CENTER FOR SAFETY EQUITY IN TRANSPORTATION (CSET)
BASELINE DATA AND OUTREACH

FINAL PROJECT REPORT

by

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for

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CSET
rural • isolated • tribal • indigenous

DISCLAIMER

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16. Abstract

The research presented herein summarizes the research and education efforts conducted at the University of Alaska Fairbanks as part of the Outreach, Synthesis, and Baseline Data efforts promoted by the Center for Safety Equity in its first year of operation. These key areas were to effectively engage relevant parties needed for larger research efforts, better evaluate what work has been done and how effective existing programs are and establish a baseline using existing and relevant data to inform and evaluate CSET safety efforts and identify commonalities and differences in RITI safety needs across the consortium states. Dozens of outreach events were hosted by CSET and several other events in which CSET participated to develop and foster key connections and collaborations with community members and agencies. CSET help sponsor and coordinate a regional conference focusing on transportation safety, bringing together diverse perspectives on the safety needs of rural, isolated, tribal, and indigenous (RITI) communities. CSET regularly participated in the annual Alaska Federation of Natives convention, using it as an opportunity for outreach and knowledge gathering. Three-dimensional models were designed and printed for the purpose of demonstrating the challenges of building roads in Alaska. Available data sources were compared to determine and highlight deficiencies in current analytical frameworks and support the need to incorporate other data sources in rural and tribal communities for the purposes of transportation planning and safety evaluation.

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SI* (MODERN METRIC) CONVERSION FACTORS

Symbol	When You Know	Multiply By	To Find	Symbol
APPROXIMATE CONVERSIONS TO SI UNITS				
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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EXECUTIVE SUMMARY

The research presented herein summarizes the research and education efforts conducted at the University of Alaska Fairbanks as part of the Outreach, Synthesis, and Baseline Data efforts promoted by the Center for Safety Equity. These key areas were to effectively engage relevant parties needed for larger research efforts, better evaluate what work has been done and how effective existing programs are and establish a baseline using existing and relevant data to inform and evaluate CSET safety efforts and identify commonalities and differences in RITI safety needs across the consortium states. Dozens of outreach events were hosted by CSET and several other events in which CSET participated to develop and foster key connections and collaborations with community members and agencies. CSET helped sponsor and coordinate a regional conference focusing on transportation safety, bringing together diverse perspectives on the safety needs of rural, isolated, tribal, and indigenous (RITI) communities. CSET regularly participated in the annual Alaska Federation of Natives convention, using it as an opportunity for outreach and knowledge gathering. Three-dimensional models were designed and printed for the purpose of demonstrating the challenges of building roads in Alaska. Available data sources were compared to determine and highlight deficiencies in current analytical frameworks and support the need to incorporate other data sources in rural and tribal communities for the purposes of transportation planning and safety evaluation.

CHAPTER 1. BACKGROUND

There is a critical need for context-sensitive transportation solutions that address the safety needs of rural, isolated, tribal and indigenous (RITI) communities. Safety approaches must be developed that are sensitive to heritage, traditional ways of knowing and learning, and the preservation of culture. While the concept of equity has woven itself through much of the transportation sector, it has been left out of the conversations on safety until only recently. The mission of the Center for Safety Equity in Transportation (CSET) is to move the needle forward on the topic of safety equity and to advance research and education as to provide everyone with fair and equitable access to a safe transportation system. The CSET mantra is that *if you have a right to get there, you have a right to get there safely.*

To that end, CSET focused much of the research and education efforts in its first year to three primary areas: outreach, synthesis, and baseline data. By strategically targeting these areas, we hoped to: 1) effectively engage relevant parties needed for larger research efforts; 2) better evaluate what work has been done and how effective existing programs are; and 3) establish a baseline using existing and relevant data to inform and evaluate CSET safety efforts and identify commonalities and differences in RITI safety needs across the consortium states. For example: surveys should have some level of consistency across state-level efforts for comparative purposes; resources might exist outside of CSET consortium states and should not be duplicated; and some types of data might exist in one state but another.

1.1. Outreach

The efforts conducted under YR1 Outreach aimed to enhance our overall understanding of RITI safety issues with RITI context. We know that culturally sensitive solutions are needed that will reduce RITI injuries and fatalities. The goals of these outreach efforts were to: 1) better understand travelers' attitudes and preferences in RITI communities based on their general and unique travel modes; and 2) better understand travelers' traditional adhesion and cultural heterogeneity in RITI communities and their impacts on RITI safety regulation, policy compliance, etc.

Outreach efforts were intended to:

- develop connections with RITI communities and engage relevant parties;
- foster relationships with people who value sense of community and want to improve transportation safety in their rural area;
- conduct boots on the ground and holistic listening sessions to better understand safety issues that are of most importance; and
- inform future research efforts during the life of the center.

1.2. Synthesis

The efforts conducted under YR1 Synthesis were aimed at enhancing our overall knowledge of RITI safety issues. The objectives of synthesis efforts were to: 1) enhance the understanding of the impact factors that affect rural traffic crash frequencies and severities, how these factors vary over time and across regions; and 2) synthesize current safety practice and resources as they apply to RITI communities at local and national levels.

The following list provides a short list of some example tasks that were anticipated synthesis efforts across the consortium members:

- perform a detailed literature search to identify what research has been done, what policies are in place in rural communities, knowledge gaps and cultural barriers;
- synthesize how crashes are being reported (and the extent of potential under reporting and non-reporting of crashes and injuries) and existing local traffic safety policies, safety regulations and enforcement;
- synthesize metrics and protocols associated with village, reservation and island self-governance;
- Identify administration and accessibility to licensing programs by RITI communities;
- synthesize known information across rural America to provide CSET and interested researchers a baseline for development of future research agenda; and
- identify existing resources (centers, programs, document, tools) that directly or tangentially address the objectives of CSET.

1.3. Baseline Data

The efforts conducted under YR1 Baseline Data were aimed at identifying and acquiring data related to RITI transportation safety recognizing that road users from RITI communities have higher risk. Pinpointing causal factors and identifying effective solutions to collisions involving RITI community road users require solid safety datasets and analytical tools. These data were also intended serve as a measurement of CSET performance and overall contribution to RITI transportation safety over time.

Examples of baseline data efforts include:

- identify and document existing crash data sources in RTI communities;
- gather and integrate region-wide multiple-year (2010-2015) RITI community safety-related baseline data, including traffic flow characteristics, crash attributes and contribution factors, crash-related trauma data and medical records, weather conditions, etc.;
- design and implement online data platform and its supporting relational database, such as SQL database to unify data storage and management;
- develop methods for RITI community safety data quality control and cleaning;
- document the characteristics of emergency response at RITI communities and identify gaps and opportunities for life saving and injury mitigation; and
- conduct a time series analysis to explore the changes in crash risk and severity over time to identify the factors in rural and tribal areas considering *all* travel modes, including traditional motor vehicles and non-traditional modes such as ATVs and snow machines.

1.4. Organization of Report

Outreach efforts are presented and discussed in Chapter 2. This includes notes on educational events, conventions and conferences, the development of 3D printed models of roads and road damage for outreach and education, and involvement in the Newtok Relocation Project. Chapter 3 discusses efforts related to synthesis and baseline data.

CHAPTER 2. OUTREACH

2.1. Educational Events

The University of Alaska Fairbanks participated in several outreach events. The following provides an example list of just a few events that CSET either hosted or in which CSET participated.

