INFRASTRUCTURE FOR ALL ALASKANS

Alaskans think about infrastructure a little bit differently than the rest of the United States. Alaska's infrastructure is truly unique, covering a vast area of over 663,000 square miles and supporting a population of just over 730,000. For transportation systems, there is no one mode of transport in Alaska, and sometimes the route is different depending on the time of year. Some homes do not have access to indoor plumbing, and while sometimes that's by choice, too often it's not. Many of Alaska's remote communities are still in need of water and wastewater systems that are safe, efficient, and sustainable, while even our most populated areas are still learning how best to handle every day solid waste in a subarctic environment.

Alaska's infrastructure investment is crucial to our way of life and the success of the economy. With declining oil prices and uncertain federal funding unable to keep up with the demand for projects or the operations and maintenance needs of current systems, the American Society of Civil Engineers (ASCE) Alaska Section wants to ensure Alaska's leaders have the best information available about the current conditions of Alaska's infrastructure. As Alaska legislators address budget challenges, the ASCE Alaska Section's Report Card – developed for Alaska, by Alaskans – demonstrates the importance of infrastructure investment.

There are solutions to Alaska's infrastructure poor grades! Together with the information provided in the Report Card for Alaska's Infrastructure, it is ASCE Alaska Section's goal that Alaska's Civil Engineers work together with state leaders to plan, design, build, operate and maintain a safe, efficient and sustainable infrastructure for all Alaskans.

RAISING THE GRADES

4 KEY SOLUTIONS

1. Have a Plan and Fund for the Future: All infrastructure owners and operators create and fund capital replacement plans for both immediate and long-term needs.

2. Maintenance is Key for Alaska: Maintenance is the everyday work that has to be done to keep things moving, and Alaska's infrastructure needs it. Sometimes it's all about the basics, and maintenance is the basic first step to good infrastructure. Maintenance need to be a consideration in design, as maintenance cost often is the largest ownership cost.

3. Keep Up Infrastructure Improvement Efforts: Elected officials must lead the efforts to improve Alaska's infrastructure for today and in the future. Alaska has some challenging times ahead, but kicking the can down the road will only cost Alaskans more in the future.

4. Innovate As We Replace: Alaska should support and encourage innovative solutions to infrastructure funding. The key to keeping up with rising needs is to keep replacing failing infrastructure with longer lasting, more resilient and smarter solutions.

Background on ASCE's Infrastructure Report Card Program

In 1998, the American Society of Civil Engineer's published the first Report Card for America's Infrastructure (Report Card). Using a simple A to F school report card format, the Report Card provides a comprehensive assessment of current infrastructure conditions and needs, both assigning grades and making recommendations for how to raise the grades. An Advisory Council of ASCE members assigns the grades according to the following eight criteria: capacity, condition, funding, future need, operation and maintenance, public safety, resilience, and innovation.

ABOUT ASCE - ALASKA

Civil engineers are entrusted by society to create a sustainable world and enhance the global quality of life. We are committed to maintaining and improving Alaska's infrastructure. Founded in 1951, the Alaska Section of the American Society of Civil Engineers (ASCE) represents about 850 civil engineers in Alaska. We understand that infrastructure is vital to our economy, health, and natural environment. With our commitment to serve and protect the public in mind, civil engineers throughout the state graded each infrastructure category according to the following eight criteria: capacity, condition, funding, future need, operation and maintenance, public safety, resilience, and innovation.

Report Card for Alaska's Infrastructure History

Members of the Alaska Section of ASCE have tried to prepare a report card for Alaska's infrastructure for over five years. Unfortunately, we never achieved full momentum, and it stalled several times. We finally had a group of dedicated engineers who were driven to complete the report card in 2016. Alaska's report card is complete, and we will have a formal launch on February 7th, in Juneau. At that time, the grades for nine categories of infrastructure will be released.

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What You Should Know about Alaska's Airports

Large portions of Alaska are only accessible by air or water. As many as 8 out of 10 of Alaska's communities are not connected to the road system. These communities depend on aviation for access to fresh foods, mail, and healthcare. Alaska Department of Transportation and Public Facilities (Alaska DOT&PF) owns and operates 242 of the 400 public use airports in Alaska and has identified rural airports as "Alaska's Lifeline. "In addition to the public use airports, another 300 landing facilities are registered with the Federal Aviation Administration (FAA) in Alaska and thousands of private landing facilities and lakes are not registered. Alaska has six times as many pilots and 16 times as many aircraft per capita, compared to the rest of the country as a whole. The people of Alaska are eight times more likely to use aviation as transportation than people in the rest of the country. Aviation in Alaska is a huge economic engine, contributing approximately $3.5B annually to the state's economy.

Capacity

Capacity and delays associated with capacity are not an issue at Alaska airports. Airfield capacity had been identified as a potential concern in the 20-year planning horizon of the 2014 ANC Airport Master Plan Update; however, activity growth since completion of that master plan has not met the forecast. The Alaska International Airport System (AIAS) – ANC and FAI, is an important cargo midpoint re-fueling stop between producers in Asia and consumers in the contiguous 48 states. Anchorage is second to Memphis in the U.S., and among the top five airports globally for cargo throughput, and serves approximately 5.4 million passengers annually. One effort to reduce future capacity issues at ANC is to incentivize some cargo traffic (those that are stopping only to refuel and change crews) to go to FAI where there is more capacity available. As traffic increases, this effort would allow destination cargo flights to arrive to Alaska while alleviating some of the pressure on ANC.

Daily fuel flowage at ANC alone is 1.7 M gallons. In 2012, Anchorage Fueling and Service Company added 4 new fuel tanks, to increase fuel storage capacity by 16 M gallons at ANC. This project helped increase the resiliency in case of a fuel delivery disruption. Due to a combination of reduced fuel sales and increased storage capacity, ANC went from about a 7-8-day reserve of fuel in 2006 to about a 20-day supply in 2016.

Condition

The Alaska DOT&PF has a robust pavement management system, inspecting airfield pavements, at both DOT&PF and municipally owned airports, every three years. The average pavement condition index (PCI) is used to measure pavement condition. All pavement surfaces are rated on a scale of 1-100, with 100 being newly constructed pavement. The current comprehensive pavement condition report for the state, published in 2013,

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report an average PCI for international and regional airports of 73, and 64 for community and local airports. Runway rehabilitation such as a pavement overlay is usually needed once PCI drop below 70, and reconstruction may be needed when PCI drops to 55-60.

In 2008, the Alaska Aviation System Plan estimated a total of $98.9 Million in deferred maintenance. The Majority of the deferred maintenance, 70%, refers to airfield surfaces, with buildings being the second largest category of deferred maintenance at $15.2M. Cargo handling facilities range from state of the art at large airports to an ATV pulling up to the cargo carrier at local airports. The common denominator is that the job gets done.

Operations and Maintenance

Only the AIAS is self-funded with regards to operations and maintenance. For all other public airports in Alaska, the airport owner has to augment some of the Operation and Maintenance costs.

Alaska DOT&PF, the largest airport owner in the state, with 242 airports, spends $34M annually on maintenance and operations at its 240 rural airports. Separated from this budget are ANC and FAI, which are self-funded. Maintenance and capital improvement needs are tracked by Alaska DOT&PF in their “needs-list”, a document that is updated annually to track both needs and in a near future, also improvements completed. The needs list, based on input from the local airport management, is used to guide annual budgeting of the state’s resources. This needs list is making its way into the digital aviation system plan over the next several years through thorough field inspections called CIMP’s (Capital Improvement and Maintenance Program). These inspections take an objective view of the needs on an airport and create a standardized system for measuring needs.

Safety

Take-off and landing are the segments of a flight with the most safety risk. When compared to many other states in the U.S., Alaska is over represented in aviation crash and fatality statistics.

In 2010, Alaska rolled out a new rate based safety metric: Fatal and Serious Injuries (FSI)/10,000 flight hours. This effort was undertaken to meet the FAA Administrators Flight plan. The goal was set to reduce FSI accidents in Alaska by 10% over a 10-year period. Base line was the average of FY06-08 (1.88 FSI/100,000 flight hours), this equals a goal of no more than 1.69 FSI/100,000 flight hours compared to the national goal of no more than 1.00/100,000 flight hours. Are we meeting the goals? In Fiscal year 2016, which ended September 2016, Alaska Aviation counted 15 fatalities, one less than the stated not-to-exceed goal for the year. Much work remains as FY 2017 started with three fatalities in Togiak.

Accidents are more common in Alaska because the availability of certified weather forecasts along flight route makes flight planning more challenging in Alaska, as the system plan shows the density of certified weather

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coverage is lower in Alaska in general than in the contiguous 48 states. Currently there are only about 130 weather stations in Alaska, to reach the same on-route density that is provided in the lower 48, we would need to construct 200 more weather stations. Safe airways are defined by well surveyed routes, access to certified weather along the route, and reliable navigational beacons along the routes.

Another factor contributing to the high accident rate is that land alternatives to support emergency evacuations are in many cases lacking, leading to higher necessary risk taking. As an example, the rural community of King Cove is home to 700 people who lack road access to an all-weather airport, occasionally leading to pilots attempting evacuations to save lives where in other states, they would have stayed on the ground. Since 1980, nineteen people have lost their lives attempting emergency evacuations from the community.

Funding & Future Need

Aviation in Alaska is a huge economic engine, contributing approximately $3.5B annually to the state's economy. With regard to capital spending, approximately $200 M is invested through the FAA Airport Improvement Program annually, with local matching funds equaling $13M - $15M are also invested annually. DOT&PF spends $34M annually on maintenance and operations for rural airports. Alaska's second largest airport owner, North Slope Borough, with 6 airports, spends approximately $1.4M in maintenance of their airports, and anticipate spending approximately $78M in capital investments during their Capital budget period 2016-2020.

Five airports collect Passenger Facility Charges to augment their capital budget. ANC being the only one collecting at the $3 per passenger level. The remaining four airports have maxed out their collection ability at $4.50 per passenger.

Another major funding source for Alaska Aviation is the Essential Air Service program (EAS). EAS provides subsidies to airlines for providing scheduled air service to communities. There are 61 communities in Alaska using EAS subsidies for passenger services. There are 237 eligible communities in Alaska, but for a combination of reasons, such as local match obligations or too small passenger volumes many communities are not taking advantage of EAS.

This may seem like a well-funded airport system by comparison, but construction costs in rural Alaska far exceed those of construction in urban Alaska and even more so than those of most locations in the rest of the country.

Shipping construction equipment and materials to communities often comes at an enormous expense – both shipping and isolating equipment from use on other projects. Many Alaska communities receive barges once or twice per year and have no road access; therefore, requiring extensive project planning in order to construct in a season. Many airports are also constructed on top of permafrost; a situation that greatly increases construction cost and overall maintenance. Permafrost also goes hand in hand with a shorter construction season where aggregates may not be thawed until halfway through the summer. Shifting ground and extreme weather

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conditions contribute to continual maintenance on lighting, pavement, and navigational aids on an airport. A review of the Alaska DOT&PF needs list reveals deferred maintenance at many airports, a problem that grows as it is pushed to the future. In 2009, Alaska DOT&PF estimated a deferred maintenance need close to $100M for the rural airport system. A new inventory of capital needs for DOT&PF owned airports is underway.

Innovation

The remote locations of Alaska airports often necessitate that engineers find innovative solutions to solve problems like scarcity of materials, extreme geography, and transportation costs. Finding sustainable design solutions may often be the only way a project can even be funded, often the final design is a combination of reduced material needs through reuse of in-situ materials and innovative solutions to augment the materials available on site. University of Alaska is studying how different stabilizers, resins and fibers can be used to "augment poor quality local materials" at lower costs than barging aggregates to the construction site. Barging, can add several hundred dollars of cost per cubic yard to a project. Engineering firms are also doing their best to repurpose local materials, a cubic yard of material saved is one that does not have to be brought in. Alaska DOT&PF has a program "Everyday Lean Innovations and Ideas" where maintenance staff is encouraged to find cost saving solutions to everyday problems. One winner designed a compact snow and ice crusher, called the Yeti, that allows staff to fracture ice and create pockets to allow deicing chemical under the ice for faster melt down.

Resilience

Alaska DOT&PF has taken several measures to increase emergency preparedness at remote locations. The state owns trailers with a portable replacement lighting system and generator that can easily be loaded on an airplane and deployed to remote locations, these trailers are stored at airports that maximizes rapid deployment. The trailer contains replacement runway lighting system with and independent power source. Remote airports have emergency generators to power airfield lighting. Alaska DOT&PF has installed emergency shelters at 21 rural communities, with 5 more communities being added to the program in 2016. These shelters are available for employees to use during bad weather or for overnight trips.

Alaska, with its vast distances and sparse population, offers a wide variety of engineering challenges to overcome in the design of infrastructure improvements. Many of Alaska's communities were established based on traditional hunting, fishing, trapping or trading areas, or in some cases the presence of particular natural resources in abundance. Site conditions are often challenging with permafrost, poor soils, lack of suitable material nearby or excessive erosion. Airport placement is often a challenge in remote communities. For example, river or ocean sandbars or coastlines have been used as initial landing sites at or nearby the community, leading to flooding and even changes in current. This is often the only suitable location for an

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airport and many locations now have improvements with lighting systems and upgraded structural sections for runways and taxiways.

