride stations, where commuters can park their vehicle conveniently near a public transit stop and continue their commute through public transit. Carpool programs and incentives have also been implemented, such as the Get On Board program by Tucson's SunTran, which works with employers and employees; and carpooling programs implemented by both Sun Tran and Valley Metro. Most impressive are the extensions and improvements to Phoenix public transit since the pass of Proposition 104 in 2015, which increased the transportation sales tax from 0.4% to 0.7%.

The list below offers a summary of the services provided by the larger urban areas in Arizona.

Services	Valley Metro (Phoenix Metro Area)	Sun Tran (Tucson)	Yuma County Area Transit (Yuma County)	NAIPTA (Flagstaff)
Bus/Express Routes	62 local, 6 RAPID, 14 Express, 20 Circulators, 1 Rural	29 local, 12 Express	9 fixed and flex routes	9 fixed routes
Streetcar	N/A	3.9 mile loop, 148 approx. capacity per vehicle	N/A	N/A
Light rail	28 miles, 12,000 passenger/hour capacity	N/A	N/A	N/A
Vans/ Shuttles	416 Vanpool vehicles 167 Dial-A-Ride vehicles	SunVan, SunShuttle Dial-A-Ride	YCAT Vanpool, YCAT OnCall (Paratransit)	Mountain Line Vanpool, Mountain Lift Paratransit

While plans are in the works to add to Arizona's existing public transit fleets, the current conditions are as follows:

- SunTran reports in their About the Fleet (2019) report an average age of their bus fleet of approximately 7.8 years.
- Valley Metro reported in their System Fact Sheet (2019) the following average age of vehicles:
  - Bus - 6.8 years
  - Rail - 10 years
  - Dial-a-ride - 4.5 years
  - Vanpool - 4 years

OPERATION & MAINTENANCE

Operation and maintenance (O&M) for Arizona transit systems includes XZY. Valley Metro provided operation statistics for FY 2017-2018 which detail a total annual operating expense of more than $369 million. However, during that fiscal year, their fare revenues only accounted for 15.46% of their operating expenses, a trend that also happened the following year. Additionally, Sun Tran encountered a similar challenge; in 2019, the organization earned less than 20% of the year's total expenses needed for the year – including routine O&M expenses. Consequently, both areas depend on a combination of federal, state, and local funds to fill gaps in funding.

FUNDING

Arizona supports transit infrastructure through fare revenue and other directly generated revenue streams such as fees charged for parking. The responsible agencies may also receive money from federal, state, and/or local government. ADOT's projected revenues for transportation infrastructure (highways and rural transit) from FY 2016 - 2040 includes $3.5 billion.

The Arizona Department of Transportation and Multimodal Planning Division (ADOT-MPD) manages and administers a variety of transit programs on behalf of the Federal Transit Administration (FTA) to benefit Arizona public transit; examples include the Metropolitan Transportation Program, Enhanced Mobility of Seniors and Individuals with Disabilities, and the Rural Public Transportation Program, to name a few. In addition, the FTA Capital Investment Grants program provides funds for transit capital investments and three projects in Arizona have been selected as part of this program:

- **Transit Spine Bus Rapid Transit (Flagstaff, AZ) - CIG Funding $32.9 million**
  The Northern Arizona Intergovernmental Public Transportation Authority proposed to implement a corridor-based bus rapid transit (BRT) service in a 13-mile corridor between the Flagstaff Pulliam Regional Airport and the Flagstaff Mall. The proposed project includes traffic signal prioritization, queue jump lanes, and some bus-only lanes
- **Northwest Extension Phase II (Phoenix, AZ) - CIG Funding $198.26 million**
  Valley Metro plans to extend its light rail system from the existing end of line station in Northwest Phoenix to the Metrocenter Mall. The project includes the purchase of three light rail vehicles, the relocation of the existing Metrocenter transit center, and the construction of a Park and Ride lot.
- **Valley Metro South Central Light Rail Extension (Phoenix, AZ) - CIG Funding $529.86 million**
  Light rail system extension from downtown Phoenix to the South Mountain Village Core via Central Avenue and 1st Avenue. The project includes track improvements, expansion of the existing Operations and Maintenance Center, purchase of 17 light rail vehicles, and construction of two Park and Ride lots.