- *Pearl Creek Elementary STEM Night*, February 1, 2018
  CSET staffed a table on road construction, design and safety for elementary school students at Pearl Creek Elementary School's annual STEM night.

- *UAF Engineering Day*, February 24, 2018
  CSET presented a road safety activity at UAF CEM's Engineering Open House on the UAF campus. Participants learned about roundabouts, traction and braking distance (see Figure 1) and turning radius using remote-controlled and die-cast cars.

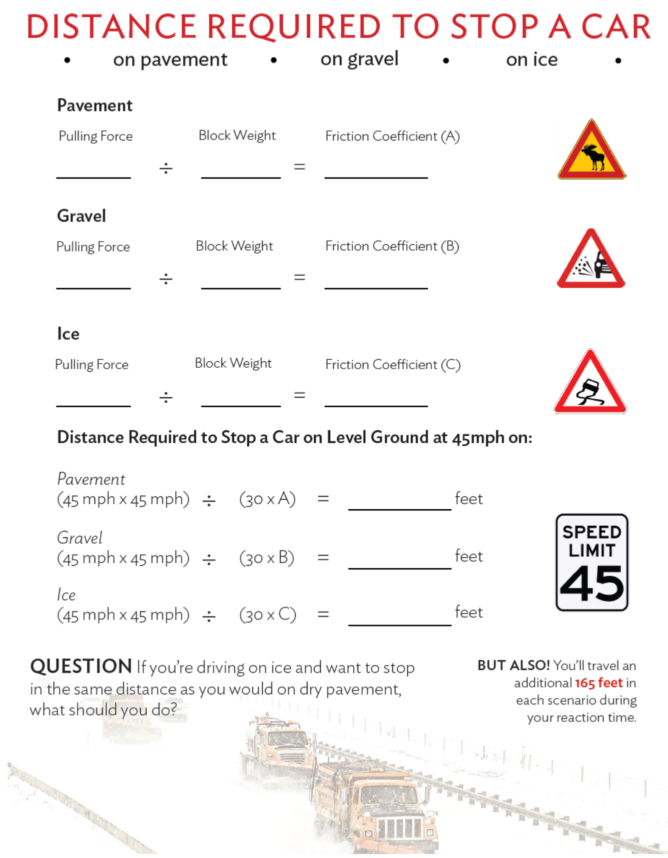


Figure 1. Worksheet used for a stopping and braking distance activity for k-12 outreach events.

- *Copper River School District*, May 16, 2018
  CSET Director Billy Connor provided a highway safety presentation for group of approximately 10 students from Kenny Lake high school in the Copper River School District. The students were visiting UAF to get information on the diverse opportunities for studies in college.

- *Palmer Elementary School*, May 8, 2018
  CSET Director Billy Connor provided a highway safety presentation for group of approximately 10 students from Palmer Elementary School. The students were visiting UAF to be encourage dreams of going to college.

- *Kids2College Event*, April 18, 2018
  CSET Director Billy Connor and CSET Associate Director Nathan Belz engaged 5th and 6th grade students from the Alaska Gateway School District and the Nordale Elementary School during the annual Kids2College event hosted by UAF (Figure 2). The students were introduced to the concepts of friction and safe stopping distances on different road surfaces including asphalt, gravel and ice.

Figure 2. Kids2College Event held at UAF on April 18, 2018

- *North Star Elementary School*, November 8, 2018
  CSET hosted 24 third grade students from North Star Elementary School visiting the UAF campus. UAF students in Civil and Environmental Engineering provided a presentation on the different types of concrete. The highlight for the students was a demonstration of the differences in concrete strength illustrated by crushing different types of concrete cylinders (see Figure 3).

Figure 3. North Star Elementary School event held at UAF on November 8, 2018

- *BEST STEM Series*, January 25, 2019
  CSET Director Billy Connor discussed engineering with homeschooled students who participate in the Building Educational Success Together (BEST) program through the Fairbanks North Star Borough. The students were introduced to the concepts of friction and safe stopping distances on different road surfaces including asphalt, gravel and ice through an activity that measured the friction coefficient of each surface and used the values to calculate stopping distances (see Figure 4).

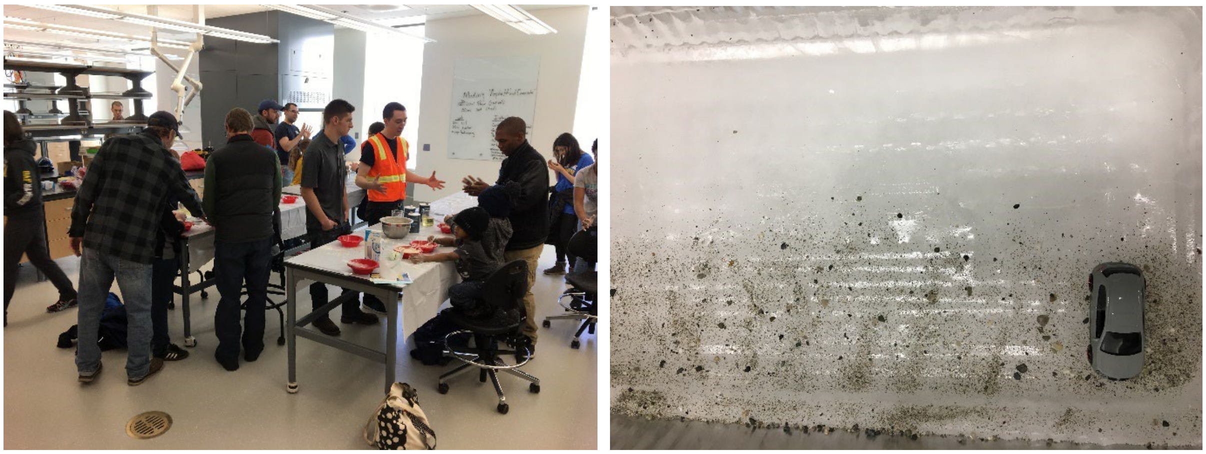


Figure 4. BEST STEM Series held at UAF on January 25, 2019.

- *Pearl Creek Elementary STEM Night*, January 31, 2019
  CSET staffed a table on road construction and design for elementary school students at Pearl Creek Elementary School's annual STEM night.

- *CEM Engineering Open House*, February 23, 2019
  CSET provided an activity to demonstrate safe stopping distance concepts and measurements to the Fairbanks community during the annual UAF College of Engineering and Mines (CEM). The activity focused on determining the friction coefficient for different surfaces to calculate the safe stopping distance. The event was attended by approximately 500 people.

- *LAB Smart Cycling Course*, June 26 and 27, 2019
  UAF hosted the Smart Cycling Course led by Pierce Schwalb of Bike Anchorage (Figure 5). The course is designed to reach people of all ages and abilities by improving skills, building confidence, and teaching others. There were 10 attendees at this event including CSET assistant director, Nathan Belz. This event was provided at no cost to participants through a Highway Safety Office grant given to Bike Anchorage.


Figure 5. Students participate in a Smart Cycling course at UAF on June 26th and 27th, 2019.

- *LAB League Certified Instructor (LCI) Training*, July 19 to 21, 2019
  UAF hosted the LCI course. Led by Jennifer Laurita of the League of American Bicyclists, the LCI course is designed to certify enthusiastic and competent cyclists how to teach Smart Cycling classes to children as well as adults. Their goal is to help people feel more secure about getting on a bike, to create a mindset that bikes are treated as a vehicle, and to ensure that people on bikes know how to ride safely and legally. A CSET project at UAF led by Nathan Belz solicited a call for proposals and provided the cost of registration and certification to five individuals that expressed dedication and interest in improving bike safety in rural communities.