Another aspect of design that is becoming more and more necessary is to consider the effects of climate trends on design criteria. How do we maintain the structural integrity of the ground when the permafrost starts to melt? How do we prevent erosion of the sandy beach that is normally protected from the winter storms by ice?

Let's Raise the Grade

- **Make funding deferred maintenance a priority**
- **Increase research funding to find cost effective alternative solutions to scarce aggregates**
- **Construct more "on-route" certified weather stations**
- **Continue the fly safe information program**

Find Out More

- **State of Alaska Aviation System Plan –** www.alaskaaasp.com

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What You Should Know about Alaska's Bridges

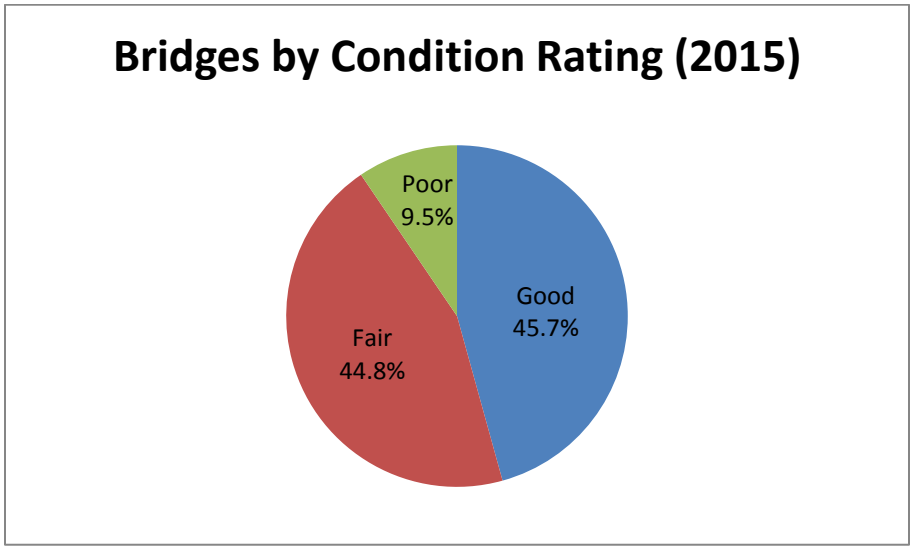
As of 2015 Alaska had 1,453 highway bridges open to the public; however, due to Alaska's vast geographic area and unique remote villages, only about half of those bridges are part of a conventional road system comparable to the rest of the United States. Alaska's "other" bridges are in communities with access limited to only boat or plane; are located in resource extraction areas with short lifespans and limited public use; or are only open for a few months of the year, such as those in Denali National Park. Most of the 481 bridges in Alaska owned and maintained by the federal government fall under these unique categories of limited use. Nearly all of the federal bridges – 455 of the 481 total – are only one lane wide and almost 75% have an average daily traffic (ADT) of 10 or fewer vehicles. As a result, this report only considers the remaining 972 bridges owned by state and local agencies, because they are permanent structures comparable to bridges in the contiguous United States.

Many bridges in Alaska are in cities not connected to the road system. These bridges off the road system don't see the same heavy traffic (both volumes and loads) as the bridges on the road system. The bridges on the road system are part of what's referred to as the National Highway System (NHS), which includes the Interstate Highway System as well as other roads important to the nation's economy, defense, and mobility. The Alaska Marine Highway System (AMHS) is also considered part of the NHS by the Federal Highway Administration (FHWA), so transfer bridges at ferry docks are included in Alaska's bridge inventory.

Condition and Capacity

With an average bridge age of 35 years, Alaska's bridges are younger than the national average of 44 years. The target design life for new bridges is 75 years, whereas older bridges were only expected to last 50 years. Some of Alaska's older bridges are reaching the end of their service life, and replacement of these bridges will ensure the public is not negatively impacted if problems arise. One of the major problems in other states that affects the life of a bridge is corrosion due to de-icing chemicals applied to the roadways. Alaska does not see these extensive corrosion problems, because de-icing chemicals don't work in in Alaska's extreme cold.

The Alaska Department of Transportation & Public Facilities (DOT&PF) is responsible for inspecting to federal standards every state and locally-owned bridge open to the public at a minimum of every 24 months. As of the 2015 published inspection data, just under half (45.7%) of bridges received a good condition rating, another large portion (44.8%) are in fair condition, and the remaining 9.5% are in poor condition. This is a slight improvement from the 11% of bridges rated poor in 2013. However, this data does not include the more than 75 bridges built or rehabilitated in 2015 and 2016.



Rating	Condition	Typical Work Required
Good	No significant defects • Condition does not adversely affect performance	Preservation activities
Fair	Minor deterioration	Minor rehabilitation such as patching concrete and painting
Poor	Advanced deterioration • Conditions impact structural capacity	Structural repair, replacement, or reconstruction of bridge

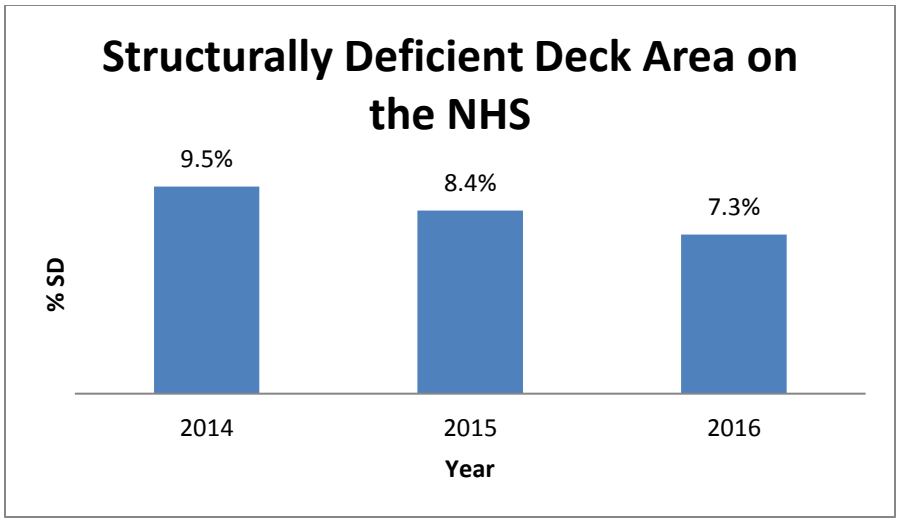
Another indication of bridge capacity is if a bridge is load posted, meaning that it cannot carry legal loads and heavy vehicles are restricted. About 10% of Alaska's bridges have a load posting, but none of

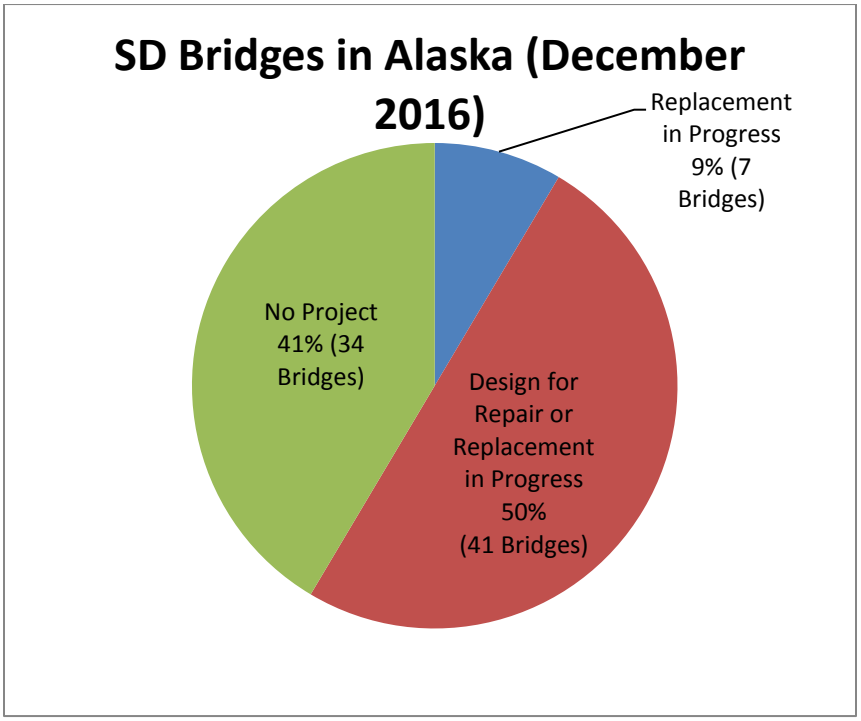
these posted structures are on the NHS, which greatly reduces the impact restricted bridges have on commerce.

Structurally deficient bridges are being replaced, like at the Tok River on the Tok Cutoff. Tthe old bridge in the background was demolished after the new one was opened. These timely replacements are key to keeping bridge infrastructure from falling into disrepair.

The long-term trend has been an improvement in the reduction of structurally deficient (SD) and functionally obsolete (FO) bridges, but the rate could be accelerated. The SD designation does not mean that a bridge is unsafe, but these bridges require repair and more frequent inspection and maintenance. FO bridges generally are narrower or have less vertical or horizontal clearance than would be required for a modern bridge. The data including federal bridges show that 144 bridges in Alaska – 9.7% – are structurally deficient, and of the bridges graded here, 82 (8.4%) are SD. The 2016 data shows that SD deck area – the actual roadway over a bridge considered structurally deficient – on the NHS has decreased from 9.5% in 2014 to 7.3% in 2016. The three longest SD bridges on the NHS account for about one-third of that SD deck area. An advantage is that fixing just a few of the longer bridges would drop the percent significantly. Seven of the 82 SD bridges in Alaska are already in the process of being replaced. Of the remaining 75 bridges, 41 have projects already in the planning or design phase for

repair or replacement. Further analysis would be needed to determine if the remaining bridges have adequate capacity for their location or should be repaired or replaced.





Funding and Future Needs

The majority of Alaska's funding for bridge maintenance and improvement projects comes from federal funds. Federal funding has allowed for adequate bridge replacement over time, but federal funding cannot be used for all bridge maintenance activities. The newest federal funding legislation, Fixing America's Surface Transportation (FAST) Act, was signed at the end of 2015. Under the FAST Act Alaska will receive an increasing amount of overall transportation funding – from $509 million in 2016 to $555 million in 2020. While this should be sufficient to continue replacing bridges, further investment in preventative maintenance may help defer these replacements and reduce the lifetime cost of structures.

Operation and Maintenance

Of the three DOT&PF maintenance regions in the state, Northern, Central, and Southcoast, only the Northern and Central Regions have bridge maintenance crews. Current bridge maintenance funding information is only available from Northern Region, which maintains 376 bridges. In 2016 about $300,000 was allocated for bridge maintenance, or only about $800 per bridge per year.

DOT&PF works with its transportation partners to improve the utilization of their system. For example, the Alaska DOT&PF has performed instrumentation and load testing of in-service bridges to better predict how bridges react to truck loads. The results of the testing program allowed commercial trucking companies to haul larger loads along the state's primary commerce corridors. However, anecdotal information indicates that commercial trucking companies would like to see more load testing of bridges and bridge capacities that exceed legal loads. Further investigation would be needed to determine the transportation industry's needs and impacts to the state economy of increased bridge capacity.

Resilience

Resilient bridges, as defined by M. Myint Lwin, retired Director of the FHWA Office of Bridge Technology, "have the capability to withstand unusual or extreme forces without collapse or loss of lives. They are able to recover from distress or major damage with minimal disruption to traffic and essential services."

As such, resilience is critical for Alaska, which is the most seismic state in the country in terms of both frequency of events and historic earthquake magnitude. Avoiding earthquake damage that closes a

BRIDGES

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Bridging Alaska Rivers has unique challenges which can include large seasonal fluctuations in flow of glacial run-off water that frequently jump channels. Other cold weather challenges are aufeis (ice accumulation), ice jams, and glacial outburst floods.

bridge is imperative, because most Alaskan roads do not have available detours and part of the state could be cutoff after a large earthquake. This occurred after the record-breaking 1964 Alaska Earthquake when dozens of bridges were destroyed and rebuilding efforts took years. As a result, DOT&PF has been at the forefront of incorporating seismic design details and methodologies, including their own seismic bridge research to develop these strategies. Older bridges in the state were not built to modern seismic standards, but the most vulnerable of these bridges have already undergone seismic retrofits to enhance how the bridge will perform during a seismic event. However, the less vulnerable bridges still need to be replaced or retrofitted. Additionally, bridges built to perform well during an earthquake are more expensive than conventional bridges in non-seismic areas.

The ability to withstand flooding and scour are also commonly associated with resilience. Alaska's bridges have a good track record in floods, and DOT&PF has a scour monitoring and retrofit program to address vulnerabilities.

Research and Innovation

As mentioned, Alaska has a history of research due to seismic conditions, but the effects of Alaska's extreme cold weather also play a part in how bridges perform and has required research for guidance not addressed by the national bridge code. Alaska DOT&PF currently spends about $2 million a year for bridge research and presently has six ongoing research programs in cooperation with various universities nationwide. DOT&PF has completed FHWA experimental features projects over the years to evaluate new bridge components such as seismic isolation bearings, polyester concrete, and types of waterproofing membranes. Alaska's long winters also mean shorter construction seasons, so DOT&PF

has developed various systems to encourage an engineering and construction process known as ABC (Accelerated Bridge Construction).

