Pilot Decision Framework for Future SNF Transportation Campaigns

SOUTHWEST RESEARCH INSTITUTE®

NTSF Meeting
June 7, 2022

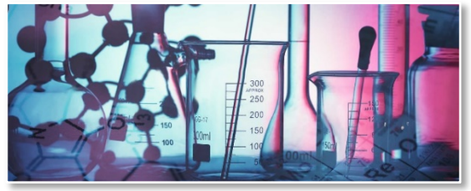
Southwest Research Institute Background

- Established in 1947 as nonprofit, 501(c)(3)
- More than 2,700 employees
- More than 1,500 acres HQ in San Antonio, TX
- More than 2.3 million ft^2 of laboratories, workshops & offices
- More than 1400 patents, 50 R&D 100 awards
- Contract R&D with government and commercial clients
- Unique IR&D Program

Market Segments We Serve

Automotive
& Transportation

Biomedical
& Health



Chemistry
& Materials

Defense
& Security

Earth
& Space

Electronics
& Automation

Energy
& Environment

Manufacturing
& Construction

Team Background

- Center for Nuclear Waste Regulatory Analyses (CNWRA) has nearly 35 years experience in nuclear projects
  - Nuclear "cradle to grave," spent nuclear fuel (SNF) focus
  - Environmental impacts
  - Stakeholder engagement
- SwRI/CNWRA team:
  - Miriam Juckett: Senior Program Manager
  - Marla Morales: Principal Investigator
  - Amy Minor: Ecology, Socioeconomics, and Environmental Justice
  - Kristin Ulmer: GIS and VBA Coding

Pilot Decision Framework Tool for Future SNF Transportation Campaigns

Western Interstate Energy Board

Developed with Sponsorship from Western Interstate Energy Board

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Project Background

- Interest in SNF transportation and stakeholder focus
- WIEB project, DOE-NE funding through cooperative agreement
- Initial focus on Western states
- Project started mid-Aug., 2021; ended Sept. 30, 2021
- Draft report to WIEB on Sept. 3, 2021
- Feedback webinar on Sept. 17, 2021
- Final report to WIEB on Sept. 30, 2021
- Internal R&D improvements completed spring 2022
- WIEB case study (Salt Lake City, UT) completed March 2022