- *UAF Engineering Open House,* February 22, 2020
  CSET provided an activity to demonstrate structural stability using the shake table in the Hi-Bay Facility to the Fairbanks community during the annual UAF College of Engineering and Mines (CEM) Open House.

- *Pearl Creek Elementary STEM Night*, January 30, 2020
  CSET staffed a table on road construction and design for elementary school students at Pearl Creek Elementary School's annual STEM night (see Figure 6).

Figure 6. CSET graduate student Tristan Sayre talks to students at Pearl Creek Elementary STEM Night on January 30, 2020.

2.2. Conventions and Conferences

CSET began co-sponsoring a regional conference with the Pacific Northwest Transportation Consortium (PacTrans) in 2018. Including having a presence and giving presentations, several sessions and workshops were planned and coordinated by CSET partners. This included, but was not limited to, the following sessions and topics. A few select photos from these sessions are shown in Figure 7.

Rural + Context Sensitive Safety
This session presented projects and research focused on improving transportation in rural areas. Transportation improvements and operations in rural communities require specialized strategies that are cognizant of local conditions, constraints, and needs. Projects, experience, and research related to context-sensitive solutions were discussed with a focus on local outreach and engagement.

Rural Safety Case Studies that Fit a Need as well as a Context
Brian Walsh, Washington State DOT

Ongoing Challenges of Providing Transit Service in Northern Climates
Glenn Miller, Fairbanks North Star Borough

Safety of Rural Unpaved Two-way Roads in Idaho
Angel Gonzalez, University of Idaho

Traffic Safety in Tribal/Indigenous/Pacific Islander Communities
Equity concerns have considerable influence on transportation and policy decisions, and most practitioners and decision-makers genuinely attempt to address these concerns. However, designs and planning decisions may seem equitable when evaluated in one context but inequitable when evaluated in another. There is little guidance on considering transport equity comprehensively. It is imperative that safety strategies and solutions for tribal, indigenous, and Pacific Islander communities consider all modes and all user types as to not diminish the mobility, right to access, and basic needs of these individuals

A Culture of Traffic Safety on Reservation Roads
Dr. Margo Hill, Eastern Washington University

Building Traffic Safety Capacity Among Washington State Tribes
Scott Waller, Washington Traffic Safety Commission

Best Practices for Planning and Developing Transportation Safety Projects in Rural Communities
Adison Spafford

Fatality Analysis of Native Hawaiians in the State of Hawaii: 2007-2016
Kishor Bhatta, University of Hawaii at Manoa

Workshop: Defining Isolation in a Transportation Context
Though there are several ways in which one might define a remote or isolated community, one that is relevant for transportation applications has not been well established. Beyond connectedness and continuity of roads, there are a myriad of factors that might make a community isolated (e.g., EMS response time, distance or time to acute care facilities, and relative ease of access to basic goods and

services). This hour was meant to spark dialogue with researchers and practitioners and bring some perspective to how we might objectively measure transportation isolation.

Dr. Cary de Wit, University of Alaska Fairbanks | Expertise: Cultural Geography
Panos Prevedouros, University of Hawaii at Manoa | Expertise: Transportation Engineering
Hillary Strayer, Alaska Native Tribal Health Consortium | Expertise: Injury Prevention
Dr. Sveta Pasternak, University of Alaska Fairbanks| Expertise: Cultural Anthropology

Figure 7. Speakers Adison Spafford (left) and Billy Connor (right) present at the conference co-sponsored by CSET in October 2018.

Permafrost Tunnel Tour

Billy Connor coordinated a tour of the Army Corps of Engineers Permafrost Tunnel and gave a presentation on permafrost and the engineering and safety concerns that must be considered when building and planning roads in the circumpolar north (Figure 8).

Figure 8. Participants of the permafrost tunnel tour and talk.

Alaska Federation of Native Convention (AFN)

The annual convention serves as the principal forum and voice for the Alaska Native community in addressing critical issues of public policy and government. The convention convenes thousands of official delegates and participants from membership organizations across the state. CSET Assistant Director, Nathan Belz, and CSET Program Manager, Vicky Wolf, regularly attended this convention. AFN draws representatives from many tribal communities across Alaska.

2.3. 3D-Printed Road Models

3D-printed road models were developed for the purpose of outreach, education, and discussion at events in which CSET partners were involved. The following describes the design process used to develop these models.

Three-dimensional models of various road sections are sketched by hand and then digitized in AutoDesk Fusion360 (see Figure 9). Certain tolerances must be integrated between shapes to allow them to "fit" and "lock" effectively after being printed.

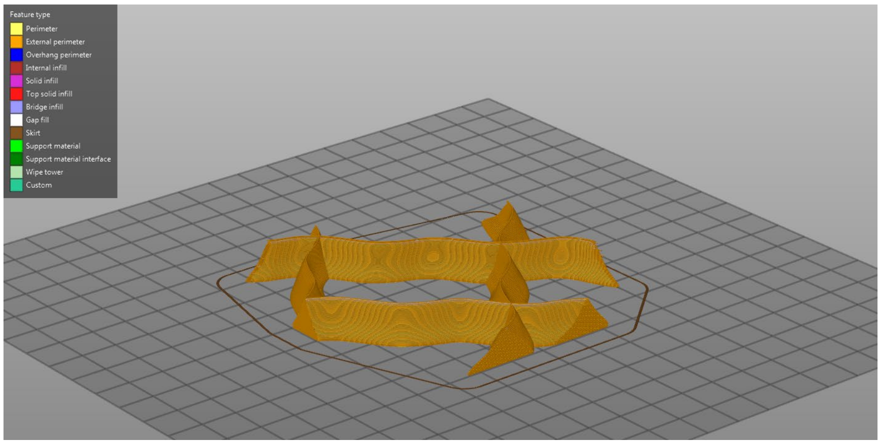


Figure 9. A rending of an ice wedge in AutoDesk Fusion360.

The digitized version of the road section is then "sliced" in a program called Cura and loaded on the Prusa i3 MK3s printer to be printed using PLA (see Figure 10). Some layers such as the brown base seen in the Ice Wedge Damage model below can take up to six hours to print.

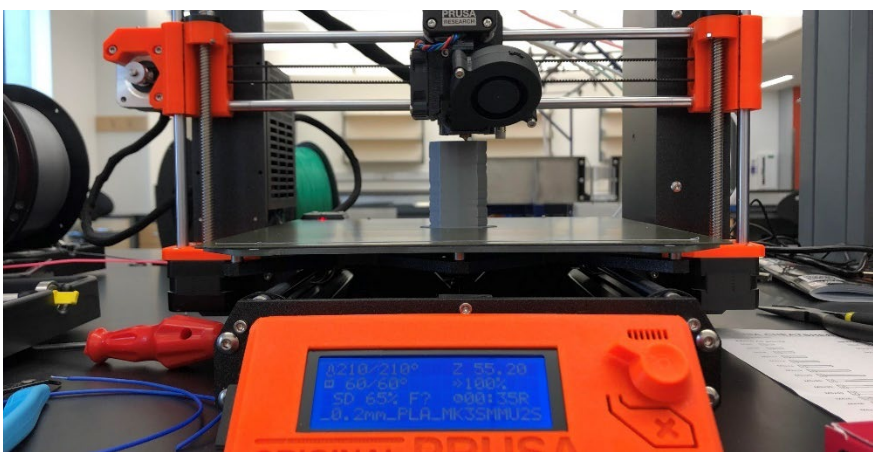


Figure 10. A section of roadbed being printed on the Prusa i3 in grey PLA filament.