Recommendations

Alaska currently has a healthy bridge inventory, but proper maintenance and timely investment are required to ensure Alaska's bridge infrastructure does not rapidly decline. Recommendations include:

- Provide adequate long-term funding sources and increase rehabilitation or replacement of structurally deficient bridges. Include adequate funding for locally-owned bridges.
- Continue to retrofit or replace seismically vulnerable bridges.
- Invest in adequate routine maintenance to ensure that Alaska's bridges meet or exceed their intended design life. Fund bridge maintenance in the DOT&PF Southcoast Region.
- Investigate if bridges on important haul routes should be strengthened or replaced to accommodate commercial trucking needs.

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DAMS

Photos by:
Thomas Hanna
Charles Cobb

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What You Should Know about Alaska's Dams

During the early 1980's, a Phase 1 inventory was completed of all Alaska dams by the U.S Army Corps of Engineers (USACE) and Alaska Department of Natural Resources (ADNR), which included dams ranging in size from "two logs across a creek" to the large hydroelectric dams in southeast Alaska. The National Inventory of Dams (NID) maintained by the USACE lists 28 dams in Alaska with a high hazard potential including state and federally regulated dams. There are currently 178 dams in the Alaska Dam Inventory, with 76 dams under state jurisdiction[i]. The NID lists 25 dams under federal jurisdiction, including 20 hydroelectric related dams regulated by the Federal Energy Regulatory Commission (FERC). The balance of the inventory is represented by non-jurisdictional dams, and the majority of these dams are relatively small or low hazard potential. The large concrete dams in Alaska include the Green Lake Dam and the Blue Lake Dam near Sitka, the Salmon Creek Dam in Juneau and the Swan Lake Dam and the Lake Connell Dam near Ketchikan, with all but the latter serving hydroelectric generators. Large embankment dams serve hydroelectric generators at Terror Lake on Kodiak Island, Bradley Lake near Homer, Solomon Gulch in Valdez, and Coopers Lake in Cooper's Landing, and store mine tailings at the Fort Knox and Red Dog Mines. Embankment dams provide flood protection for Fairbanks at the Moose Creek Diversion and for Seward at the Lowell Creek Diversion. Small dams provide potable water supplies across Alaska, from Anchorage to Barrow, from Kotzebue to Kodiak to Ketchikan, and from Atka to Metlakatla.

With the passage of the Alaska Water Use Act of 1966 (AS 46.15) Alaska demonstrated leadership in dam safety. The Alaska Dam Safety Program was organized by ADNR in the mid-1980's and improved and formalized by the passage of the Alaska Dam Safety Act of 1987 (AS 46.17). Regulations were passed in 1989 and revised in 2004 (11 AAC 93). The *Guidelines for Cooperation with the Alaska Dam Safety Program*, last revised in 2005, provides a detailed overview of the state regulatory program for dams. The current Alaska Dam Safety Program is managed as a cooperative effort between ADNR and stakeholders in design, construction, and operation of dams in Alaska. Based on statute, the dam safety program has established regulations for applications for new dam construction, repair, modification, operation, removal or abandonment of Dams. ADNR issues "Certificates of Approval" for these activities. The regulations also require periodic safety inspections for all jurisdictional dams, and emergency action plans for high and significant hazard potential dams. The State of Alaska employs two full time engineers to ensure the safety of the state's jurisdictional dams. Federally owned and operated dams, and dams regulated by the FERC are specifically exempt from state jurisdiction by state law.

During August and September of 2012 several areas of Alaska saw extreme, extended rainfalls that produced record breaking flood levels. The rain events were later reported by the National Weather Service as "500 year storms" in some areas. No dams failed during these floods.

DAMS

Photos by:
Thomas Hanna
Charles Cobb

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Capacity

Alaska has a small number of dams compared to most other states. The suspension of the Susitna hydroelectric project may signal a limited capacity for large scale hydroelectric development in Alaska. A significant interest remains for increased small hydroelectric capacity, such as the Crater Lake project proposed by the Cordova Electric Cooperative, especially given the dependence on diesel powered electric generators in many communities. Anchorage is the largest population center in Alaska and relies on the Eklutna Dam and the Ship Creek Dam for the primary source of drinking water. Other relatively large communities that utilize dams for water supply include Sitka, Wrangell, Craig, Hydaburg, Metlakatla, Barrow and other villages. These water supply dams are especially important for communities with fish processing such as Kodiak, Petersburg, and Dutch Harbor. Many Alaska villages are in need of water supply system improvements. For example, the City of Atka has a modern water treatment system, but its source is a small, decrepit non-jurisdictional dam. This indicates a demand for additional capacity that could be served by new, small, water supply dams in rural Alaska.

Condition

Condition assessment ratings are assigned to dams using criteria developed by the USACE. Currently, 18 of the 28 high hazard potential dams listed in the state and national inventories have an overall condition assessment rating of satisfactory or fair. This means these dams have no safety deficiencies identified for loads under normal operating conditions. Dams with satisfactory ratings are expected to demonstrate acceptable performance under all loading conditions including extreme floods and earthquakes in accordance with current applicable regulatory criteria or tolerable risk guidelines. Dams with lower ratings may have recognized deficiencies, or simply need additional evaluations to better understand their expected performance under extreme loads.

Over the last several years, a number of state regulated dams were rehabilitated through a collaborative effort by dam owners and state funding after deficiencies were identified during inspections. Major remediation projects include the Lower Fire Lake Dam in Eagle River, the Lake Lucile Dam in Palmer, and the Mahoona Dam in Ouzinkie. Private dam owners who conducted major repairs include the Lake O' the Hills Dam in Anchorage, and the Itasigrook Dam and Isatkuak Dams in Barrow. State regulated high hazard potential dams known to be deficient and in need of risk mitigation include the Lowell Creek Diversion Dam in Seward, and the Upper and Lower Wrangell Dams in Wrangell. An update is in progress to the Dam Hazard Annex of the State Hazard Mitigation Plan which will provide a more detailed review of the condition of dams in Alaska.

Operations and Maintenance

ADNR issues *Certificates of Approval to Operate a Dam* for dams that are in service and in compliance with the regulations. All dams must have a current Operations and Maintenance (O&M) manual before the ADNR will issue a certificate. The O&M manual must include instructions for operating the dam, maintenance requirements, schedules for routine maintenance and inspections, and other important information. Compliance with the requirements of the O&M manual is always included as a condition to a *Certificate of Approval to Operate a Dam*.

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These certificates are renewed based on the same cycle as a periodic safety inspection. In 2016, approximately 78% of state regulated dams have an O&M manual. All FERC regulated dams in Alaska and two dams operated by the USACE have an O&M manual, which represents 88% of the federally regulated dams listed on the NID.

Public Safety

The Alaska dam safety regulations require a periodic safety inspection every three years for high and significant hazard potential dams. Low hazard potential dams must be inspected every five years. These inspections must be conducted by a qualified professional engineer and approved by ADNR. If the inspection engineer recommends work on the dam for maintenance or to improve safety, ADNR will reference those requirements as a special condition of the *Certificate of Approval to Operate a Dam*. Compliance with periodic safety inspection requirements has generally increased over the past 15 years. For state regulated dams, the hazard potential classification must be reviewed with periodic safety inspections to ensure that downstream development has not changed the risk profile of existing dams.

High and significant hazard potential dams regulated by the federal and state governments are required to have emergency action plans (EAP). There are a total of 17 state regulated high hazard potential dams in Alaska and 14 have an emergency action plan in place, while all 11 federally regulated, high hazard potential dams in Alaska have an EAP. Currently, 89% of the high hazard potential dams have emergency action plans while 59% of the significant hazard potential dams have emergency action plans. Furthermore, many of the communities where dams are located have multi-hazard, community emergency response plans that may include the dam, but these plans are not recognized under the current state dam safety regulations.

At least 9 dams have been removed in the last two decades, and planning is in progress to remove the Lower Eklutna Dam near Anchorage.

Funding & Future Need

The Alaska Dam Safety Program is primarily funded by the state General Fund. Fees collected for dam reconstruction and new construction applications are used for project specific technical reviews. Federal funding for state dam safety programs is contingent on state funding and is considered as a supplement. The funding total provides for the two positions employed. The Federal support comes with performance reporting requirements including updates to the NID. The ADNR has provided updates for the state jurisdictional dams to the NID since it was established, but does not receive any reports on federal jurisdictional dams in the Alaska. Application fees are spent on professional engineering consultants under contract to ADNR to support complex technical reviews, as needed. Future spending is authorized through capital improvement program budget methods.

While there are dams with serious deficiencies that are in need of funding for repairs, dam owners with public interests and the Alaska state legislature have collaborated greatly over the last several years to address a number of deficient dams. A dam currently in serious need of funding for a major rehabilitation is the high hazard potential, Lowell Creek Diversion Dam in Seward. The dam and a 2068-foot long tunnel through Bear Mountain were

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constructed by the U. S. Army before World War II to protect the community from flooding; both the dam and the tunnel are undersized based on current hydrologic design standards. The dam is owned by the City of Seward, but Congress has historically mandated maintenance responsibility for the tunnel to the USACE. Section 5032 of the Water Resources Development Act of 2007 orders the USACE to develop an alternative flood mitigation project or transfer maintenance responsibility to the City of Seward in 2022 whether the dam and tunnel are rehabilitated or not. The City of Wrangell also has two high hazard potential water supply dams that need rehabilitation due to seismic risks. There is no formal program in Alaska for funding rehabilitation of deficient dams.

Innovation

The Alaska Dam Safety Program is nationally recognized for innovation. The *Guidelines for Cooperation with the Alaska Dam Safety Program* provide a transparent overview of the entire regulatory program and includes guidance on important information expected from dam owners such as design standards, operations and maintenance manuals, emergency action plans, and incident reporting. The application process described in regulations is being profiled in a white paper on state and federal design review processes for dams under development by the Design Review Committee of the Association of State Dam Safety Officials. The Hazard Potential Classification and Jurisdictional Review form used by ADNR provides a unique format to regularly review the hazard potential classification of dams, or equitably determine if a proposed dam is under state regulatory jurisdiction. The Alaska Dam Safety Program is also closely involved in regulating mine tailings dams in Alaska and is leading a national discussion on the unique aspects of regulating tailings dams. The Alaska Dam Safety Program has a website at http://dnr.alaska.gov/mlw/water/dams/ with links to important information, including statutes and regulations.

In addition, a number of dams in Alaska, including new construction and rehabilitation projects, as well as water and tailings dams at mines, utilize geosynthetic membranes, geotextiles, geopipes, and other relatively novel materials in innovative applications.

Resilience

Many Alaska dams are low hazard potential dams located far from otherwise developed areas or close to the sea, and not all communities rely solely on impoundments for drinking water. Most high and significant hazard dams have emergency action plans to mitigate the concentrated risks. Of the few without an appropriate emergency action plan, many are covered by community emergency response plans showing a community resilience even if a dam operator may not meet regulatory requirements for current emergency action plans. The *Emergency Action Plan for the Alaska Dam Safety Program* provides a generic response plan for all dams in the state.

No dams failed during severe flooding events in 2012, although a levee failure was suspected near Talkeetna. The relatively few dams and low population at risk from dams in Alaska indicates that the overall risk from dams to Alaska is relatively low and the resilience is high. However, apart from the concentrated risks associated with the

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specific dams, the more acute situations with the Lowell Creek Diversion Dam in Seward and the Upper and Lower Wrangell Dams, represent significantly higher risk and potential impacts from a dam failure to those communities.