Other forms of revenue for Arizona's public transit sector come from federal grants and passenger revenue. In 2015, Proposition 104 passed in Phoenix which is meant to be the foundation of a plan to invest over $31 billion across 25 years in the metropolitan public transit system through various sources including federal grants. Early this year the City of Tucson in conjunction with Sun Tran announced they will be receiving a new grant from the FTA Human Trafficking Awareness and Public Safety Initiative, totaling over $221,000.

FUTURE NEED

A statewide Long-Range Transportation Plan named What Moves You Arizona (WMYA) 2040 was developed to address the growing needs of the state's transit system. The plan covers a 25-year horizon from 2016 to 2040 to address the current transportation infrastructure. The first step involves carrying out research for Arizona's MPOs and other ADOT partners regarding the state's current transportation status, including anticipated system performance. In February 2018, the WMYA plan identified an investment need of $14.8 billion to operate, maintain, and improve the state's key public transit facilities and services. It also revealed that $6.2 billion is needed for passenger rails, and nearly $1 billion would be needed to address bicycle and pedestrian needs. The total needs for the 25-year time span was more than $98 billion.

The program also provided investment priorities from the gathered data. It broke down investment areas into three categories: preservation, modernization and expansion. From allocated future resources, it suggests investing 35%, 18%, and 47%, respectively, into each category, noting expansion with almost half those resources. Currently, four light rail extensions and streetcar are planned or under construction to create an approximate 49-mile system by 2030 in the Phoenix metropolitan area.

PUBLIC SAFETY

Arizona has a unique challenge due to its extreme weather, where transit users are more sensitive to the distance needed to access transit stops. Valley Metro and Tucson's SunLink provided studies that estimated the accessibility to transit in the areas with larger populations. Valley Metro shared a 2017 American Community Survey (ACS) indicating that 2,098,240 people live within ¼ mile of a bus route. This survey also reports that Maricopa County has a population of 4,307,033, which would indicate that 51% of the Maricopa population live within ¼ mile of a bus route. SunLink reports that 100,000 people live and work within a half mile of the streetcar route. Tucson has an estimated population of 545,975, indicating that the streetcar is accessible to approximately 18.3% of the Tucson population.

INNOVATION

- City of Peoria is currently testing an autonomous shuttle service
- Flagstaff and Lake Havasu have evaluated the potential of implementing on-demand transit service
- Waymo is partnering with Valley Metro Rail to provide first/last-mile connections
- Cities including Phoenix, Tucson, and Mesa are beginning to adopt bikeshare programs
- Cities including Tempe and Phoenix have begun to adopt the use of carshare programs (i.e. Scoop)

RECOMMENDATIONS TO RAISE THE GRADE

- **Advocate and support legislation to increase funding related to repairing and rehabilitating Arizona's public transportation infrastructure.**
- **Raise and allocate state gas tax to support the expansion of local and regional transit systems.**
- **Prioritize the movement of public transportation through bus rapid transit (BRT), transit signal priority, and transit only lanes.**
- **Coordinate efforts with land use planners and developers to incorporate transit-oriented development principles to create more walkable and accessible urban environments.**
- **Leverage the opportunities provided by e-bikes and e-scooters to connecting users in the first/last mile trips, as well as creating a larger and more robust pedestrian and bicycle networks.**

SOURCES

What Moves You Arizona (WMYA) 2040 - Arizona's Long-Range Transportation Plan

ADOT Multimodal Planning Department - Transit Programs and Grants www.azdot.gov/planning/TransitProgramsandGrants

AASHTO Bottom Line Report

Federal Transit Administration Grants - www.fta.dot.gov/grants

National Transit Database (NTD)

MAG Transportation Programming Guidebook MPO/COG Reg.

Federal Highway Administration - https://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm

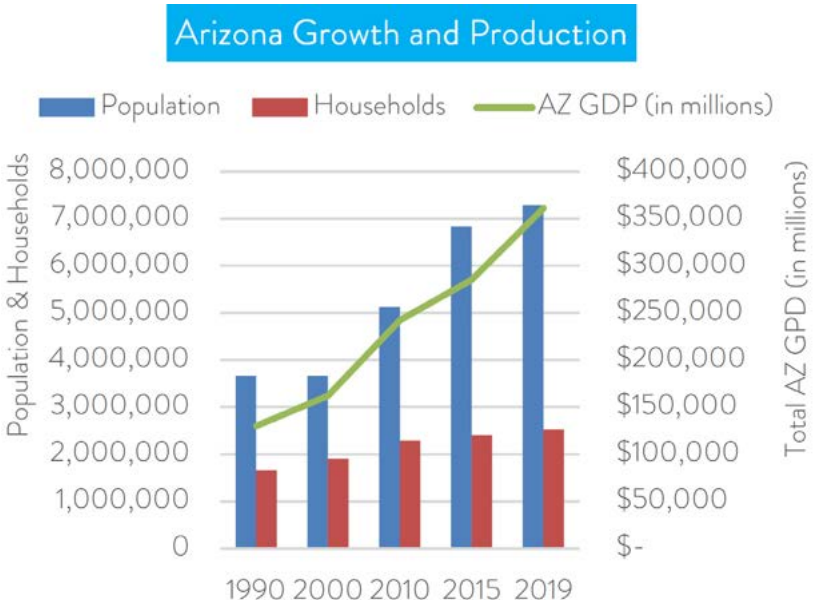
WASTEWATER
GRADE: C-

EXECUTIVE SUMMARY

Wastewater infrastructure serves our basic sanitation needs with a measurable value for public health, quality of natural environments, and the ability to support population and economic growth. However, for Arizona's wastewater sector to maintain the state's economic and projected population growth, 25 to 50% of the state's wastewater network, and 10% of the wastewater treatment plants (WWTPs) require rehabilitation, plus expansion of more than a dozen WWTPs. Additionally, disparities in technical, financial and management capacity exist between urban and rural utilities. Throughout the sector, up to 15% of additional staffing or workforce replacement is needed. Although the majority of WWTPs have up-to-date assessments of their needs, Arizona's wastewater infrastructure has a $1.4B investment shortfall. Though a significant funding gap for our wastewater infrastructure exists, there has been a positive trend in recent investments, but those trends are not uniform across the State.

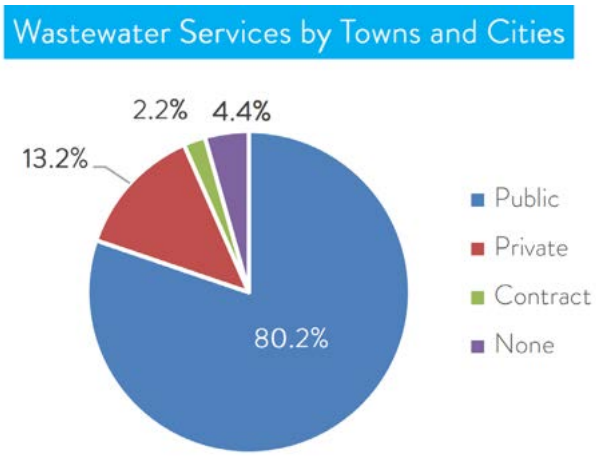
INTRODUCTION

Arizona's population exceeded 7 Million in 2019 according to the U.S. Census Bureau and has experience a 315% growth since 1970. One of the distinctive features of our population distribution is that as of 2019, 78.6% of Arizona's total population resides in one of the incorporated Cities or Towns and 65.1% of our urban population resides in the Phoenix Metropolitan area, located in Maricopa County.