Some models and features do not always print well (see Figure 11) or simply will not lock or fit with other pieces well and require slight design modifications. In other cases, certain shapes simply will not print successfully, or prints will fail unexpectedly.

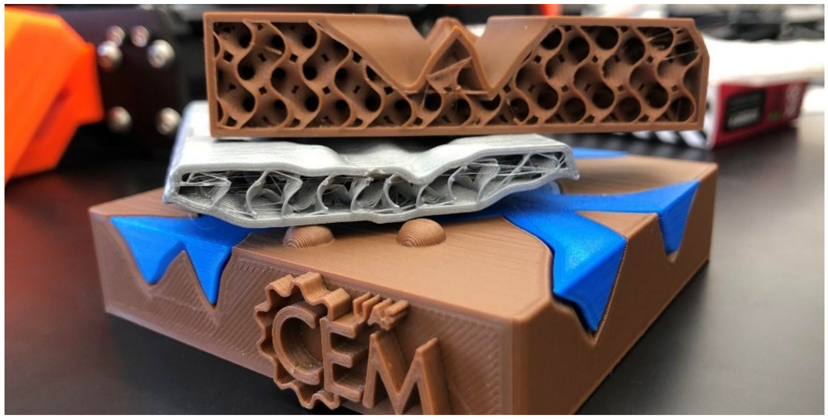


Figure 11. An example of a failed print on a section of road where the filament did not properly adhere to the print bed.

Educate

The final models are then used during STEM and K-12 outreach events to teach kids about what “good” and “bad” roads look like (see Figure 12) while discussing things that we as engineers do to keep our roads in safe and efficient working order. The undergraduate students who helped with the project, Jordan Zelhuber and Monroe Morris, shared their work at the annual PacTrans+CSET conference in 2019 (see Figure 13). The final 3D model products are presented below.

Figure 12. An example of a completed 3D model of how permafrost and ice wedge features propagate to a road surface.

Figure 13. CSET-supported students, Jordan Zelhuber and Monroe Morris, showcase their 3D-printed road models at 2019 conference sponsored by CSET and PacTrans.

Typical Road

A typical road section includes sub-base gravel which sits on top of the natural subgrade, base gravel, and usually a base and surface course of pavement. When built and maintained properly, a road can stay in a state of good repair for decades or more. When not cared for or when located in places that have difficult environmental and climatic conditions, a road may need constant repairs to counteract the "forces of nature."

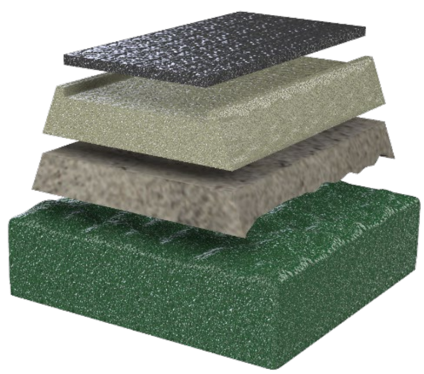


Figure 14. Isometric view of a 3D model of a typical road section.

Ice Wedge Damage

Road damage results when central parts of the ice-wedge polygons are compromised by the loss of the protective organic layer above (e.g., when clearing for the construction of a road). Thermokarst development results and causes continued ground subsidence which is visible in the road surface. Over time, ponding of water on the surface can occur and with formation of shallow thermokarst lakes which eventually deepen and enlarge, will cause relatively fast degradation of ice-rich soils under the lake.

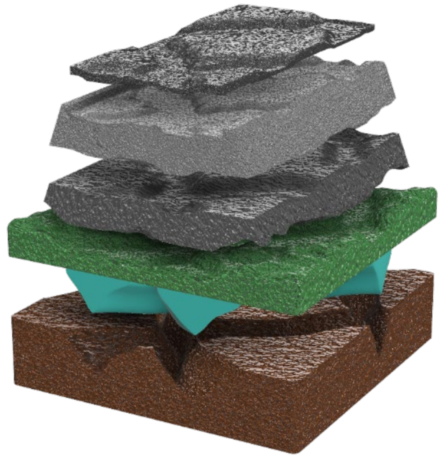


Figure 15. Isometric view of a 3D model of a road section underlain by an ice wedge.

Shoulder Rotation
When snow is plowed off the roadway, it typically accumulates on the side slopes of the road or in the ditches. The insulative properties of the snow keep the active frost layer from penetrating as deep as it would have if the road were not present. Permafrost and related frozen ground features are then compromised, resulting in deeper thawing and subsidence of the areas beneath where the snow had accumulated over the winter. This causes external rotation of the road shoulders which manifest as longitudinal cracks in the pavement surface and subgrade.

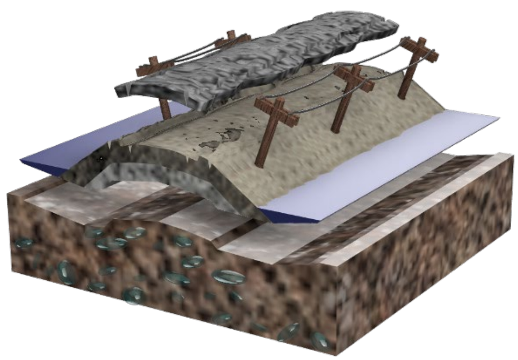


Figure 16. Isometric view of a road section with shoulder rotation damage.

Thermosyphons
Gas-filled hairpin thermosyphons are also placed horizontally beneath a portion of the asphalt surface. The refrigerant inside evaporates in the bottom portion and condenses when it travels as a gas to the top. Each thermosyphon helps to keep the permafrost below remain frozen. This method has been used on several roads in the state that are vulnerable to thawing.

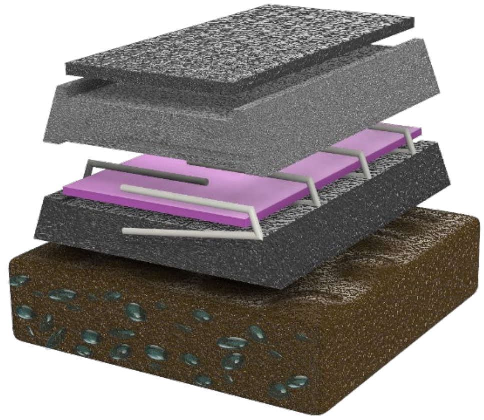


Figure 17. Isometric view of a road section with thermosyphons installed.

Freeze/Thaw Damage

Every winter a few culverts seem to “sink” or “settle.” Many of these culverts were compacted with non-frost-susceptible materials, and the roadway around them is just heaving up to make them seem lower. When backfilling pipes, we should reuse the material, if possible, in the trench around the pipe to help alleviate this problem. If we use a non-frost susceptible material around the culvert, it does not heave in the winter. As the road on either side heaves, the culvert appears to settle. Frost-susceptible materials are prone to more problems and will be weaker in the spring, causing those areas to sink and making the area above the culvert appear to “heave.”

Figure 18. Isometric view of a road section with freeze/thaw damage in the vicinity of a culvert.