Let's Raise the Grade

- **Make repairs to Lowell Creek Diversion Dam and the Upper and Lower Wrangell Dams**
- **Create a revolving emergency fund for dam and levee repairs, where municipalities can borrow funds to start major repairs to prevent local disasters.**
- **Continue funding the Alaska Dam Safety Program in ADNR**
- **Develop a Levee Safety Program based on the success of the Alaska Dam Safety Program**
- **Emergency action plans for all High Hazard Dams by 2020**

Find Out More

- **Alaska Dam Safety Program -** http://dnr.alaska.gov/mlw/water/dams/

References

- **Guidelines for Cooperation with the Alaska Dam Safety Program (2005) -** http://dnr.alaska.gov/mlw/water/dams/AK_Dam_Safety_Guidelines062005.pdf
- **Update on the Alaska Dam Safety Program and the draft Water Resources Development Act of 2012. Report dated December 14, 2012. Charles F. Cobb P.E., State Dam Safety Engineer, Department of Natural Resources, Division of Mining, Land & Water, Water Resources Section.**
- **Personal interview with Dam Safety Engineers Charles F. Cobb and Ben Wagner. September 20, 2016.**
- **Why Lowell Creek Diversion Tunnel is such a priority. Heidi Zemach. Seward City News. November 18, 2015.** http://sewardcitynews.com/2015/11/why-lowell-creek-diversion-tunnel-is-such-a-priority/
- **Water Infrastructure Development Bill Passes Senate. Press release from Sen. Murkowski's office, September 15, 2016. Provided in personal email communication from Ryan West, legislative correspondent, received September 15, 2016.**
- **Sullivan Secures Victories for Alaska's Water Infrastructure. Press release from Sen. Sullivans Office, September 15, 2016. Provided in personal email communication from Margret Sharpe, Wasilla office for Senator Sullivan, received September 15, 2016.**
- **Flooded Lowell Creek bridge – Seward, AK – 9/19/02, YouTube published September 20, 2016,** https://www.youtube.com/watch?v=e0KbzZ9CT0Y
- **2013 Lowell Creek Bridge Flooded Clip1, 2, &3. YouTube published December 2013,** https://www.youtube.com/watch?v=DR9T_2jUVV4 https://www.youtube.com/watch?v=4nWAfP3yx7U https://www.youtube.com/watch?v=ti5ZUnUStkM
- **2016 National Inventory of Dams data provided by the USACE.**

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What You Should Know about Alaska's Energy Infrastructure

Alaska enjoys integrated and abundant power generation and transmission systems in the Railbelt corridor (from Fairbanks to the Kenai Peninsula) and in portions of Southeast Alaska. These systems produce about 90% of Alaska's total generation (about 5.9 megawatt-hours (MWh) out of a statewide total of 6.55 MWh in 2011). Most of these power plants are in good condition, and several major plants are new. Transmission is, however, constrained and dispatch of the most economic power is not currently guaranteed. Much of the data about Alaska's Energy Infrastructure is not publicly available, therefore for this report we contacted several of the utilities to gain greater insight into their infrastructure.

For the rest of Alaska, in what could be called the rural or off-road system, the challenges are greater. Most rural utilities are "microgrid" systems not connected to other communities. Although there are successful rural cooperatives, basic operation and maintenance remains difficult in many small communities around the state. Basic administration such as billing is often challenged, as are workforce training and retention.

Capacity

Railbelt

Based on large investments made in power generation in the last decade, the supply-side ("upstream") generation capacity is assessed as adequate for current and foreseeable demand. Railbelt utilities now have a surplus of modern, high quality generation equipment.

But the transmission component has not kept pace. State studies indicate over $900 million in transmission upgrades are warranted in order to fully achieve full system redundancy (i.e., ability to back up from multiple generator sources) and dispatch of the most economic power in the system.

Southeast

Southeast Alaska's generation capacity is mostly provided by hydropower. Juneau and other communities also have diesel generator backups, which periodically must be used because of avalanches or other events. There appears to be an abundance of affordable hydropower in many communities, and the ASCE

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team did not review any literature suggesting that generation capacity in Southeast Alaska was compromised generally.

On the transmission side, transmission capacity appears generally adequate, although some lines have been demonstrated vulnerable to interruption due to avalanches and other factors. Though specific to the communities served (mainly Ketchikan, Petersburg and Wrangell), the Swan Lake – Tyee Lake intertie, completed in about 2009, have provided increased reliability and redundancy to the service area.

Finally, it is important to bear in mind that the Southeast region is a large area that includes rural communities, which have isolated systems that are dependent on diesel, similar to rural areas elsewhere in Alaska. For these communities, the condition is probably more similar to rural mainland Alaska than to more developed areas in Southeast Alaska.

Rural

The Alaska Energy Authority survey of rural powerhouses in 2012 indicated the capacity of the systems was adequately and appropriately sized in the majority of villages (83.2%). About 4.3 percent were classified as undersized, and the remainder oversized.

Generators in this region run almost entirely on liquid fuel. ASCE did not locate reports challenging the capacity of bulk fuel storage tank farms, so these are assumed to have adequate capacity.

Condition

Railbelt:

A major Southcentral Alaskan utility (Municipal Light and Power) has noted that some major generation equipment is aging, requiring additional maintains support. It is also fuel inefficient.
However, ML&P and other utilities have been aggressively replacing older equipment with new units, allowing the older units to be retired or placed in standby. The total investment is reportedly between $1.2 and $1.5 billion in the past five years.

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ASCE did not locate information generally derogatory to the physical condition of transmission lines in the Railbelt, although we are aware of some pole lines that have been subject to settlement and jacking issues. However, two major utilities contacted by ASCE self graded their infrastructure conditions at a score of 3 and 4, respectively, out of 5 points.

Southeast:

A major Southeast utility scored itself at 4 of 5 in the "condition" category. No further condition information was found by ASCE in open literature, relative to the condition of generation or transmission facilities in the region, so this assessment is accepted as characteristic of the region.

Rural

The Alaska Energy Authority (AEA) inventoried about 250 community power plants in Alaska with capacity ranging from 45 kW to 374,000 kW. AEA specifically inventoried 523 individual generating units in Alaska, of which only about 29% were assessed to be in "good" condition by the AEA in 2012. 60% were rated fair and about 11% were considered in "poor" condition. These conditions appear to be related to maintenance challenges, compounded by difficulties in recruiting, developing and retaining qualified maintenance personnel in remote locations.

With regard to bulk fuel facilities, the Denali Commission has documented the challenged condition of bulk fuel tank farms in rural Alaska, describing 56 communities remaining with "unmet needs." At the current rate of funding, it could take several decades to repair or refurbish deficient tankage facilities.

In general, conditions of energy facilities are an example of the divergent conditions between rural and urban Alaska . ASCE Report Card criteria require that the energy sector within the State should be evaluated as a whole. It is difficult at least, and perhaps not possible, to reconcile the conditions of rural utilities (outside of AVEC) with the much more advanced situation of the on-road utilities.

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Operation and Maintenance

Railbelt

Two responding Railbelt utilities self-assigned a 4 of 5 score in this category. ASCE does not have independent information to augment that score and accepts the 4 of 5 as representative for the Railbelt as a whole.

Southeast

The Southeast utility that responded to ASCE assigned a 4 of 5 score to itself. ASCE does not have independent information to augment that scoring and accepts 4 of 5 as representative for Southeast as a whole.

Rural

The responding rural energy cooperative assigned a 3 of 5 score.in this category. Challenges to operation and maintenance of rural facilities outside the cooperative systems are well documented in studies documented in the background report available upon request.

Public Safety

For this category, ASCE is largely reliant on utility responses based on its survey. It is noted that the public safety measure suggested by ASCE were loss of power events exceeding 48 hours. Never would be a 5, yearly a 3, monthly a 1. This was suggested as a measure of public safety because, were such an outage to occur in mid-winter, it could have life safety consequences, particularly in rural Alaska (in addition to the risks of damage to the energy infrastructure). Railbelt utilities scored themselves 3 or 4 of 5; the responding Southeast utility scored itself at 3 of 5; and the responding rural cooperative scored itself at 4.5 of 5 (a score that may not be representative of rural utility reliability outside the co-op system).

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Funding

Any discussion of funding for energy in Alaska should be prefaced by an overview of fundamental economic conditions. The most urbanized portion of Alaska (i.e., the Railbelt area) enjoys access to relatively cheap natural gas for power generation, and Southeast utilities benefit from inexpensive hydropower. The rest of the state is heavily reliant on liquid fuel, which is expensive to transport. This form of fuel places a high burden on consumers and adversely affects economic viability of communities. The State of Alaska has a program known as Power Cost Equalization (PCE) that mostly offsets these costs, but does not completely resolve the problem.

Railbelt

Responding utilities self-rated as well funded. However, with respect to Railbelt transmission improvements. there do not appear to be any currently available means for funding $900 million in identified projects.

One significant and long-identified project - an intertie to connect Copper Valley Electric Association to the Railbelt grid – has not been accomplished as a result of funding limitations. It should also be noted there is also an opportunity to connect the Alaska Highway (Tok area Alaska Power and Telephone system) to the Interior (Golden Valley Electric Association) grid. The extent of their distribution systems stretch to within 50 miles of one another, potentially saving Tok area consumers approximately half of their electric bills.

Southeast

The responding Southeast utility rated its funding capacity at 5 of out 5. ASCE relies on this as representative of other utilities in the region.

Rural

The responding rural cooperative assessed its funding capacity at 4 of 5, perhaps reflecting its effectiveness as a cooperative in efficiently delivering services based on a centralized administrative, billing, operation and maintenance entity.

For other operators, funding challenges are implied by findings relative to bulk fuel tank farms, and by the challenges in maintaining generator equipment to a good condition.

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Future needs

Responding utilities in all regions indicated their infrastructure capacities are projected as satisfactory for continued operation in the future. However, based on observations (also noted in the "condition" category), the continued operability of rural generators is challenged, and therefore may not meet future needs.

Resilience

The resilience of Alaska's energy infrastructure has not been comprehensively studied. However, in all regions, the resiliency has been tested by severe weather conditions, seismic events and other emergencies. Overall, the systems have performed well, in part owing to redundancy of generation equipment.

Innovation

For the responses attained from utilities, ASCE had suggested the following: "Energy from Renewable Sources (% of Total), Use of Energy-Saving Technology (i.e. Smart Meters): Are you involved in a clean energy project or program?" For this category, responding utilities rated themselves between 4 and 5. In addition, ASCE notes the work currently being pursued by Renewable Energy Alaska Project (REAP) and the Alaska Native Tribal Health Consortium (ANTHC) focused on developing viable and sustainable alternatives to high cost liquid fuel.

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Let's Raise the Grade

The following actions are recommended:

- Extend and improve energy cooperatives and business processes/incentives, to enhance and streamline operation and maintenance, particularly in rural areas. This will require creation of policies that will promote formation of energy consortiums and cooperatives.
- Along with these improvements, invest in workforce development to build the capacity of local workers to operate and maintain rural facilities. This will likely lead to more efficient and effective utilization of capital expenditures for lifecycle upgrades and replacements.
- Upgrade Railbelt transmission line capacity to improve redundancy, reliability, and economy, following recommendations in the Alaska Energy Authority study.

- Consider extension of Railbelt infrastructure to accessible areas on the major road system, notably to Copper Valley Electric Association (Glennallen/Valdez area) and Alaska Power and Telegraph (Eastern Interior/Tok area).

Find Out More *[Resources]*

- **UAA Institute of Social and Economic Research: Alaska Energy Statistics 1960-2011 (**http://iser.uaa.alaska.edu/Publications/2013_12-AlaskaEnergyStatistics2011Report_Final_2014-04-30.pdf **)**
- Alaska Energy Authority Pre/Post – Watana Transmission Study Draft Report (http://www.akenergyauthority.org/Content/Publications/AKRailbeltTransmissionPlan.pdf **)**
- **US Department of Energy/Lawrence Livermore National Laboratories:** Sustainable Energy Solutions for Rural Alaska (https://emp.lbl.gov/sites/all/files/lbnl-1005097.pdf)

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What You Should Know about Alaska's Roads

State Highways and Roadways

Alaska's roadways, although very limited in total miles compared to most states, are vital to the economic growth and development of the state. The Alaska Department of Transportation and Public Facilities maintains 5,609 centerline miles of highways, 3,737 of which are paved. The highway system provides connectivity for freight and travel from the lower 48 states through Canada into Alaska, and from Alaska's economic hub, Anchorage, to communities across the state. Alaska, having some of the richest and most productive oil fields in the country, requires transport of equipment and infrastructure to the oil fields on the North Slope of Alaska. The 414 mile Dalton Highway (Alaska Route 11) is the only highway that connects Alaska's North Slope oil fields to the rest of the state, and shutdown of this highway for maintenance or due to catastrophic events has major effects on Alaska's economy, and affects the production and price of oil. Other major highways include the Alaska Highway, Seward Highway, Glenn Highway, Parks Highway, and Richardson Highway, which are corridors that provide connectivity throughout the central and northern part of the state.

Municipal and Borough Roadways

Municipal and Borough Roadways are typically a mixture of paved and unpaved roads in Alaska's hub towns and cities. Many of these areas are a mixture of state and municipal or borough owned roads, and are maintained by state and local governments. These towns and cities are the main population centers spread across the state where goods are typically shipped to in order to reach villages by road and air. Many of these areas contain populations over 1,000 people.

Village and Rural Roadways

Village and Rural Roadways consist mainly of unpaved roads, walkways, trails, and boardwalks in areas outside of Alaska's hub towns. These areas contain populations of less than 500 people and the local roadway facilities are typically maintained by local village governments and regional native corporations. The roads, walkways, trails, and boardwalks in these areas are of importance to locals because they serve as routes to local hub towns, medical facilities, schools, and routes to subsistence hunting and fishing locations. Villages located north of the Arctic Circle and Western Alaska are built on permafrost which experience thawing and melting in the summer months. These conditions make it unsustainable and cost prohibitive to build conventional roadways due to rapid deterioration. Many of these villages are connected by a series of boardwalks that are accessible by pedestrians, four-wheelers (all-terrain vehicles), and snow machines (snow mobiles).