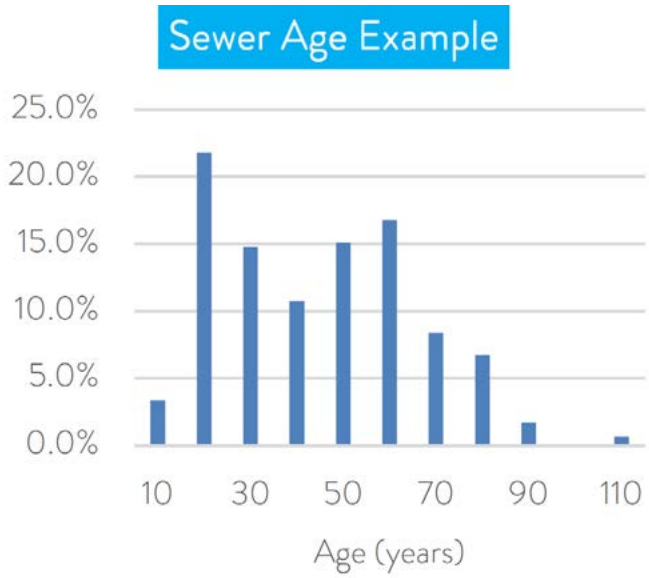
CONDITION & CAPACITY

There are over 26,000 miles of sewer collection pipelines and approximately 315 wastewater treatment plants (WWTP) in Arizona, where approximately 65% (204) of those WWTPs discharge treated effluent for beneficial reuse, accounting for 82% of treated effluent from WWTP in Arizona. Our wastewater infrastructure is provided by over 90 public utilities, across 43 Towns, 44 Cities in 15 Counties, in addition to approximately 50 private wastewater utilities, as regulated by the Arizona Corporation Commission. The diversity of Arizona's population, community density, and residential and industrial wastewater needs drives the trend towards concentration and development of centralized wastewater infrastructure.



In review of the capacity of the public wastewater collection entities, there are expansions required in the near future to extend infrastructure to and through planned development, with some upgrades of the existing wastewater collection network needed to enable expansion. However, we found that a majority (52%) currently maintain, or have recently completed master planning assessments, formally identifying the available capacity, in addition to the conditions of collection systems. This demonstrates a proactive approach to sustaining capacity needs in our collection systems.

When the age of that infrastructure was evaluated for one of the largest utilities, we found the majority was constructed 30 to 60 years ago as depicted in the example on the right. The materials for this type of infrastructure, although planned to have a 50+ year life cycle, were observed to have a life cycle closer to 30 to 40-years. Therefore, a massive effort will be required by our utilities to rehabilitate or renew 25% to 50% of our collection infrastructure in the next 10 years.



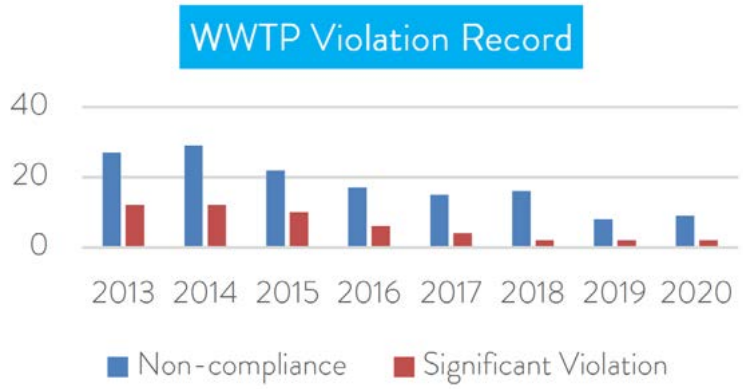
For WWTP's, once 80% of the average daily capacity is used, the design for expansion and/or improvements is directed and at 90%, construction should be initiated. Based on the available performance and capacity data, and review of short-term capital improvement planning of 151 of the public WWTP, it was identified that at least 14 expansions of WWTP with at least two new WWTP, plus the re-commissioning of two WWTPs are planned or needed in the next five years.

Evaluation of the response and needs of the private wastewater treatment providers revealed approximately 10% of the 50 providers have WWTP's that are projected to need improvements or expansion due to performance and/or capacity. Additionally, it is anticipated that up to 28% (88) existing public and private WWTP have advanced condition and or performance concerns, that may require rehabilitation, renewal and or optimization.

Approximately 16% of Arizona's existing households and 6% of new construction relies on decentralized wastewater treatment systems such as septic tanks according to a 2018 report on the construction industry from the U.S. Census Bureau. Septic systems remain a viable solution, well regulated by ADEQ and County environmental quality departments, and when engineered, constructed, regulated and maintained correctly, the potential negative impacts to our aquifers and natural habitats are minimized.

OPERATION & MAINTENANCE

Since 2013, there has been a reduction of approximately 63% in the quantity of enforcement cases relating to our WWTP's. However, the number of inspections has also reduced almost 61% in the past 10 years. This data reflects variations in our regulation agencies' capacity across those years and the commitment of providers to bring operations into compliance.



Most recently, ADEQ has both bolstered its staff and capacity, and invested in efficiency to support the costs associated with regulation and enforcement. However, other County environmental quality departments currently have a record number of requisition openings and staffing gaps. Review of public providers indicated a 5% to 15% of those openings left unfilled. Additionally, there is an ongoing and increasing shortfall in O&M staff to sustain our wastewater infrastructure. Out of 50% of public utilities evaluated, an average of two O&M staff openings remains unfilled annually. That may equate to 2% to 5% of staff for larger utilities but could equate to 25% of smaller utilities.