2.4. Newtok Relocation Project

Newtok is a small community of 453 residents located on the Ningliq River along the western coast of Alaska. Newtok is experiencing similar problems to that of more publicized Shishmaref, AK where houses are falling into a shifting and eroding landscape. Newtok is immediately threatened by thawing permafrost and coastal erosion due to fall storms, causing the Ningliq River and adjacent slough to widen and migrate in the direction of the community. The village is currently undergoing planning and execution of a nine-mile move to Mertarvik, a new location near Nelson Island, formed primarily by an old lava flow offering more stable ground.

Figure 19. Location of Newtok and Mertarvik, AK. (Ostrander, 2016).

There are projected to be several more "Newtoks" across Alaska, and perhaps the rest of the United States, as previously frozen ground begins to thaw. CSET used this opportunity to learn from the Newtok relocation project and help other very rural and isolated communities develop standards for safe roads that meet their unique travel needs using a context and culturally sensitive approach.

The location and layout of the community had been completed, including the general locating of streets and major roadways, when CSET started collaborating. The community layout, as requested by the community, centralizes public facilities in the northern sector of the village. Near term housing will be located to the southwest of the public areas. This layout tends to favor efficiency of wastewater collection. However, it will require the use of vehicles to move around the community on gravel roads when the village has historically been accustomed to travel on smaller and narrower boardwalks. The anticipated modes of transportation do not include cars (or perhaps an isolated truck or two) but as proposed, the new roads into and throughout the community will be large enough to drive cars on.

Overall, these efforts involved myriad parties including (but not limited to) the Newtok Native Corporation, Denali Commission, State of Alaska, Alaska Native and Tribal Health Consortium (ANTHC), Bureau of Indian Affairs (BIA), Newtok Village Council, DOWL, Sherman Engineering and Kinney Engineering who have significant experience working with and in isolated and indigenous communities. Making connections with these parties was invaluable for follow-on CSET research and outreach efforts.

CSET was provided with an incredible opportunity to get inside a community at the beginning of a road system development and figure out what will fit their needs and be safe considering that they are transitioning from boardwalks and ATVs to gravel roads and some automobiles. We were able to learn from them how they plan to use their "new" roads and what they want and need out of a rural transportation system.

Current design standards do not apply as these roads do not fit on our conventional road hierarchy scale (see Figure 20). Simple considerations might be: how much signage there should be or how and where to install street lights to avoid visual pollution? Or how do you design for night-time sight distance for ATVs which have no published standards on illumination? And what signage is appropriate considering it needs to be provided in the local Yupik language. Further, why build full-width automobile-ready roads for a community that does not have automobiles? In order to minimize development costs now, one might consider starting with ATV/UTV trails and pathways now and develop the "right-of-way" later as the demand, population, and resources increase over time.

Figure 20. Boardwalks serve as roads in Newtok (left) as the ground is unstable or prone to erosion (right).

Figure 21. A gravel road in Mertarvik under construction (left) and the Mertarvik community ribbon cutting ceremony (right).

Several other agencies and contractors had already started working on the community streets and the layout in Mertarvik, but ANTHC and the Newtok Village Council (NVC) asked that CSET provide suggestions on ways that safety could be incorporated into their transportation system. These suggestions required significant input and many discussions with NVC. CSET's involvement is outlined herein.

CSET Director, Billy Connor, and Assistant Director, Nathan Belz, reviewed interim plan sets and provided feedback on elements such as traffic control, access points, and intersection details. This included suggesting modifications to geometric layouts such as increasing intersection curve radii (see Figure 22) and removing short roadway tangent sections (see Figure 23).

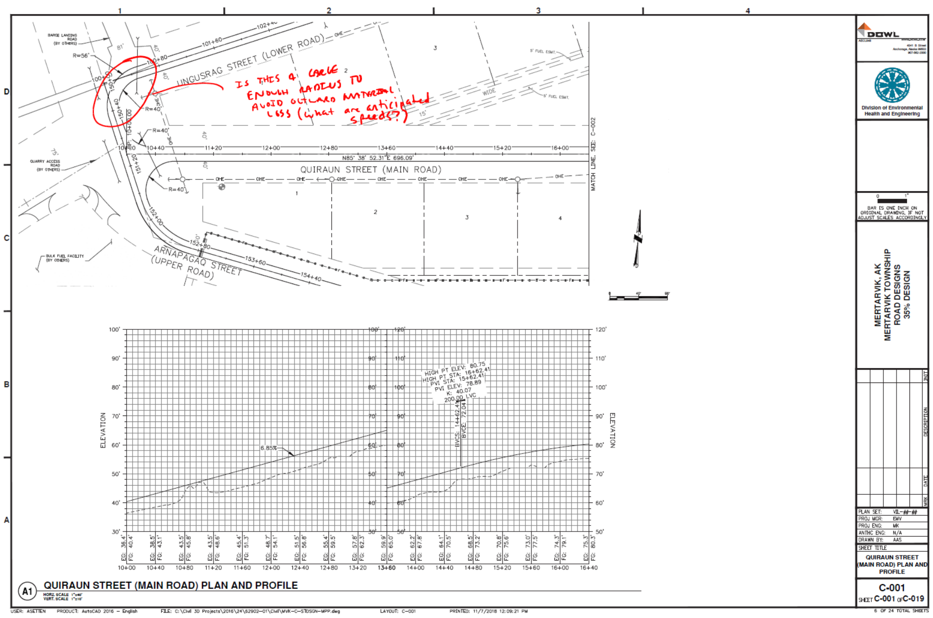


Figure 22. Mertarvik road plan with CSET notes to increase radius to avoid migration of road material.

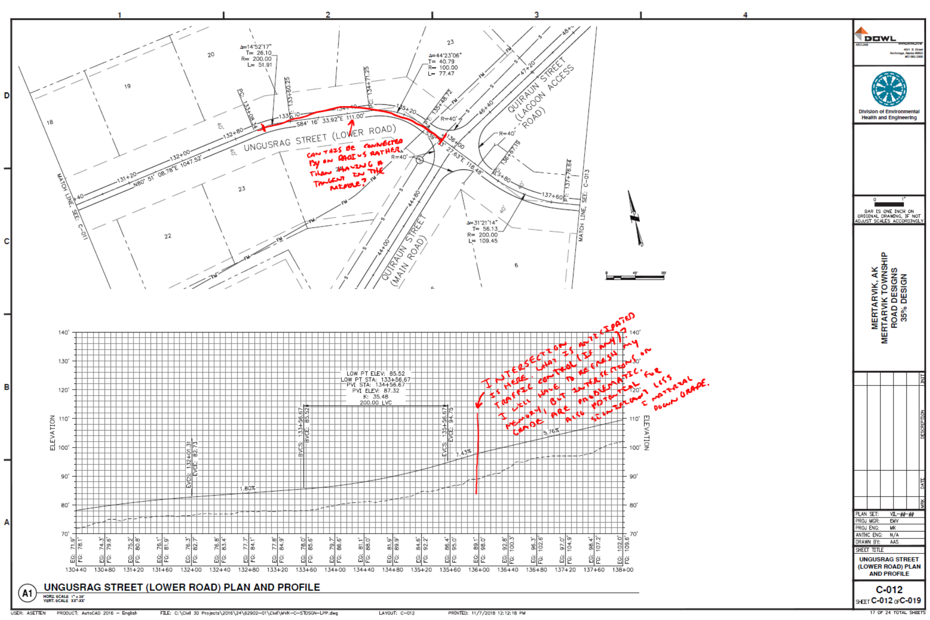


Figure 23. Mertarvik road plan with CSET notes to eliminate short tangent section to avoid lane encroachment.