Capacity

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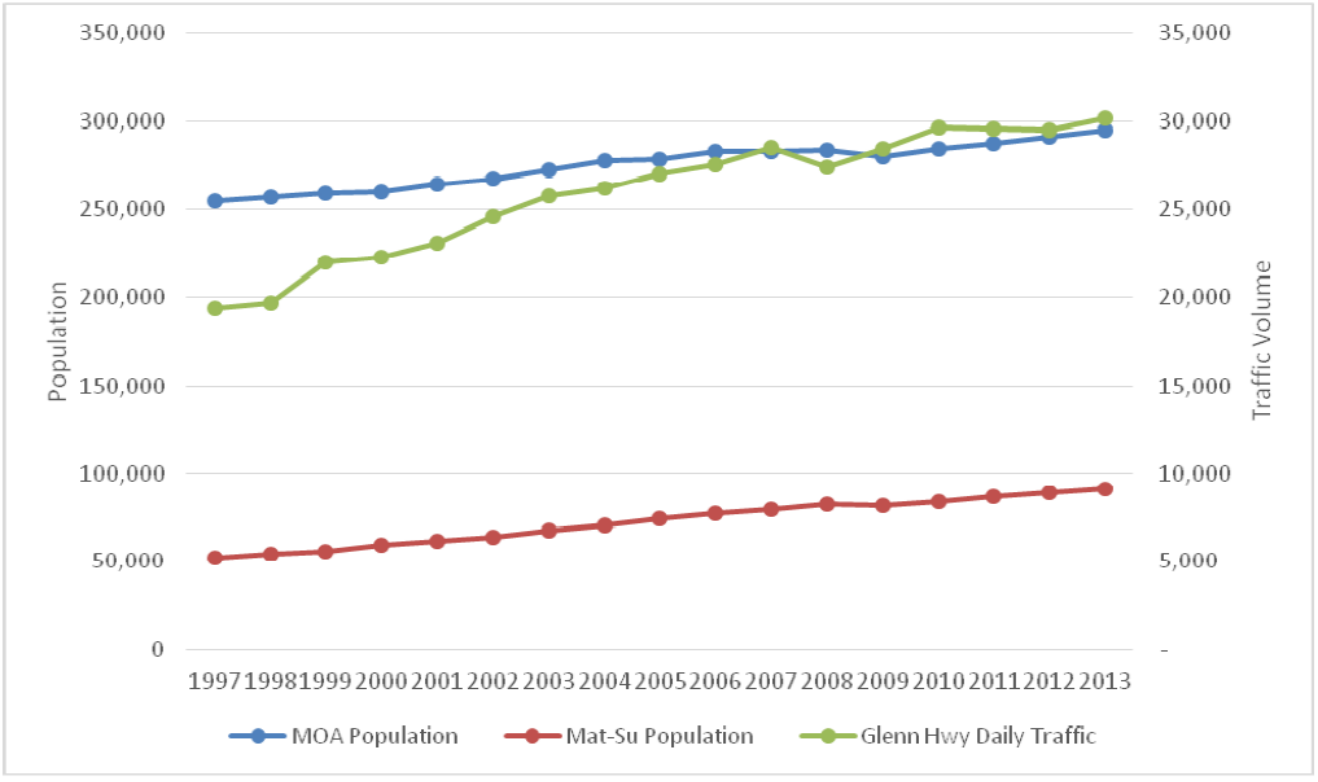
Alaska has the lowest population density in the country, 1.3 people per square mile, and because of this there is low traffic congestion outside of its population centers. However, Anchorage contains nearly 40% of the state's population, causing the Municipality of Anchorage (MOA) and the nearby Matanuska-Susitna Borough (MSB) to experience the heaviest traffic in the state. These areas have the highest population densities across the state. The MOA and MSB have experienced steady population growth over the last decade, which have contributed to capacity issues in the area. The figure below shows increasing traffic volume (vehicles per day) along the Glenn Highway which connects the borough and the municipality, in conjunction with population growth in Anchorage from 1997 to 2013. Several intersections in Anchorage experience Level of Service E and F, which are the highest congestion designations, during peak AM and PM traffic.



Source: US Census American Community Survey 5-year Estimates, Status of the System Report 2010, Volumes from DOT & PF Annual Traffic Volume Reports

The Anchorage Metropolitan Area Transportation Solutions (AMATS) have identified several projects which will make improvements to the Road System, Public Transportation, Pedestrian and Bicycle Systems, and Freight

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Distribution and Regional Connection Elements. Many of the projects highlighted in the AMATS plan are currently underway, however, in order to keep up with a rate of 1-3% increase in population growth per year, the AK DOT&PF, Municipality of Anchorage, and Matanuska Susitna Borough will continue to require investing in the projects highlighted by the study.

Condition

In 2013 the Alaska Department of Transportation & Public Facilities released Alaska's Pavement report. The report is an evaluation of approximately 4,100 lane-miles of Alaska's highways in order to come up with a comprehensive score of the condition of the state's pavement. The evaluation includes several data points that are entered into the Performance and Economic Rating System (PERS) software. These data points include:

- General sectional information, such as numerical identification, number of lanes, road classification, pavement type, functional class, etc.
- Traffic data (vehicles per day) and equivalent axle loadings.
- Structural data showing materials and thicknesses forming the support system of the roadway.
- Surface data with rutting and with IRI (International Roughness Index) indicators used to calculate remaining life.
- Modeling information allowing the engineer to account for varying conditions by modifying the formulas.
- Past construction and maintenance data.

PSR Ratings Guide

>4.0		Very Good
<4.0	> 3.5	Good
<3.5	> 3.1	Fair
3.4		2017 Statewide Goal
<3.0	> 2.6	Marginal
<2.6		Poor

Using these data points the PERS software calculates a Pavement Serviceability Rating (PSR) for each roadway segment evaluated and a comprehensive PSR for all roadways evaluated. The rating system assigns a score between 0 (very poor) and 5 (excellent). The evaluation resulted in a cumulative PSR of 3.1, which is Fair, however just above a Marginal rating. This result was mainly affected by irregularities in the pavement including cracks, potholes, and frost heaves.

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The department is currently developing the 2016 Alaska Pavement Report, at the time of this publication the report was not yet available.

Operations and Maintenance

Maintaining roadways in Alaska is very challenging due to many factors that are not commonly experienced in many other states. Extreme weather conditions, with temperature that range from -60° in winter to 100°F in summer, areas where snow can average over 200" per year that are prone to avalanches, and temperate rainforest locations that average over 150" of rain per year, create conditions that are ripe for pavement ware. From October through April it is legal for drivers to use tires with studs for traction in snowy and icy conditions. The use of studs causes rutting, which are a longitudinal grooves along the wheel path, over a period of time, which significantly decreases the life of the pavement and the ride quality. Many roadways in middle and northern Alaska are built on permafrost, which is a thin layer of soil over several feet of ice. With the average temperatures across Alaska on the increase, this is causing the melting of permafrost, which causes roadbeds in these areas to fail. The melting and freezing of permafrost and subsurface water cause and effect called "Frost-Heaving" which is characteristic of large vertical deviations, bumps and dips, which can be very dangerous for drivers and cause very poor ride quality. Many of Alaska's highways are in remote locations that are hundreds of miles from the nearest cities which make them difficult to access by maintenance and construction crews. These factors combined make each road mile in Alaska significantly more expensive to construct and maintain in comparison to a road mile in most other states. With significant budget cuts planned at the state level it will become increasingly difficult to maintain rural roads.

Public Safety

The AK DOT&PF has adopted the Alaska Strategic Highway Safety Plan (SHSP) which involves a multi-disciplinary approach to improving public safety on state roadways: Engineering, Education, Enforcement, and Emergency Medical Services. The goal of the plan titled *move Toward Zero Deaths*, is to significantly reduce roadway fatalities by half by 2030 and eventually eliminate roadway fatalities.

In an analysis performed in 2013 of the SHSP it has been noted that Alaska has achieved improvements in public safety on highways, but there still remains room for improvement. The three-year average of fatalities on highways were consistently on the decline until 2013. Since 2013 there has been a 40% increase in fatalities. The three-year average of serious injuries has risen which does not meet the 3.1% reduction per year desired in the plan.

In order to achieve reductions in fatalities and improve on reductions in serious injuries the department is focusing on three areas of emphasis with strategic initiatives to ensure targets are met.

Driver Behavior

1. Strengthen enforcement programs related to driving violations.
2. Improve the prosecution and adjudication of all driver violations.
3. Educate drivers to be responsible.

Roadways

1. Implement education/awareness programs to enhance roadway safety.
2. Implement engineering programs to enhance roadway safety.
3. Implement improvements to EMS to enhance roadway safety.
4. Utilize data and electronic information programs to enhance roadway safety.
5. Implement HSIP-qualified strategies.

Special Users

1. Implement education/awareness practices to enhance bicycle, pedestrian, motorcyclist, and OHV safety.
2. Implement engineering programs to enhance bicycle, pedestrian, motorcyclist, and OHV safety.
3. Implement evaluation programs to enhance bicycle, pedestrian, motorcyclist, and OHV safety.

Funding

According the Statewide Long-Range Transportation plan, the DOT&PF does not currently have sufficient funding in order to preserve the existing transportation and for future development. Without an increase in state revenue, funding in not expected to increase in the near term due to sustained low oil prices. The State of Alaska experienced a $3 billion budget deficit in 2016, which has been referred to as Alaska's worst economic recession since the 1980's. The budget deficit has triggered law makers to make significant cuts to state programs, including reducing budgets maintenance and operations for the DOT&PF. In June 2016 Governor Walker vetoed $250 million in highway construction spending, which put a pause on 8 highway projects around the state. In December, 2015 the Fixing America's Transportation Infrastructure (F.A.S.T.) Act was signed into law, which allocated $2.6 billion to Alaska for highway preservation and improvement projects. The F.A.S.T. act is expected add nearly $555.3 million per year in highway spending through 2020 which will offset a portion of the significant cuts that are being planned at the state level.

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Innovation

In 2009 the AK DOT&PF released its *iways* architecture, which is an innovative plan to improve efficiency, safety, and reliability of the state's transportation system by implementing Intelligent Transportation System (ITS) technologies. The department has been implementing projects throughout the state which include advanced communication, information processing, and computer hardware and software. These projects include 511 Traveler Information, Automated Vehicle Identification (AVI), Roadway Weather Information System (RWIS), and Traffic Signal Electronics Modernization. The current draft of the Statewide Long Range Transportation Plan includes policies that will continue support of the iways architecture in order to continue to use and implement new technologies that will improve efficiency and effectiveness.

Resilience

A limited study was conducted by FHWA in 2016 regarding Alaska's resilience to climate change, which highlighted case studies of three events that resulted in infrastructure damage which was linked to a changing climate. The study concluded that in many areas, due to sparse population, cost cannot be considered into the traditional benefit-cost analyses and broader factors of concern need to be taken into account to reflect appropriate response measures.

The current draft of the AK DOT&PF's Long Range Transportation Plan (LRTP) includes a risk-based analysis of trends affecting transportation system performance, which highlight climate change, earthquakes, natural disasters, and extreme weather events as having a high likelihood of affecting transportation infrastructure and increasing cost in the future. The plan includes policies that take these events into consideration in the project development phase in order to improve system resiliency.

Let's Raise the Grade

- Replace substandard roadways with pavement sections and materials that are more resilient to the extreme conditions.
- Construct new roadways with service life of the road as a priority, utilizing non-frost susceptible soils and strong pavements that can withstand the ware from the use of studded tires, frost heave, and melting tundra.
- **Focus a portion of funding toward projects that will ease congestion issues in the areas of the state that experience poor Level of Service.**
- **Continue to support efforts to improve public safety by minimizing roadway fatalities and injuries.**
- **Continue funding and implementation of innovative transportation infrastructure.**

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Find Out More

- http://dot.alaska.gov/stwddes/desmaterials/assets/pdf/pavement_report_2013.pdf
- http://dot.alaska.gov/iways/documents/iways-SummRpt.pdf
- http://dot.alaska.gov/stwdplng/areaplans/2030/assets/SWLRTPPfinal022908.pdf
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ALASKA MARINE HIGHWAY SYSTEM

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What You Should Know about the Alaska Marine Highway System

The Alaska Marine Highway System (AMHS) is the state's publicly owned ferry system. As is typical throughout Alaska, highway access is unavailable to most Southcoast communities, many of which are on islands or in remote areas where roads are not feasible. These coastal communities therefore rely heavily on the AMHS for travel and to transport goods. This critical infrastructure system currently consists of 11 vessels connecting 33 Alaskan and two non-Alaskan communities through scheduled ferry service. From the southern terminus in Bellingham, WA the AMHS stretches more than 3,500 miles to Unalaska/Dutch Harbor[ii]. Overall, the AMHS generates about 1,700 direct and indirect employment jobs. The AMHS is a cohesive system of vessels and dedicated staff that provide essential connectivity in our state It also includes all the terminal facilities that allow passengers, their vehicles and cargo to load and offload. The AMHS was designated as a National Scenic Byway by United States Department of Transportation in 2002, and earned the distinction as an All-American Road in 2005.[iii]

Capacity

AMHS passenger traffic has averaged 320,000 passengers over the last ten years. Over the same period vehicle traffic has averaged 106,400 vehicles per year. AMHS also plays an important role in freight transport, where goods such as perishable food, seafood, vehicles, trailers and all-terrain vehicles are shipped in tractor trailer vans, allowing customers to take delivery of their new car etc. in their home community.