The best approach for identifying the practices and funding needed to support and sustain the state's wastewater sector is an increase in the use of proactive management techniques such as asset management and maintenance management. Formalized condition assessments, an evaluation of the actual and available level of service and/or a criticality analysis improve the strategic use of financial resources. Additionally, there has been increased investment in predictive and reliability-centered programs, focused on the monitoring and measurement of maintenance activities. These types of investments support data driven decision making, which yields a more effective financial and maintenance management outcomes of wastewater infrastructure. Within the past five years, 33% of public providers had initiated or continued, all, or portions of an asset management program focused on collection systems, 39.6% providers did the same for WWTP's.

FUNDING AND RESOURCES

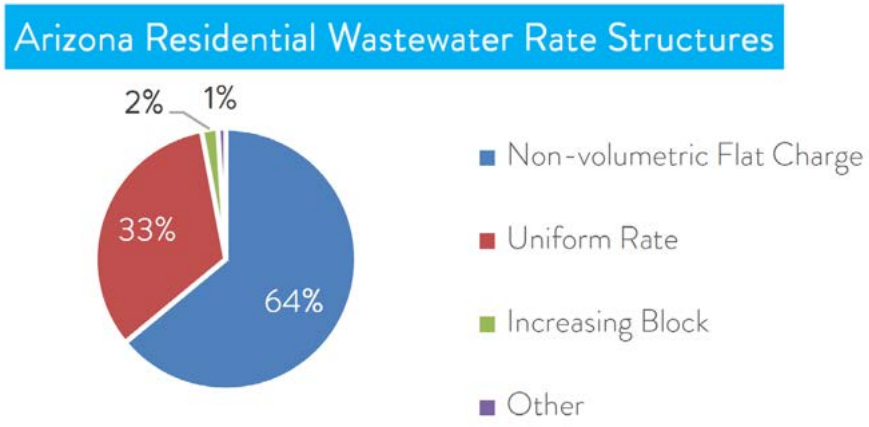
Wastewater utilities have a variety of funding sources, unique to whether they are public or private, and based on the type and extent of the infrastructure. Such funding sources include fees relating to services provided, development impact fees for new services, contribution from other tax revenue and external funding from State and Federal programs.

One of the primary external funding sources is the Water Infrastructure Finance Authority (WIFA), which finances drinking water and wastewater infrastructure projects for communities throughout Arizona. WIFA administers three main programs:

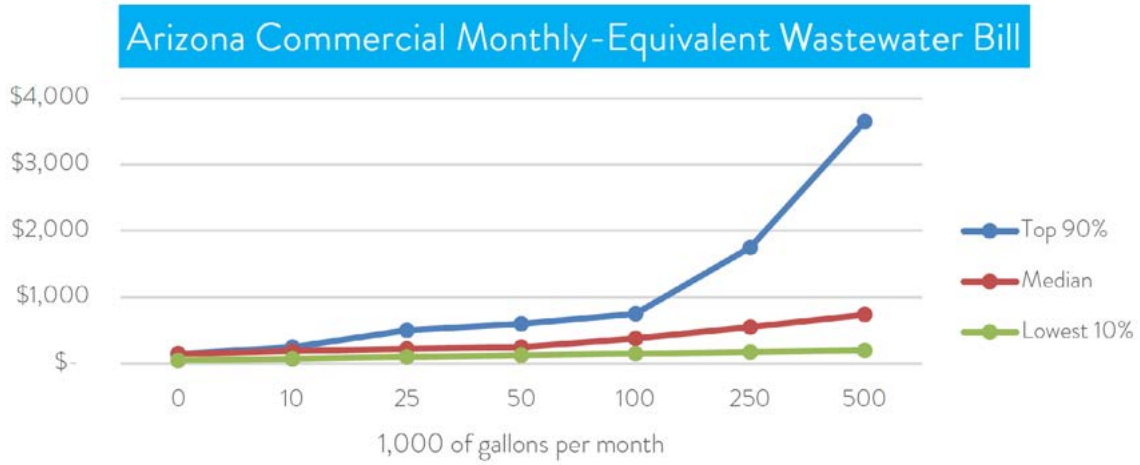
- Clean Water Revolving Fund Program – provides low-interest rate loans for the planning, engineering, constructing, upgrading and/or equipping of publicly owned wastewater and water reclamation projects. For disadvantaged communities designated by WIFA, it may also provide hardship grants instead of loans.
- Technical Assistance Program – Assists eligible wastewater and drinking water systems serving populations of 10,000 or fewer to prepare for project construction through pre-design and design grants.