CSET Assistant Director traveled to Newtok and Mertarvik on two occasions to engage with the community and was able to participate in the community ribbon cutting ceremony (see Figure 21). However, due to the COVID-19 pandemic and restrictions on travel, a few of the outreach and educational activities that were planned to be held in Mertarvik had to be cancelled. This included:

- A workshop on mitigating and managing dust from gravel roads - an education and outreach activity will be administered in two phases, one full-day training prior to relocation and one full-day training after.
- Providing education and outreach opportunities to help with
    - transitioning from a boardwalk-based system to a road network (e.g., using roads safely in mixed-use roadway environments that include walking, biking, and ATVs; consideration of clear zones and location of utility poles; etc.) and translate any education and outreach materials into Yupik; and
    - instilling a safety culture that fits with the Newtok community traditions and heritage
- A bike education and maintenance training workshop including the distribution of reflective gear and bike helmets for local children and repair tool kits and “fix-it” stations and coordination of the construction of a covered bike parking area.

The knowledge gained through this outreach activity was invaluable for formulating a context for extremely rural and isolated transportation safety. CSET researchers were able to develop strong connections with the residents of Newtok and other agencies/parties involved. CSET continued to foster and support follow-on activities with Newtok and Mertarvik over the life of the center. These efforts also served to directly inform follow-on CSET research efforts and also set the stage for developing a guide on practices for safety-focused planning and design of rural community roads in Alaska that would provide alternatives to the AASHTO Policy on the Geometric Design of Highways and Streets and the AASHTO Geometric Design Policy for Very Low-Volume Local Roads (<400 ADT), particularly in communities where transport by non-automobile and off-highway-type vehicles is more common.

CHAPTER 3. SYNTHESIS AND BASELINE DATA

Previous work by Perkins, Belz, and Bennet (2019) explored the use of non-standard safety data, such as crashes of off-highway vehicles (i.e., ATVs or "four-wheelers") and snowmachines, as well as non-standard accident reporting (e.g., such as hospital records and newspaper articles). This study found non-standard data to be especially important in rural and remote regions where much transportation is not on highways, non-highway vehicles are common, and administrative resources are scarce. Common areas and discrepancies between data reporting systems were examined for case examples of a large, medium and small-sized community in Alaska. Findings noted that newspaper reporting in smaller communities may vary in thoroughness, but a large fraction were picked up in local news sources that were not in either the DMV or Trauma Registry records. As such, the most complete set of crash "data" for these small towns and villages may be found in the local newspaper. Thus, when seeking support for transportation system improvements that would improve vehicular safety, CSET recognizes and encourages communities to consider the use of data beyond the more conventionally relied upon sources (i.e., state crash data).

To that end, the synthesis and baseline data presented here explores both conventional and less-conventional data sources as well as defining and categorizing our geographic area of interest. As an example, Figure 24 shows the Census-designated places (CDPs) of Alaska. Below that, Figure 25 shows the same CDPs but categorized as being connected or not connected and by which type of facility (i.e., highway, secondary roads, or trails). By and large, the central and mid-coast region of the state is well connected by highways and secondary roads primarily in a north-south orientation. As you move to the west and further to the north, it is more common to find communities that are not connected to other communities or are only connected by trails or other informal transportation corridors such as rivers. Other communities rely primarily on air travel to reach and stay physically connected with the rest of the world.

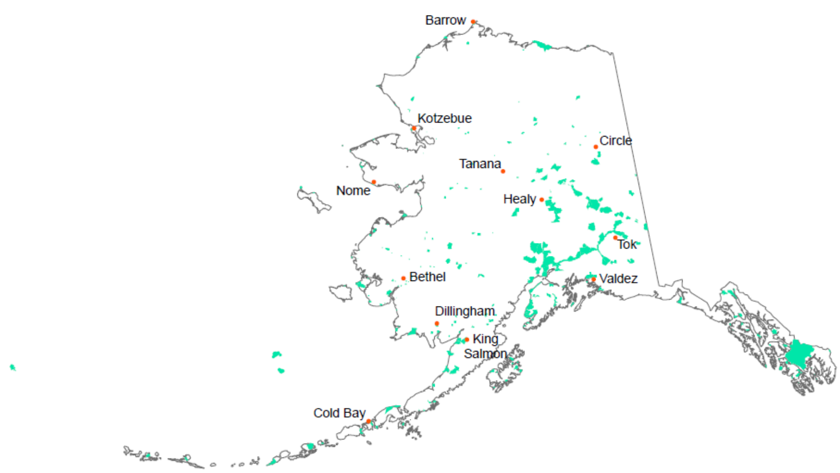


Figure 24. Census-designated places of Alaska with selected named towns and villages.

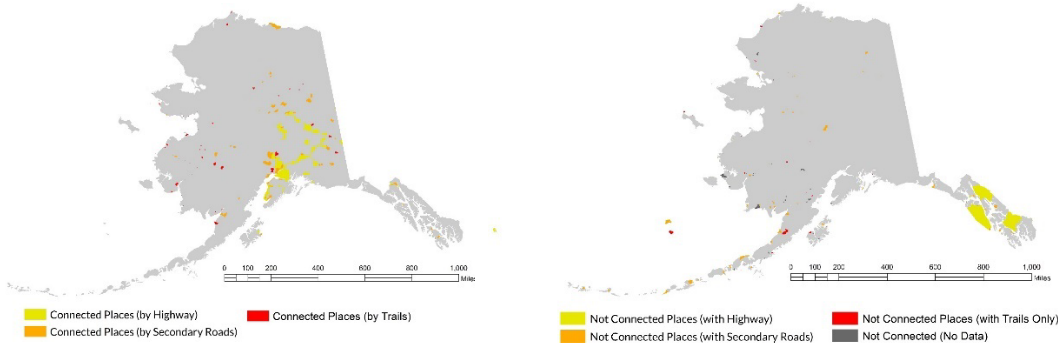


Figure 25. CDPs of Alaska categorized as connected and not connected and by which type of facility.

While attending the annual Alaska Federation of Natives convention (AFN) in 2017, 2018, and 2019, CSET Assistant Director, Nathan Belz, and CSET Program Manager, Vicky Wolf conducted a simple three question survey.

- In what town, village, or city do you live?
- What transportation mode do you most often use for your daily needs?
- What is your most important transportation safety issue?

Results from the 2017 survey are shown in Figure 26. The geographic representation is well spread across the state and covers rural communities ranging in size from 250 residents to nearly 8,500 residents. The most prevalent transportation safety concern was driver behavior (most common was speeding) followed then by road surface quality (i.e., ruts and potholes). Figure 27 shows that residents in smaller and more rural communities rely on all-terrain vehicles, snowmachines, and non-motorized forms of transportation as compared to those in medium to large sized communities (those with more than 5000 residents).