The table below shows the individual capacities of each vessel in the AMHS fleet.

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Table 1. AMHS Vessels

	Year Built	Passenger Capacity	Vehicle Capacity (20-feet)	# of Staterooms
Matanuska	1963	499	88	106
Malaspina	1963	499	88	72
Taku	1963	370	69	40
Tustemena	1964	174	36	24
Columbia	1974	600	134	103
Leconte	1974	247	34	-
Aurora	1977	300	34	-
Kennicott	1998	499	80	109
Lituya	2004	149	18	-
Fairweather	2004	250	36	-
Chenega	2005	250	36	-

Source: AMHS.

The Alaska Department of Transportation and Public Facilities (ADOT&PF) prepares an Annual Traffic Volume Report each year. This report provides a wealth of information about the historical usage for each segment in the AMHS. One of the sections in this report is called "Link Volume Summary." This section compares the overall capacity to the usage and allow AMHS to best deploy their vessels based on demand, but also gives a good insight into the level of utilization[iv]. A review of the reports for 2010 – 2015 show that as a system on average, the usage is between 24 – 31% of capacity for passengers and 57 – 62% of capacity for vehicles.

There are three categories of vessels in AMHS: Mainline Ferries, Day Ferries, and Shuttle or Fast Ferries[v]. The Mainline Ferries all have the amenities needed for passengers who may be onboard overnight or for multiple days. Cabins are available for rent and cafes and restaurants offer food for purchase. Not surprisingly, stateroom utilization is much higher on longer journeys. The Chignik – Kodiak link shows a cabin utilization of 92% during 2015[vi]. Judging by the last ten years' traffic levels, it appears that AMHS does have the capacity for current and likely future demands.

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Condition,

The Department of Transportation and Public Facilities own 11 vessels. Two of them, TAKU and CHENEGA, are in non-operational status due to budget reductions. One of them, TAKU, is in the process of being sold while CHENEGA is in long term unmanned layup. With five of the nine operating vessels being 40 years old or older, and three of those vessels being over 50 years oldvii, the AMHS is operating with an older fleet that is nearing its life expectancy. In the latest approved Long Range Transportation Plan (LRTP) from 2008 it was noted:

> The fleet survey report assumes the vessel life expectancy at 64 years and that the vessels need to be repowered at mid-life, about 32 years. As the vessels get older, ADOT&PF estimates that the maintenance costs will increase significantly. ADOT&PF staff also believes that the 64 year life expectancy is optimistic and is heavily dependent of operating conditionsviii.

The LRTP is being updated and in its draft form it also points to the aging fleet as one of the challenges AMHS is facingix. An aging fleet requires significant investment for maintenance. To combat costs associated with maintaining old vessels, new vessels (e.g., the Alaska Class Ferries) are being designed and built. The new vessels will have smaller crews and may have better fuel efficiency. Two vessels are scheduled for delivery in 2018, both will have capacity for 300 passengers and 53 vehicles. These vessels are intended for day-traffic, on shorter routes where the ferry returns to the point of origination the same day. The vessels TAKU and CHENEGA, listed above, was removed from service in 2015 due to lack of funding for overhaul necessary to keep the vessel in good operational condition.

ADOT&PF documents the condition of the ferry terminals and marine facilities used by the Alaska Marine Highway System in all of its ports of call. The ownership and configuration of shore side facilities at each of these communities vary from community to community. Owners include the State of Alaska, Bellingham Port Authority, the Prince Rupert Port Authority, various city owned wharves, and privately owned fish processing docks. Common for all 42 separate berthing facilities in these 37 communities is that above water components are inspected biennially, and under water inspections are performed on a five-year cycle. The inspection results are included in the annually updated Shore Facilities Condition Survey Reportx. In addition to using the shore facilities condition survey report as a facilities condition inventory, it is also used to identify capital project needs for each shore facility and their system wide respective priorities.

Operation and Maintenance

AMHS provides year-round and seasonally scheduled ferry service. The schedule varies from year to year, depending on available funding and operation budgets. Based on available funding ADOT&PF prepares an operations schedule to best meet the essential needs for community service. With portions of the fleet being close to the end of their anticipated service life, maintenance costs are likely to increase significantly over the next several

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years. The draft Long Range Transportation Plan[xi] identifies operating and maintenance as one of the challenges that the AMHS is currently facing. Both labor and fuel costs have grown over recent years. In 2014 and 2015, fuel accounted for 20% and 18% respectively of overall operating costs. The three largest cost groups for operations and maintenance (O&M) are Marine vessel operations (which includes payroll) at close to 70%, Fuel at about 17-18%, and Shore Operations at about 5% of overall O&M expenditures. In 2008, ADOT&PF anticipated an average annual need of $120M for O&M[xii]. In review of the financial reports of fiscal years 2009-2015[xiii] we can see that the actual numbers have ranged between $122M in FY10 and $152M in 2013. This range represent the amount provided by state legislators in appropriations. Rather than being the representation of the actual O&M need, expenditures are the result of operations planning to utilize the budgeted funds to the greatest utility for the community. The financial reports alone are therefore not a good measurement of the actual trends of Operations and Maintenance costs. Maybe a better indicator of the challenges AMHS is facing for O&M is the fact that MV TAKU and CHENEGA were taken out of service due to lacking funding for scheduled overhaul of the vessel. If we study fare-box recovery rates, we can see that the cost recovery has gone from about 50% in 2004 to just over 30% in 2015. This illustrates maybe the greatest challenge for AMHS: How to contain operating costs while maximizing revenue generation.

Funding

In a sense the AMHS is an extension of the National Highway System, providing travel routes to reach remote communities in Alaska. The funding mechanisms are very different; while the National Highway System initially was self-funded through user fees, and is operated as a service we all need as the backbone of our nation's economy, the AMHS is run as an enterprise fund, relying on the Alaska Legislature to appropriate general funds to make up for the short fall in revenue vs. expenditure to operate the system.

AMHS spent $84.0 million in Alaska in 2014 counting operations ($45.7 million) and capital ($38.2 million) expenditures, and an additional $100.7 million in payroll expenditures[xiv]. If we place those expenditures alongside the operating revenues, which in 2015 were $53.9 million[xv], we can see that the state needs to appropriate more than $100 million annually. However, current fiscal challenges may result in significant budget cuts, which will result in challenges for operations and maintenance. Budget cuts for FY 2015 resulted in the removal of MV TAKU and CHENEGA from service, as capital funding for necessary overhaul was eliminated from the budget[xvi].

Historically fare-box recovery rates were around 50% until 2005, when the fleet was increased from 9 to 11 vessels. The fare-box recovery shows a slowly declining trend over the last ten years[xvii] The State has commissioned fare studies in that were completed in 2008 and 2015. The 2008 rate study had to reach outside USA to identify comparable ferry systems. The study found that AMHS has a lower fare-box recovery rate than other similar

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systems. But studies also show that some of the routes have a much better recovery rate than others. The recommendation from the 2008 study was that fares should first be normalized based on common utility, such as nautical miles travelled[xviii]. The Tariff study prepared in 2015 found that tariffs have not changed since the latest increase in 2007, meanwhile the cost to operate has increased by 33%. Alternative freight and cargo rates have meanwhile increased by as much as 236 percent per nautical mile[xix].

Future needs

The current funding situation presents several challenges for the AMHS. In their community engagement presentation, the following opportunities were presented on how to better prepare for a leaner future:

- Promote AMHS as an important part of Alaska's transportation system – serves much more than SE and SW Alaska
- Maintain core services to all 33 Alaskan ports, Prince Rupert, and Bellingham
- Budget Constraints – minimize impact to Alaskans
- New reservations system to improve customer service
- Continue finding efficiencies and reducing costs to maintain service
- Retire excess vessels … Reduce fleet and/or reduce routes
- New vessels: Two Alaska Class, Tustumena replacement
- Dock modifications
- Revisit Southeast Alaska Transportation Plan
- Economic Impact Study update

In addition to the two new vessels entering service in 2018, the four oldest vessels in the fleet need to be replaced over the next twelve years. The 2008 transportation plan identified this need to be a total of $600M[xx], in addition to this capital investment in new vessels ADOT&PF also anticipates an average annual cost of $23M for vessel refurbishment and recertification. In the Shore facilities report from 2015 the need for capital improvements to Ferry Terminals and Docks was totaled to be $92.4M[xxi].

Approved capital investments for the next 5 years can be found in the Alaska Statewide Transportation Improvement Program[xxii]. The list of projects includes Ferry Terminal Modifications in Gustavus, Haines, Auke Bay, Skagway, and Tenakee, shore facility and vessel condition surveys, ferry refurbishments, construction of new ferries, and upgrades to the sewage systems at several terminals. These capital improvement needs total close to $500M.

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Public Safety

In the 2012 system analysis several goals were set for the AMHS, including to increase the Transportation System Safety through implementation of improvements in marine navigation systems, and to support safety inspections of marine vessels. These goals are measurable as accident rates per 100,000 people per transportation mode, the frequency of incidents that interrupt inter-community travel, and frequency of opportunities for isolated community residents to travel to health care providers[xxiii].

Resilience

Resilience can be measured in the ability to respond to the failure of one or more components such as a vessel needing to be taken out of service unexpectedly. Only two years ago, the combination of various vessels in the AMHS allow for dispatching changes to cover the absence of any vessel at any time. With fewer operational vessels (9 vs. 11), this is no longer always the case causing gaps in service when vessels need to be taken out of revenue service for maintenance or due to mechanical breakdowns. Typically, vessel overhauls are scheduled during the off season, where one vessel is taken out of service at a time, while still providing service to the coastal communities.

Innovation

AMHS adheres to environmental standards set by the International Maritime Organization, U.S. Environmental Protection Agency, and State of Alaska Department of Environmental Conservation. In addition, AMHS is a member of the Green WATERS Program, a voluntary program aimed toward reducing waste and operating in a cleaner, greener, and more sustainable environment. The AMHS Ship to Shore Environmental Guide was designed to provide employees with the tools to respond to environmental concerns quickly and efficiently. AMHS also uses best practices and cost-effective technologies that not only protect the environment but maintain a high quality of life for Alaska residents, such as:

- Fueling with ultra-low sulfur diesel
- Using environmentally acceptable lubricants
- New program to streamline hazardous waste
- Using technology to reduce paper waste
- Recycling plastic and paper products

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Key Marine Highway Facts

- The total economic impact of AMHS results in **1,700 jobs** and an estimated **$273 million** in direct and indirect spending.
- **In 2015, AMHS served 288,133 passengers and 100,547 vehicles per year, 2/3rds of which are Alaska Residents.**
- Alaska has **6,640 miles** of coastline, and the AMHS serves 33 communities using 11 vessels.
- Every dollar of General Fund money budgeted to AMHS generates **$2.30** economic activity in Alaska.
- Fewer ferries and more downtime will result in increased cost of goods which will **significantly increase the cost of living** in coastal communities.

Let's Raise the Grade

- **Plan and budget for adequate annual maintenance to minimize the amount of vessel downtime.**
- **Continue to seek operational efficiency improvements in order to decrease the cost of vessel and shore side operations.**
- **Provide a one-time increase in the funding in the Marine Highway System Fund to allow the system to have time and resources to accommodate annual changes in funding support.**
- **Develop a long-range strategic plan for the operations of the Marine Highway System to direct business decisions regarding scheduling and vessel usage.**
- **Develop a long-range vessel repair and replacement plan to make sure that the vessels are operating at peak efficiency.**
- **Implement strategies to increase ridership including consideration of commercial carriers and visitor use.**

Find Out More

- The Economic Impacts of the Alaska Marine Highway System (http://www.dot.state.ak.us/amhs/doc/reports/econ_15.pdf)
- 2015 Annual Traffic Volume Report. Alaska Marine Highway System
- Alaska Marine Highway System Analysis
- Shore Facilities Condition Survey (http://dot.alaska.gov/project_info/AMHS_Shore_Fac_Report.shtml)

PORTS AND HARBORS

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What you need to know about Alaska's Ports and Harbors

Ports & harbors across Alaska provide services that support critical economic activities. These facilities play a vital role in the communities they serve by providing local employment opportunities, promoting economic diversification and meeting cultural and subsistence lifestyles. In 2015, $28B and 40.8 million tons of goods were moved via marine transport out of state; and, $4.8B and 3.4 million tons of goods into the state via marine transport. Ports & harbors ensure a thriving commercial fishing industry exist with over $1.7B of fish product landed in Alaska in 2014, including six of the top ten fishing ports by volume in the US. Tourism plays a significant role in several communities with over 1 million passengers arriving via cruise ships in 2016. Other harbors rely on summer independent travelers who use facilities for recreational or charter fishing and mooring floats necessary to attract yacht cruisers.

Capacity

Alaska possesses 33,000 miles of coastline, more than the combined shoreline of the continental U.S., yet there are only 125 ports & harbors within the state. Alaska is dependent upon resource extraction, including fisheries, but lacks infrastructure to support vessels operating in Alaska. As a result, there is $5B lost revenue opportunity to the Seattle port & harbors infrastructure. Recent infrastructure improvement to cruise ship docks in Southeast Alaska has enhanced the capacity to moor neo-panamax size cruise ships at ports supporting tourism. The largest ports by volume include Valdez (Trans-Alaskan Pipeline terminus), Nikiski (oil refinery), Anchorage (consumer products) and Kivalina (Red Dog Mine) which currently maintain their respective facility capacity to meet export demands. The Port of Anchorage has the capacity to receive necessary goods and products required for the largest population centers.