Smaller utilities cannot always self-fund and depend on federal funding (administered through the state), especially for capital improvement projects.

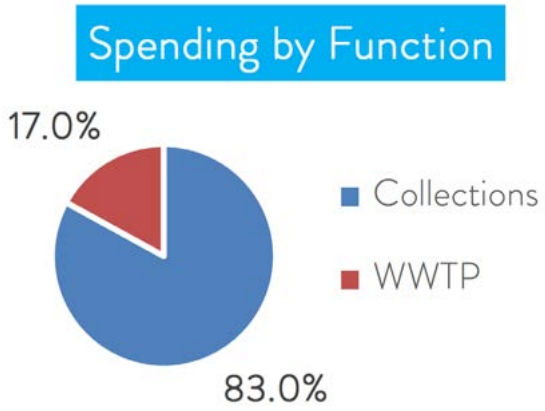
Of 132 providers evaluated, the majority (64%) of residential rate structure are based on a non-volumetric flat-rate structure. In contrast to the majority of residential customers, the use of increasing block or volumetric based wastewater fee structuring is used for commercial and industry needs and recovers more cost as the use increases.



The results of a recent survey revealed that 2 out of 5 utilities had not updated their rates in the last 5 years. This means approximately 56 wastewater utilities in Arizona are either operating based on old assumptions of revenue versus operating costs, or, have evaluated their rates and costs and have either decided they are adequate to sustain the required level of service, or have been unable to achieve requested rate increases through their specific political processes.



Overall, the change in status of the financial needs since 2015 continues to increase, along with the gap in available and applied funding. According to the USEPA Clean Watersheds Needs Survey (CWNS) in 2012 and 2020, the projected 2020 total financial needs to address known issues relating wastewater infrastructure for Arizona is $7.739B over the next five years, up 10% from 2012. Of that, a need of over $900M is identified, specifically for small communities. The projected spending over the next five years was $6.4B, indicating a shortfall of $1.4B.



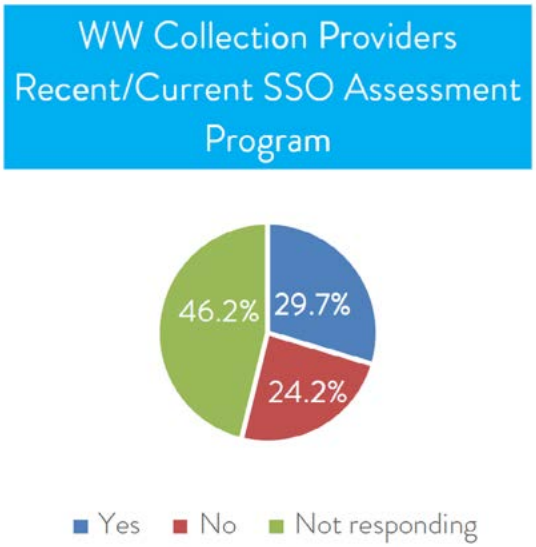
In review of the CIP spending across wastewater utilities between 2015 and 2020 we found an average increase of 4.2% amongst the largest public entities, in addition to significant investments in condition assessments and asset management programs. The percentages relating to collections or WWTP's spending in Arizona revealed a larger portion on collection systems. However, it is important to note that not all providers have a WWTP and rely on other utilities for that service.

PUBLIC SAFETY

Another concern for public safety relates to sanitary sewer overflows (SSO), which occur when raw sewage or untreated wastewater are released to the built or natural environment and can pose a threat to water quality and public health

The quantity, frequency and severity of SSO's can be reduced by proper evaluation and monitoring of the existing wastewater systems, and during the design and construction of new facilities. Based on recent USEPA projections of at least 23,000 - 75,000 SSO's per year (not including sewage backups into buildings) in the U.S., and based upon available recent data for Arizona, there is an estimated range of 500 to 950 SSO's in Arizona annually.