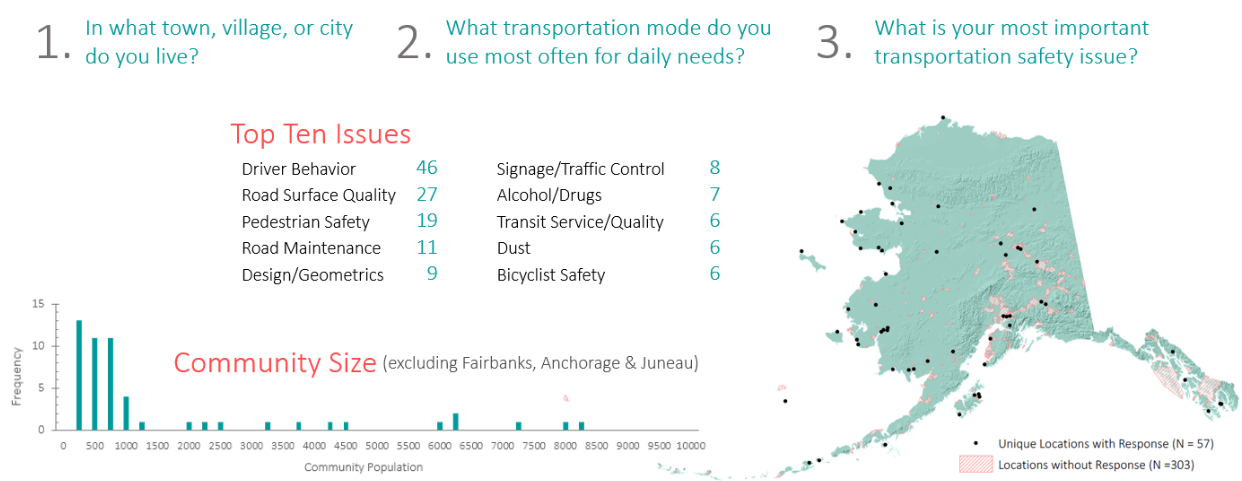


Figure 26. AFN survey results from 2017.

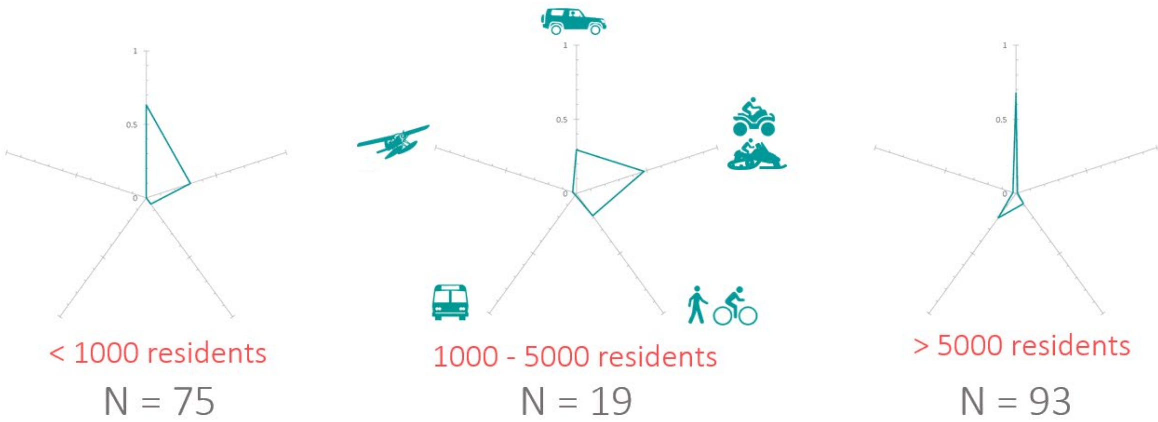


Figure 27. AFN survey results for the most common mode used for daily needs categorized by community size.

In order to achieve a larger response rate with better representation, the survey was conducted in three consecutive years and also determine if safety issues were prone to changing over time. The compiled results from the 2017, 2018, and 2019 surveys can be found in Figure 28 below. Driver behavior, again typically speeding on small local streets, tends to be the most prevalent concern.

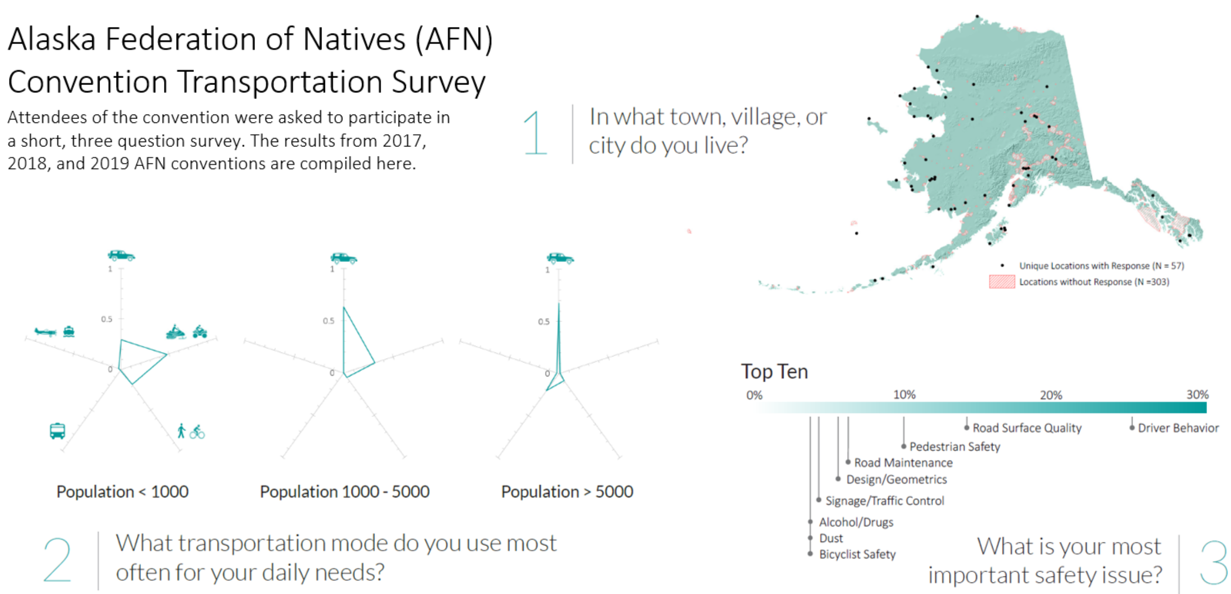
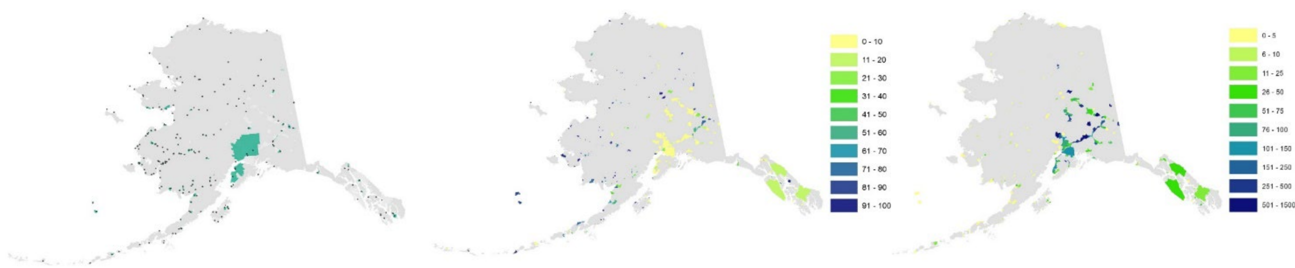


Figure 28. Alaska Federation of Natives Convention CSET Survey Results, 2017-2019.