Project Overview

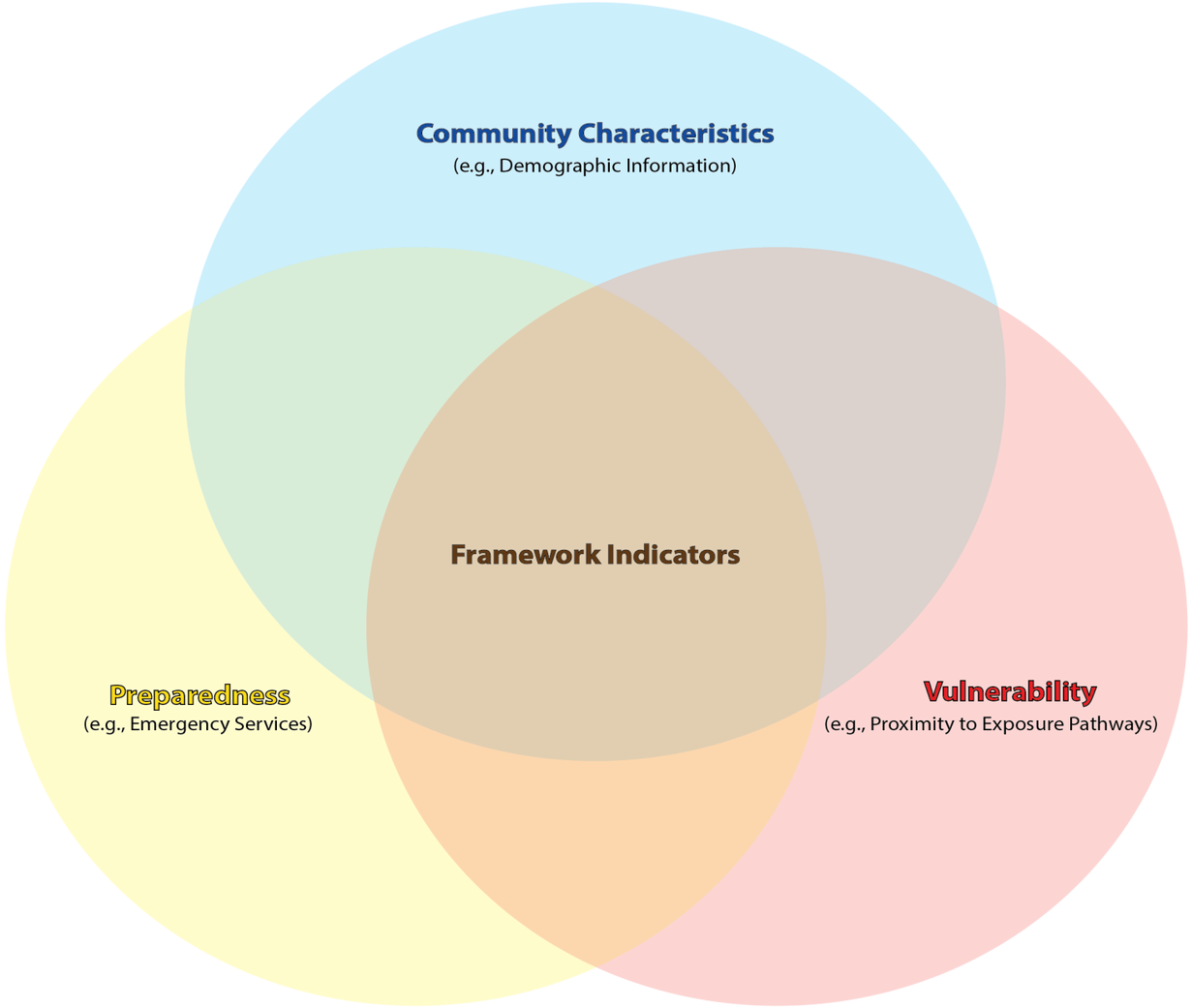
Project Goal

The objective of this project is to create a community-focused decision framework that incorporates various community descriptors that identify and characterize preparedness along SNF transportation routes as a complementary tool to available performance-based frameworks.

Facilitates:

- Targeted decision-making
- Resource allocation
- Communication strategies

Indicators scaled and weighted to produce an overall framework score.