Condition

The condition of the ports and harbors across the state vary greatly. Ports and harbors that can leverage funding through State matching grants or have access to cruise ship "head taxes" have the potential to maintain, upgrade or replace. Often, however, funding can be limited and repairs limited to "band-aid" fixes. For example: The Port of Anchorage dock facility has exceeded its useful life and severe piling corrosion threatens to impact port operations serving 74% of the Alaskan population, including military facilities of national significance. It requires an estimated $400 million to accomplish replacement and modernization of the facility. To date only a quarter of the funding needed has been secured. Engineering studies show that Port of Anchorage docks are severely corroded and its wharf piles have been classified as being in poor condition since 2000. Anchorage currently budgets more than $5 million annually to maintain operational capacity of existing wharf piles and other aging Port

infrastructure, but this work does little to enhance the facility's earthquake survivability. This situation imperils Alaska's economy because the State does not have cargo import capacity or infrastructure that could adequately substitute for the Port of Anchorage if it is significantly damaged by an earthquake or other disaster.

Operations & Maintenance

The majority of harbors, constructed circa statehood in 1959 and were maintained by the state until 2000, when Alaska Department of Transportation began program of divesture to local municipalities. This has resulted in operations and maintenance inconsistency throughout the municipal harbors and the 24 state managed harbors. This is primarily due to municipalities possessing varying levels of resources (both financial & human capital) to maintain their respective infrastructure. Several port and harbor facilities (Anchorage, Homer, and Nome) are dredged annually to ensure navigability and access to key communities and are typically funded at the federal level. However, after several decades, there remain numerous harbors requiring maintenance dredging to which funding has yet to be prioritized.

Funding

There exists in excess of $100M in recapitalization needs for the Alaska small boat harbors alone. The vast majority of harbors are maintained by the local municipalities with limited funding available from the state level. Additionally, waning state grant opportunities have challenged ports and harbors to conduct major preventative maintenance and to reconstruct facilities which are past their useful life. Many of the small boat harbors support subsistence lifestyles and thus are unable to collect sufficient fees to maintain or rebuild aging infrastructure. Small boat harbors, which cater to a cash economy, must generate sufficient revenue during the short Alaskan boating seasons, typically May through August. In 2006, the Alaska DOT established a 50%-50% matching grant program allowing for reconstruction of small boat harbors; however, the program has only fully funded all applicants twice. The ability for harbors to generate sufficient fund balances and the state's ability to continue to fund the program severely jeopardizes harbor reinvestment opportunities. A survey conducted of all Alaska harbormasters resulted in funding being the most significant challenge in providing services to maintain and recapitalize aging infrastructure.

Ports accommodating cruise ships have access to additional funding through the Commercial Passenger Vessel Excise Tax (CPV). The CPV is collected by the state which redistributes a portion of the tax collected to the cities and boroughs in which cruise ships make port calls.

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Future Needs

Alaska lacks deep water Arctic ports. An emerging Arctic Ocean poses both opportunity and risk for trans-shipment, destinational shipment and future resource extraction requirements along coastal Alaska. Enhancing port infrastructure – including deep-draft port facilities currently unavailable north of Unalaska/Dutch Harbor – would meet the State's goal of encouraging economic development in remote areas. It would provide local and regional economic development opportunities (resource extraction, tourism, and research); decrease Arctic region operating costs; provide protected dockage to support offshore oil and gas endeavors, fishing fleet, and resource extraction vessels; and provide vessel repair and maintenance support as well as facilities for emergency response and assistance vessels. It would improve international relationships and increase U.S. exports, optimize the aforementioned benefits while preserving natural resources; raise awareness of U.S. as an Arctic nation; and provide upland support to vessels operating in the region (fuel, water, electricity, food, medical, and storage, laydown/staging for resource extraction).

Public Safety

Alaskan ports and harbors are experiencing challenges with abandoned and derelict vessels many, which are from WWII-era and wooden. Alaska ports & harbors face risk associated with removal and disposal from irresponsible owners. The distances between harbors and reliance on water transportation for access for emergency and freight services necessitates safe, secure and accessible ports and harbors. In 2012, the Port of Nome was unable to secure barge deliveries of heating and transportation fuels before the sea-ice made the harbor inaccessible resulting in an historic operation requiring a U.S. Coast Guard icebreaker and Russian ice-strengthen tanker to deliver fuel in mid-winter.

Resilience

The Port of Anchorage sees 85 percent of the consumer goods for Alaska. The Port of Anchorage is in an active seismic zone and has experienced the highest recorded earthquake in North America; seismic activity could result in a supply interruption thereby paralyzing much of Alaska, including strategic military facilities. In addition, a significant number of other Alaskan ports & harbors are not connected to the terrestrial road system. This increases dependency upon marine transportation hubs but also exposes the communities to risks associated with coastal erosion, weather impacts or natural disasters which disrupt logistical supply chains.

Innovation

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The goal is to build facilities that last longer, are more environmentally friendly and meet user needs well into the future. Alaska has some of the greatest tidal ranges in the world, most of the new cruise ship berths recently constructed utilize floating "pontoon system" to embark and disembark passengers which enhance the safety and efficiency of large passenger vessels. Several ports which have cruise ships embarking have successfully leveraged the use of state Commercial Passenger Vessel Excise Tax for building infrastructure which improves safety and efficiency for the cruise ships and its passengers.

Recommendations

1. With limited opportunities to fund port and harbor recapitalization projects at the federal level, it is imperative that the State of Alaska prioritize legislative grant appropriations and matching harbor grant opportunities to the maximum extent allowable. Without safe and efficient access to ports and the ocean, the main regional economic driver in many of our communities is gone.
2. The Port of Anchorage is in desperate need of capital infusion to rebuild aging infrastructure and construct resilient facilities which provides 85% of all consumer goods to three-quarters of the state's population. Funding $300M through State legislative appropriations or bonds are necessary to realize the port needs in Alaska's largest city.
3. Several federal waterways are maintained the US Army Corps of Engineers through dredging and breakwaters projects within Alaska. Annual dredging at ports such as Dillingham and Ninilchik are necessary to maintain economic vitality for their rural regions. Other Army Corps projects include dredging on a 10-year cycle for the Cook Inlet Navigation Channel, Bethel, Ketchikan and Seward. The recent 2017 passage of the Waterways Infrastructure Improvement for the Nation (WIIN) Act will positively impact Alaska harbors directly by permanently requiring 10% of the annual Harbor Maintenance Trust Fund be directed to emerging ports, which move less than one million tons of commercial cargo across the docks. The WIIN Act will also provide funding to the Small, Remote, Subsistence Harbors program which will greatly benefit Alaska's waterways; however, this program requires and merits federal appropriation on an annual basis. This program was made permanent in the last WRDA bill giving Alaskan ports and harbors access to a consistent stream of funding in keeping navigation channels open and our jetties repaired.
4. That the State of Alaska and the federal government work in concert to develop the necessary infrastructure and governance to meet the economic opportunity which a Deep Draft Arctic Port provides to this Nation.

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SOLID WASTE

Anchorage Regional Landfill
Courtesy: David Squier

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What You Should Know about Alaska's Solid Waste

Alaska, the largest state in the Union covers 663,300 square miles, has 33,000 miles of coastline but only around 13,000 miles of road. This vast expanse makes dealing with solid waste challenging. The road system connects around 100 of the over 375 communities in Alaska which means collecting waste from Alaska's outermost communities has to be done either by air, sea, or left in the community. Alaska's extreme weather, permafrost, small population, and high costs combine to make dealing with solid waste a unique and challenging problem. The Alaska Department of Environmental Conservation (ADEC) has three classifications for landfills:

- Class I (Large) >20 ton per day 9 Facilities serving ~594,000 people
- Class II (Medium) 5-20 ton per day 14 Facilities serving ~60,000 people
- Class III (Small Remote) <5 ton per day 184 Facilities serving ~84,000 people

Class II & III Landfills

Alaska remains the only state operating Class III landfills. Class III landfills are not connected by road to a larger landfill or are more than 50 miles by road from a larger landfill and serve less than 1,500 people. Alaska was granted primacy over federal regulations given the unique challenges faced. An estimated 95% of rural Alaska communities use open waste disposal sites. Depending on the geological conditions present in each community, these landfills range from shallow trenches to pads on permafrost. Many of these dumps and landfills lie close to groundwater and within the boundaries of the communities. Over the years the waste stream has dramatically changed in rural Alaska from primarily organic waste to plastics, electronics and hazardous materials. These items require additional landfill space and have increased pollution potential if not disposed of correctly.

While Class II and III landfills play an important role in Alaska's solid waste infrastructure, for the purposes of this infrastructure report ranking they were excluded from the scoring. This is due to the complexity of the issues involved with them, the differences between communities, the differences between regulations, and the lack of regulation and monitoring at these sites. This report is solely ranked by surveys done on the Class I landfills, which serve 80% of Alaska's population. There are numerous studies and reports that discuss the challenges faced with Class II and III landfills; several of these are listed in the resources at the end of this section. This report is intended to serve as a basis for solid waste infrastructure rating in Alaska for Class I landfills. Class II and III landfills should be included in the statewide score in the future. The inclusion of these landfills will likely lower the infrastructure grade significantly due to the myriad of challenges faced in rural Alaska.

Class I Landfills

Class I landfills are the largest and most regulated landfills found in Alaska. They receive more than 20 tons of waste per day for disposal.

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Anchorage Regional Landfill
Courtesy: David Squier

C

Class I landfills are required to prevent leachate from leaving the landfill by means of a composite liner system. Leachate is water that percolates through the waste and leaches out the constituents. Additionally, the landfill must be designed to have no more than 12 inches of leachate on the liner at any one time. This requires leachate to be actively managed and disposed of. Several landfills in Alaska treat leachate in a wastewater treatment plant, others re-inject leachate back into their landfill. The Central Peninsula Landfill disposes of leachate by an innovative leachate evaporation system.

Class I landfills waste disposal leads to decomposition and other reactions in the waste that generates a significant amount of landfill gas. Landfill gas is usually composed of mostly methane which is a hazardous greenhouse gas. To minimize leachate generation and control landfill gasses after the landfill has reached its final capacity, Class I landfills are required to be capped by a liner system that is as impermeable as the bottom liner system. Class I landfills are also required to monitor, record, and manage environmental impacts to groundwater and air quality during operation and a minimum of 30 years after the landfill has been closed.

Waste Backhaul

Waste backhaul refers to the practice of shipping waste out of the community. Backhaul in Alaska is usually referring to shipping out hazardous waste or recyclable material, however several communities in southeast Alaska also ship out municipal solid waste. Shipping waste in southeast Alaska is accomplished by loading the waste into containers which are shipped to a lined landfill in eastern Washington. Backhauling waste in southeast Alaska is principally implemented because of the high rainfall the region receives would make leachate management difficult and costly. Other backhaul practices in Alaska includes Class I landfills shipping out hazardous waste because they are not permitted to dispose of some types of waste.

Capacity

Class I landfills in Alaska typically have a capacity of 1-50 years for existing lined areas. The Anchorage Regional Landfill was built in 1988 and has capacity through 2050. Most Class I landfills within Alaska have been built within the last 20-30 years, and most sites have additional room and plans to expand when needed. Surveys received from landfill operators show that the typical Class I landfill has a total life of 20-60 years including all additional space for future expansions. Lined landfills try to minimize the amount of lined area ready to receive waste for two reasons. The first is cost, as it would be prohibitively expensive to develop the entire landfill site at one time. To spread the cost throughout the life of the landfill, landfills are typically developed in stages or “cells”. The other reason landfills minimize the lined area is leachate. Because the bottom of the Class I landfills have impermeable liners, leachate collects and must be properly treated and disposed of for a cost. To minimize the amount of leachate produced, landfills only develop additional lined cells as needed.

SOLID WASTE

Anchorage Regional Landfill
Courtesy: David Squier

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Recycling efforts in Alaska divert a small amount of waste from landfills. However, much of the recyclable material is shipped out of state to be processed.

Condition

Evaluation of the condition of Class I landfills in Alaska was based on survey questionnaires and ADEC yearly scores. Class II and III landfills were not evaluated in this score. Transfer stations were not evaluated for scoring. No critical issues were seen with Class I landfills in the state of Alaska. A minor issue seen with landfills in the state of Alaska includes proper planning documents to ensure funding is adequate for future growth and keeping up on the condition of current infrastructure. A unique issue seen in Alaska due to lack of infrastructure present is the Anchorage Regional Landfill hauls leachate by means of trucking to ensure proper disposal to the Anchorage Water and Waste Water Utility sewer system. To improve the condition of the leachate disposal system the Anchorage Regional Landfill is currently evaluating options such as direct piping installation to remove issues that arise from hauling leachate. This would help limit the landfill's carbon footprint.