To look at potential disparities in and across safety data sources, we first identified which Alaskan communities were designated as tribal or as federally recognized Alaska Native communities. There are currently 229 federally recognized Alaska Native communities and tribal lands of Alaska. As you can see in Figure 29, there are clearly more crashes logged in the DMV records in urban areas, as can be expected. However, when overlaying this information with records from the Alaska Trauma Registry, other regional and RITI disparities become more apparent. Figure 30 shows the ratio of DMV crash records to Trauma Registry Records for 2009 through 2014 by Zip Code. 2014 was the most recent data available at the time of analysis. Zip Code was used as the geographic unit because the Alaska Trauma Registry only identifies incidents down to the Zip Code level and was the least common denominator between the two data sets. With the exception of Utquiagvik/Barrow, the only two areas where transportation and on-road incident records are more likely to show up in the DMV records are the largest urban centers of the state, Anchorage and Fairbanks. The areas shown in either cyan, green, yellow or red are areas where there were more transportation and on-road incident records in the trauma registry than in the DMV records. Areas in red, such as Kotzebue and Point Hope in the northwest region of the state, had as few as four and as many as 100 times the number of records in the trauma registy than in the DMV records. This illustrates the importance of utilizing other data sources than just state crash records for the purposes of transportation planning, safety evaluation, and performance outcomes measurement.



(a) (b) ©

Figure 29. (a) The 229 federally recognized Alaska Native communities and tribal lands of Alaska, (b)Census-designated places of Alaska by percent Alaska Native population, and (c) number of crashes in DMV records by Census-designated place for 2009-2014.

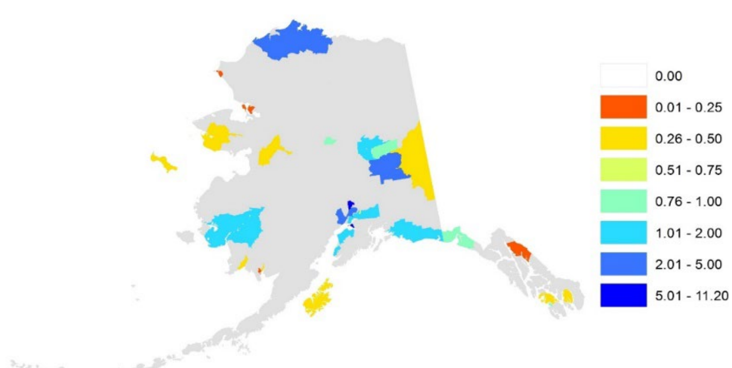


Figure 30. Ratio of DMV crash records to Trauma Registry Records for 2009 through 2014 by Zip Code.

Following on that finding, we determined the number of on-road crashes and the number of on-road traumas from the DMV records and the trauma registry respectively, and then normalized that value for each community by the number of residents. Since traffic data is not available in some locations, community size is used here as a proximity for potential traffic level and therefore “exposure”. Table 1 shows the top 20 locales based on five-year total of DMV crash records per capita while Table 2 shows the top 20 locales based on five-year total of trauma registry records per capita. The communities highlighted in green are communities that are classified as a federally recognized tribe or Alaska Native community and further highlights the potential disparities that exist if relying only on the more “conventional” data sources. This finding prompted an additional study currently supported by CSET and the Alaska Department of Health that aims to link the crash and trauma databases to improve our understanding of transportation safety issues in Alaska.

Table 1. Top 20 Locales Based on Five-Year Total of DMV Crash Records

PLACE NAME	POPULATION	ALASKA NATIVE	PERCENT AK NATIVE	# OF CRASHES (2009-2014)	CRASHES PER CAPITA
Dot Lake	13	3	23.08	19	1.462
Eureka	29	2	6.90	34	1.172
Livengood	13	3	23.08	15	1.154
Chicken	7	0	0.00	7	1.000
Mendeltna	39	0	0.00	30	0.769
Petersville	4	0	0.00	3	0.750
Paxson	40	0	0.00	29	0.725
Tolsona	30	0	0.00	15	0.500
Nelchina	59	5	8.47	27	0.458
Wiseman	14	0	0.00	6	0.429
Alcan Border	33	0	0.00	12	0.364
Primrose	78	4	5.13	28	0.359
McKinley Park	185	0	0.00	64	0.346
Point Possession	3	0	0.00	1	0.333
Chickaloon	272	17	6.25	90	0.331
Cooper Landing	289	4	1.38	95	0.329
Chistochina	93	50	53.76	30	0.323
Glacier View	234	2	0.85	72	0.308
Harding-Birch	299	10	3.34	91	0.304
Moose Pass	219	3	1.37	58	0.265

Table 2. Top 20 Locales Based on Five-Year Total of Trauma Registry Records

PLACE NAME	POPULATION	ALASKA NATIVE	PERCENT AK NATIVE	# OF ON-ROAD TRAUMAS (2009-2014)	TRAUMAS PER CAPITA
PORTAGE CREEK	2	1	50.00	1	0.500
LIVENGOOD	13	3	23.08	2	0.154
WHALE PASS	31	0	0.00	2	0.065
GLENNALLEN	483	37	7.66	23	0.048
COOPER LANDING	289	4	1.38	13	0.045
MENTASTA LAKE	112	85	75.89	5	0.045
TAKOTNA	52	12	23.08	2	0.038
GULKANA	119	91	76.47	4	0.034
TRAPPER CREEK	481	31	6.44	16	0.033
PORT HEIDEN	102	85	83.33	3	0.029
LEVELOCK	69	58	84.06	2	0.029
PAXSON	40	0	0.00	1	0.025
SHUNGNAK	262	247	94.27	6	0.023
WASILLA	7831	406	5.18	164	0.021
KOLIGANEK	209	200	95.69	4	0.019
STONY RIVER	54	45	83.33	1	0.019
GAKONA	218	43	19.72	4	0.018
PITKAS POINT	109	106	97.25	2	0.018
MOOSE PASS	219	3	1.37	4	0.018
SELAWIK	829	708	85.40	15	0.018

Indicates community is a federally recognized tribe

Lastly, another interesting finding is that events or incidents involving all-terrain and off-highway vehicles (OHVs) and snowmachines are more likely to be captured in the trauma registry. Figure 31 shows the number or trauma-related events by Zip Code for 2009-2014.

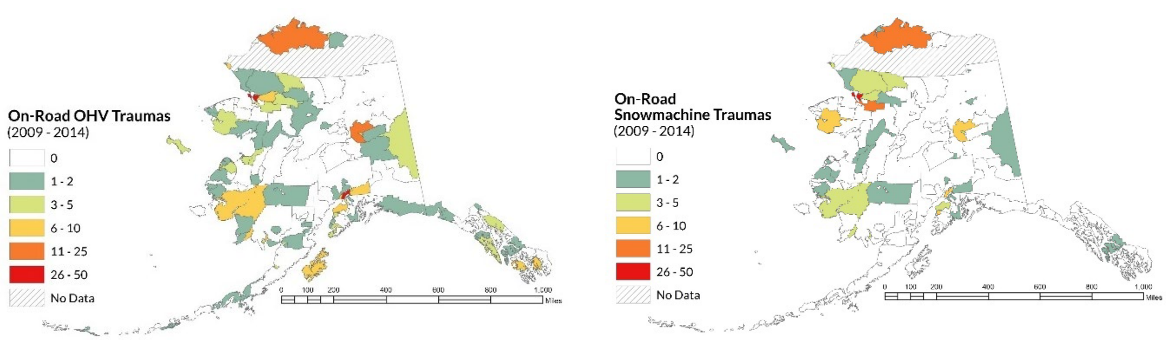


Figure 31. Records from the Alaska Trauma registry by Zip Code that indicate (a) off-highway-vehicle-related events that occurred on a roadway and (b) snowmachine-related events that occurred on a roadway, 2009-2014

CHAPTER 4. REFERENCES

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