Project Overview

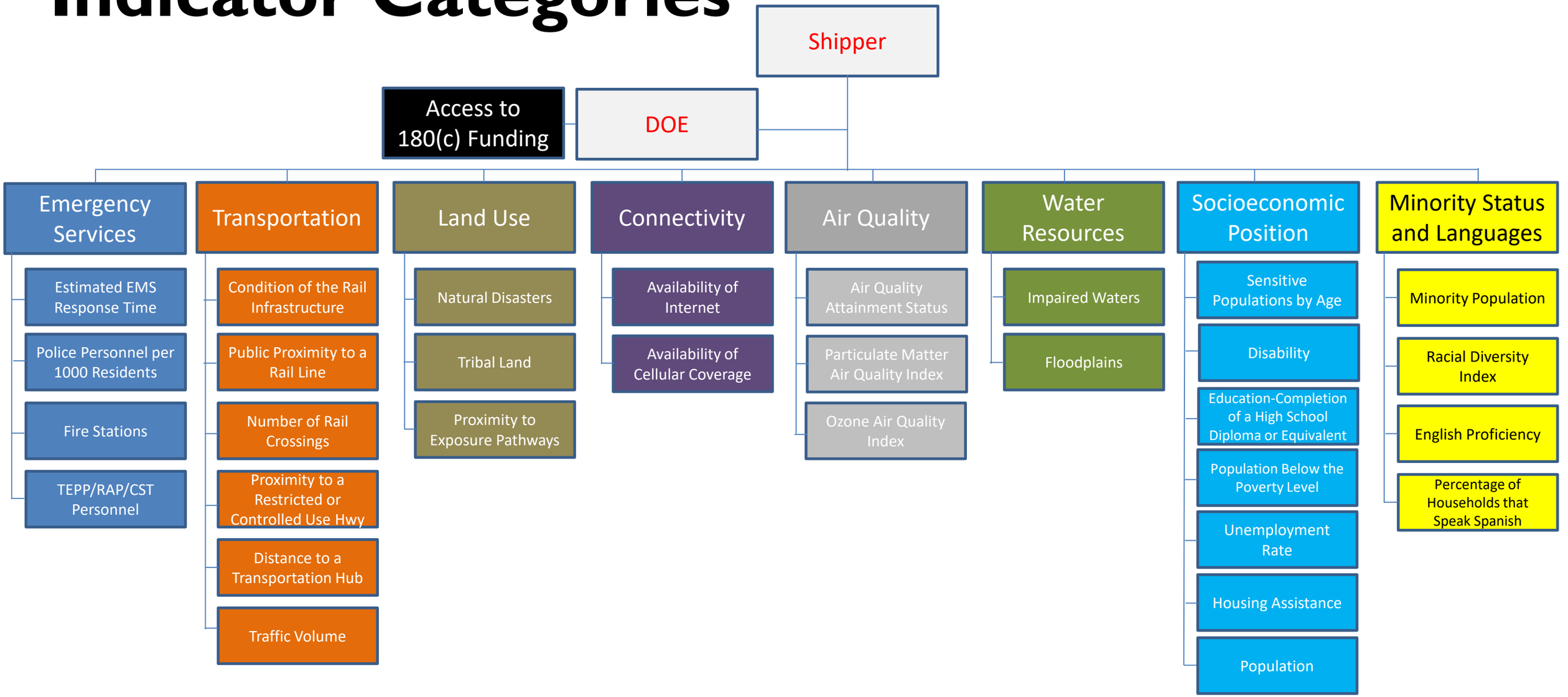
Assumptions

Four major assumptions for indicator selection:

- DOE ships the SNF,
- With DOE as the shipper, communities along the transportation route have access to Nuclear Waste Policy Act (NWPA) Section 180(c) funding,
- SNF shipped via railways, and
- Transportation occurs under a non-radiological release scenario.

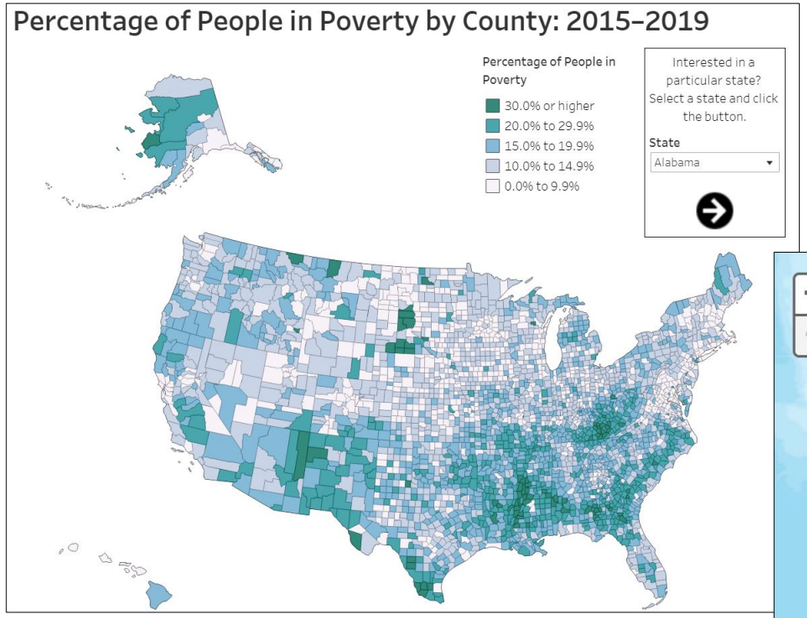
Source: https://www.energy.gov/sites/default/files/2020/10/f80/2020_10_ATLAS_Fact-Sheet_FINAL.pdf