Operations and Maintenance

Operation and maintenance needs vary significantly within the state of Alaska. Funding sources for operation and maintenance varied in its source making the landfills that meet their operation and funding needs non-consistent. Sources of funding varied from property taxes, to commercial users, to rate based individual users paying monthly bills for solid waste service. Larger communities seem to be able to handle their operation and maintenance needs on a more consistent basis due to the funding available and backup pieces' of equipment being available for maintenance emergencies.

One unique issue seen in Alaska solid waste operations is self-haul (when the public delivers their own waste to the landfill) versus collection services. This balance varies greatly depending on the location of the landfill within the state. For example, the Anchorage Regional Landfill has only 15 percent of the collection being self-haul while in Unalaska the self-haul rate was 80 percent.

Another unique operations item in Alaska is snow removal and keeping frozen material from being used as daily cover in winter conditions. Large snow removal equipment along with equipment sized to dig through frozen soil conditions are necessary for the landfill to operate correctly.

Funding

Class I landfills in Alaska are receiving adequate funding on average. Rate increases are often incorporated into long term planning to account for current and future funding needs. However, due to state and federal funding shortfalls, improvements and expansions to facilities can result in sharp increases in residential rates which can be impractical for residents.

SOLID WASTE

Anchorage Regional Landfill
Courtesy: David Squier

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Although not included in scoring, many Class II and III landfills in rural Alaska lack adequate funding for operations and maintenance as well as capacity. The cost of construction intensifies the existing funding issues in rural Alaska.

Public Safety

Evaluation of the Health and Safety of Class I landfills in Alaska was based on survey questionnaires. Health and safety issues with Alaska Class I landfills include bird control and landfill gas surface emissions. Due to Alaska's large bird population, balancing the need for bird control while also protecting bird species such as bald eagles is a daily challenge for many landfills across the state.

Landfill gas emissions are also a challenge at some landfills in Alaska. Some surface gas emissions are due to the soil available for daily cover having a low percentage of fine grained particle present in the soil. Steps to correct surface gas emissions in landfills in the state of Alaska include gas well installation and utilizing daily cover material with high fines (when available) to help limit surface gas emissions.

Innovation

Many Class I landfills are incorporating sustainable practices into their business models. Anchorage has established a gas-to-energy project that transfers methane off-gas from the landfill to energy that feeds into the electrical grid. Unalaska is using a green laser system to deter birds from the landfill, which is an innovative solution that is effective at removing birds, as well as incorporating a leachate tank that holds up to five days of landfill leachate before discharging to the wastewater treatment plant. This ensures that leachate is properly treated before being discharged into the ocean, and comes after violations of the Clean Water Act resulted in large fines for the city.

Let's Raise the Grade

- **Make state and federal funding for improvements a priority**
- **Increase investment for long-term planning and capacity**
- **Ensure the sustained sufficiency and reliability of statewide landfill facilities**
- **Continue and grow innovative landfill practices such as energy-to-gas projects and recycling efforts**
- **Incorporate Class II and III landfills into future scoring efforts**
- **Work with rural Alaska to ensure all landfills are permitted and operating safely**

Find Out More

- State of Alaska Solid Waste program - http://dec.alaska.gov/eh/sw/
- http://www.alaskavillagevoices.org/garbage-what-happens-to-it-in-rural-alaska/

SOLID WASTE

Anchorage Regional Landfill
Courtesy: David Squier

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- http://www.zendergroup.org/backhaul.html

WATER & WASTEWATER

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What You Should Know about Alaska's Water and Wastewater

Alaska is the geographically largest state in the union covering 663,000 square miles. With an approximate population of 740,000, that translates to a population density of 1.1 people per square mile, by far the lowest density of any state. Over 75% of Alaskan communities are inaccessible by roads creating a unique environment for water and wastewater services. Because of this, communities operate their own separate water and wastewater utilities, without regional watershed management authorities. Each individual system is responsible for controlling water from the source, through distribution to end users, sewer collection, treatment, and discharge. Because of the end-to-end nature of these systems, this report evaluates water and wastewater systems together. Alaska's water and wastewater systems can be generally divided into two categories; municipal and rural. Municipal systems are typically located in the larger population centers of Southcentral, Interior, and Southeast Alaska such as Anchorage, Fairbanks, Juneau, Ketchikan, etc. These systems are quite similar to municipal water and wastewater system found throughout the rest of the United States, consisting of water treatment, pressurized distribution, wastewater collection via gravity/lift stations, and conventional centralized treatment systems. These systems are operated by a municipal utility and are funded primarily through user fees and/or local taxes, with some receiving state grants for capital upgrades. Although approximately 75% of the Alaska population lives in these larger population areas, an estimated 25% of households within these communities are on private drinking water wells and septic systems. As private well and septic systems fail, they are sometimes unable to be replaced due to proximity issues to neighboring property well and septic systems creating health problems or expensive solutions

There are 280 communities on rural systems most of which are Alaskan Native villages and are only accessible by water or air. Rural systems may include piped systems (both above ground and underground), gravity and vacuum sewer collection systems, individual septic tanks and wells, haul systems (separate house water and sewer tanks), and washeterias (single-point community showers and laundry). Thirty-one of these communities have no available water or wastewater system. Residents in these communities' haul water from rivers, lakes, and ice, surviving on as little as five gallons of water per day per person. Rural systems are often run by tribal governments and are funded mainly through federal grants and programs administered by the state's Village Safe Water (VSW) program or Alaska Native Tribal Health Consortium (ANTHC).

Capacity

Alaska's municipal water and wastewater systems track at or below national averages for percentage of houses served within a community. In rural Alaska, 75 communities in Alaska are considered underserved, meaning 55% or less of homes are served by a piped water and wastewater system, or covered haul system. Thirty-one communities have no access to safe, treated drinking water or safe disposal of wastewater. As a result, Alaska is ranked last among the states and Puerto Rico for percentage of homes with complete water and wastewater services, with 23% of Native Alaskan households and 19% of households below the poverty line lacking complete

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household plumbing. Though most communities have an abundance of available water resources, there is a lack of infrastructure to access those resources.

Condition

The average water/wastewater system in Alaska is 20 to 30 years old. While most of the larger municipal systems have stayed on top of maintenance, and continue to expand and improve service, there is still room for improvement. The surge of federal funding in the 1970s and 1980s that created most of the systems in rural Alaska did not provide any funding for ongoing maintenance. Across the state many systems have exceeded their design life and are operating on the original community infrastructure.

Additionally, Alaska's extreme weather and environment has taken a toll on infrastructure. Many of the materials and designs implemented during the 70s and 80s had never been used or tested in these conditions. For example, in the 80s much of the water piping was PVC pipe, which becomes very brittle when exposed to freezing temperatures causing breaks and pipe collapse. Further, melting permafrost and frost heaving has damaged manholes and disrupted sewer grades, increasing blockages and freezing. Corrosive soils coupled with the use of cast iron and ductile iron pipe from the 1950s through the 2000s has resulted in many failures of water mains.

Operations and Maintenance

Alaska has some of the highest water/wastewater system operation and maintenance (O&M) costs in the United States. It has the second highest average electric rates and the fourth highest average fuel rates. Rural communities have their own fuel storage and power generation facilities without access to larger grids. Because of this, electric rates in rural communities are often 4 times the national average with some community rates over $1/kW-hr. Fuel prices are equally high with prices ranging from $5 to $10 per gallon. Compounding this is the general isolation of rural communities which increases the price of goods significantly. A lack of local jobs and tax base means rural communities lack the ability to self-fund O&M on their water and sewer systems through fees or taxes. As a result, O&M costs are often subsidized by state or federal sources resulting in significant budget short falls and deferred maintenance.

Alaska also has a lack of certified water and wastewater treatment operators. This issue is compounded in rural communities for a variety of reasons. To combat this, Alaska has developed the Rural Maintenance Worker program in which maintenance workers partner with multiple communities, regularly traveling to communities within their region to do routine maintenance, check operations, and provide training.

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Funding

VSW estimates that of 220 villages, they need approximately $565 million in funding for improvements and expansions. The 2016 State budget only funded 9% of total urban grant requests leaving an $81.3 million annual funding deficit. This was a 25% funding drop from 2015. Alaska has a total estimated need of $1.5 billion for water and wastewater systems. Without a focused effort and increased funding, Alaska's water and wastewater systems' dependability will continue to deteriorate resulting in fewer Alaskans having access to clean, sanitary water and wastewater services.

Future Need

There are 106 communities in Alaska that are either underserved or have no water or wastewater systems. In addition, Alaska is projected to have a 20% population increase by 2045. Municipal systems face the challenge of keeping up with an approximately 80% increase over 30 years in Alaska's population centers. If a state natural gas pipe line, or other large development project happens, the population in Alaska could increase at a faster rate. Without focused planning, Alaska will not be able to keep up with the demand placed on water sources, distribution systems, or provide adequate wastewater treatment to meet stringent requirements.

Public Safety

Alaska ranks last in percentage of people with access to water and wastewater services. It is 30 years behind the national average. This effects the health of Alaskan residents with Alaska having some of the highest rates of pneumococcal, respiratory tract, and gastrointestinal infections in the United States.

Resilience

Climate change and melting permafrost are decreasing systems' resiliency. The U.S. Army Corps of Engineers lists 83 communities at risk of significant erosion damage. Most communities are along rivers or coasts with no road access requiring fuel to be shipped by barges. Changing river channels, ice, and flooding restrict fuel deliveries resulting in communities running out of fuel and shutting down water and wastewater systems. In recent years, above ground distribution systems have floated away during flooding events or severe winter weather has frozen water systems solid. The lack of access often means weeks if not months of shutdown.

Innovation

The extreme conditions and remote locations within Alaska necessitate looking for innovations. Alaska's remote communities have incorporated modular and package treatment systems to reduce construction, operation, and maintenance costs. Due to limited access to trained operators, several school districts and native heath corporations has used advanced remote monitoring and control systems. The Lower Kuskokwim School District

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operates some of the most remote and challenging systems. For the last 10 years, they have successfully pioneered remote monitoring and control systems in the state. There have been several design programs, like the state's Alaska Water Sewer Challenge, that seek to develop innovations.

Let's Raise the Grade

In order to improve Alaska's Water and Wastewater Infrastructure Grade more Alaskans need to have access to clean, safe, and reliable water systems. Municipal systems need to expand to meet the increased growth rate for the next 30 years. Rural systems need to expand to more communities to serve more Alaskans. Systems need to be designed and constructed to withstand extreme weather and Climate Change. Systems need to increase efficiencies to reduce operational costs due to high fuel costs.

These can be addressed by a combination of the following:

- Make State and Federal funding for improvements a priority
- Better coordinate between State, Federal, and Alaska Native programs
- Perform system evaluations to identify and assess risks and incorporate into planning efforts
- Develop and implement innovated technology and operations
- Focus on durable and sustainable system designs to reduce lifecycle and O&M costs
- Bridge the gap in O&M funding to allow communities to maintain existing infrastructure.

Find Out More

- Rural Alaska Sanitation, "Unserved Community List", 2015.
- Village Safe Water Program, State of Alaska.
- Alaska Water and Sewer Challenge.
- Alaska Municipal Water and Wastewater Capital Projects Lists.
- Anchorage Water and Wastewater Utility.
- Fairbanks Golden Heart Utility.
- City and Borough of Juneau Utility.
- USDA Rural Development, Alaska.
- Alaska Native Villages and Rural Communities Water Grant Program, EPA.
- Barrow Utilities.

Closing comments from the Report Card Committee

The Report Card for Alaska's Infrastructure 2017, is a collaborative effort undertaken by the Alaska Section of the American Society of Civil Engineers (ASCE). This effort was made possible through the hard work of several of our members and also non-members.

Our Infrastructure is all too often taken for granted in our daily lives and we often fail to consider what it takes to ensure the infrastructure is constructed and maintained to meet the needs of our society and future generations.

During 2016 we have reviewed publicly available information on nine of our state's infrastructure systems, often had questions for the infrastructure owner's or our peers. All the time wanting to give an objective overview or our infrastructure we have relied heavily on public knowledge and the professional expertise of our peers and our own knowledge of the infrastructure we work with every day. This report card is the result of that effort.

We hope that this report card will give valuable insight in, and a better understanding of Alaska's Infrastructure.

Our vast and beautiful state offer many unique challenges to those providing the infrastructure necessary for our everyday lives. Our state would not be the great place to live, work and play without our infrastructure. Thank you to all that make that possible.

Through the whole process we have had valuable help, guidance and support from ASCE staff members including Brittney Kohler, Becky Moylan, and Carolyn Sofman; and the ASCE Committee on America's Infrastructure.

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For the report card committee

Greg Kinney, P.E.

Tor Anderzen, P.E.

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1. Has or will have an impounding capacity at maximum water storage elevation of 50 acre-feet and is at least 10 feet in height measured from the lowest point of the toe to the crest of the dam; or
2. Is at least 20 feet in height measured from the lowest point of the toe to the crest; or
3. Poses a threat to lives and property as determined by the department after an inspection. Artificial barriers with a Class I (high) and Class II (significant) hazard potential classification as defined in 11 AAC 93.157 are considered dams. This definition of a dam is inconsistent with the definition used by the USACE for the NID, which contributes to inconsistencies between the state and federal databases.

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