The ability to identify and reduce the number of SSO's is dependent on active assessments, monitoring and evaluation of our infrastructure. We found that out of the 91 public wastewater providers, and public information available 29.7% either have a current and on-going wastewater collection system condition and performance assessment or have completed one in the past five years. Another 24.2% of public providers have not, with 46.2% not responding or did not have information publicly available. Of the same 91 public providers, SSO data was available for 30%, in which the best reduction in SSO's since 2015 was 50%. However, the best results were mainly found with the largest providers, who have the resources to develop and implement assessment, monitoring and management programs. Those results substantiate that the investment can provide results and identify a gap in others having the capacity to develop or implement such programs.



INNOVATION & RESILIENCE

Improving the technical guidelines and regulatory framework to support improvements in the design, construction and operation of wastewater utilities, and for improved value and efficiencies in water reuse is in essence, an industry cultural change that reflects the need to develop and sustain more resilient and sustainable wastewater infrastructure. .

One example of that is the current development of the Arizona Department of Environmental Quality (ADEQ) Wastewater Treatment Plant (WWTP) Design Guidance Manual. The intent of the manual is to provide improved guidance regarding best practices and minimum acceptable requirements for design of WWTPs and their component processes and equipment in conformance with ADEQ's Aquifer Protection Permit (APP) rules and regulations. The Manual will provide improved guidance to consultants, designers, engineers, and applicants who are seeking an APP for a new WWTP, modification or amendment.

Another key stride in Arizona relates to direct reuse. Reclaimed water is already a significant resource helping Arizona meet increasing water needs, by offsetting the need to serve some industrial, agricultural and irrigation needs that would otherwise be met with raw groundwater or surface water, or potable water. Direct potable reuse (DPR) is the process of conveying treated wastewater effluent from a WWTP directly to an advanced water treatment plant (AWTP) for treatment, distribution, and potable consumption. There are a number of technical challenges and concerns that are currently being evaluated. However, the need for DPR is limited in Arizona at this time, due to various reasons, including but not limited to the following:

- •Those areas that have limited access to fresh water supplies do not have the wastewater collection and treatment infrastructure, or volume of wastewater to be economically feasible
- •82% treated wastewater effluent is already allocated for groundwater recharge, or beneficial reuse

However, several of Arizona's utilities have expressed interest, and supported, and invested in the development of these guiding documents. In 2019, the City of Scottsdale was the first in Arizona to obtain a permit to for a permanent AWTP to treat recycled water for potable water uses. This is a monumental step that many in the industry worked on for a decade, to demonstrate the interest and

RECOMMENDATIONS TO RAISE THE GRADE

In order to close the gap between the needs to sustain and improve our wastewater systems, and the funding and resources available, we need to both:

1. Exponentially decrease the costs to plan, deliver and maintain our infrastructure, and
2. Exponentially increase the available funding and resources

Only focusing on one of those items will not be enough. Here are some ways to work on, raising the Wastewater Grade:

- Work to bridge the disparity between the success of rural and urban utilities
- Continue the current industry momentum of implementing condition and performance assessments
- Formalize, initiate and expand asset management and maintenance management programs
- Take the time to review rates as operating context evolves, and evaluate the effectiveness of you rate structure(s), striving to keep rates predictable and affordable
- Evaluate the long-term cost with design decisions
- Align with the goals of the ASCE Grand Challenge, focusing on extending the life cycle of infrastructure
- Communicate the value of wastewater to your community, policy makers and legislators
- Promote the careers of wastewater professionals to our K through 12 grade students
- Identify opportunities to improve efficiencies, including administrative and bureaucratic systems, management, engineering, construction and O&M
- Consider social justice issues regarding inequality
- Increase funding to State and County environmental quality departments to carry out its mission to keep Arizona's water healthy
- Continue the pursuit of direct potable reuse

SOURCES

Here are some other links to information and data about our wastewater infrastructure:

American Society of Civil Engineers

Arizona Department of Water Resources

Arizona Laboratory for Emerging Contaminants

Arizona Municipal Water Users Association (AMWUA)

Arizona Water Association

Central Arizona Project

The History of Sanitary Sewers in Arizona

The University of Arizona Water Resources Research Center

USEPA

University of North Carolina (UNC) Environmental Finance Center

Water Environment Federation

The Water Research Foundation

WateReuse