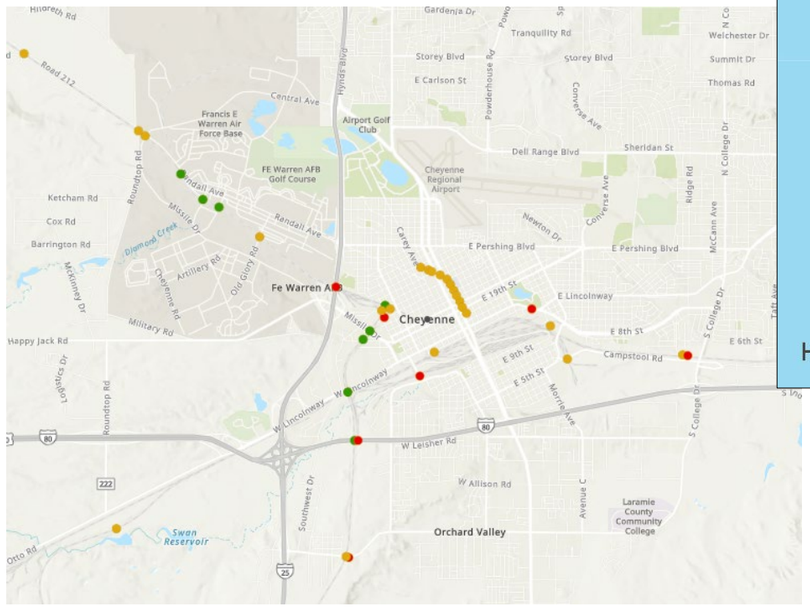
Indicator Categories



Data Sources

- National
  - EPA
  - Census Bureau
- State or Regional
  - Impaired Water Segments
  - Traffic Volume
- Local
  - Rail Crossings
  - Transportation Hub Proximity





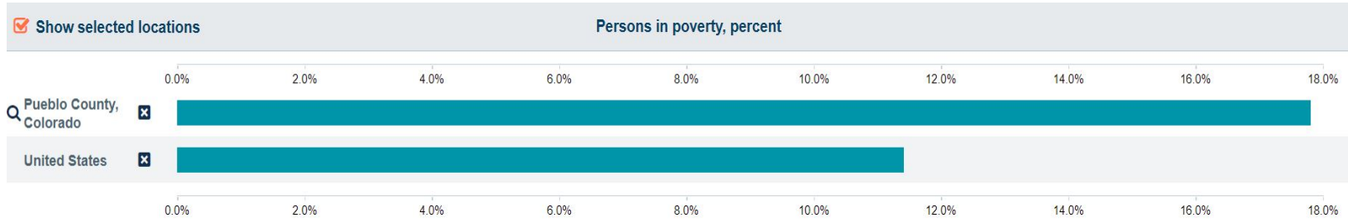
Qualitative

- Air Quality

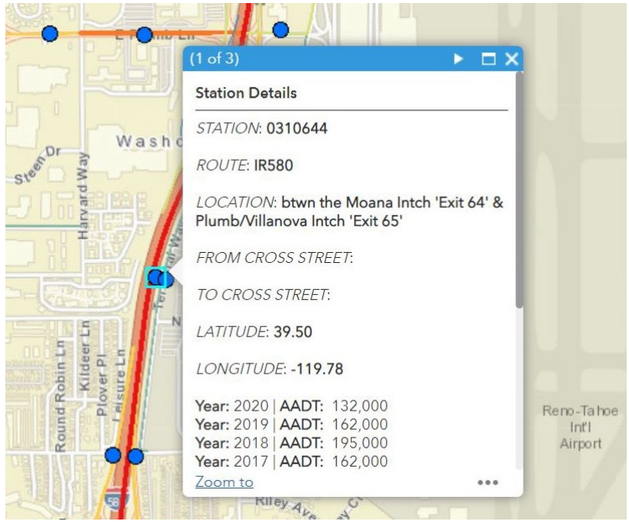
Daily AQI Color	Levels of Concern
Green	Good
Yellow	Moderate
Orange	Unhealthy for Sensitive Groups
Red	Unhealthy
Purple	Very Unhealthy
Maroon	Hazardous

Quantitative

- Poverty Level



- Traffic Volume



Apples vs. Oranges vs. Lemons

Scaling

	Scaled Value	# of Fire Stations
Most prepared/ least vulnerable	5	≥ 26
2nd most prepared/ 2nd least vulnerable	4	20 - 25
Neutral	3	14 - 19
2nd least prepared/ 2nd most vulnerable	2	8 - 13
Least prepared/ most vulnerable	1	≤ 7

- Occurs within each indicator
- Groups possible data values
  - Grouped data values are assigned a scaled value
- Scaled 1 to 5
  - Every indicator must have a data value assigned a scaled value of 1 and a data value assigned a scaled value of 5

Scaling

	Scaled Value	Ozone Air Quality Index (AQI)	Impaired Waters
Most prepared/ least vulnerable	5	Good	No 303(d) Segments
2nd most prepared/ 2nd least vulnerable	4	---	---
Neutral	3	Moderate	---
2nd least prepared/ 2nd most vulnerable	2	---	---
Least prepared/ most vulnerable	1	Unhealthy	303(d) Segments Present

Weighting

- Compares indicators with other indicators
- Weighted 1 to 5 to indicate relative influence on community preparedness or vulnerability

Preparedness/ Vulnerability Influence	Weight	Indicators
Most influential	5	Public Proximity to a Rail Line
Highly influential	4	Estimated EMS Response Time
Moderately influential	3	Floodplains
Less influential	2	Availability of Internet
Least influential	1	English Proficiency

The Framework

- Built in Excel
- Possible data values, scaling, and weighting formulas are built in

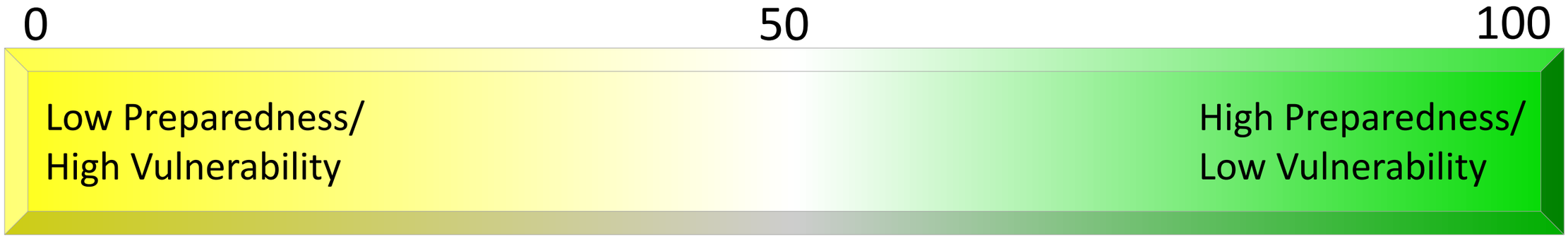
Automation of Data Retrieval

Using funding from SwRI's IR&D program, refined the framework tool to reduce the labor burden and the likelihood of user error by automating data retrieval, processing, and input

	Indicator	Question to be Answered	Clear All Data Value	Scaled Value	Weight	Weighted Value	Data Source	Downloaded Value
Land Use	Natural Disasters	How many natural disasters have there been in the area of analysis in the last 20 years?		0	1	0	Download	
	Tribal Land	How far are Tribal lands from the area of analysis?		0	2	0	Look Up	
	Proximity to Exposure Pathways	How many potential environmental exposure pathways (e.g., Superfund sites, landfills) are located within 3 miles of the area of analysis?		0	2	0	Look Up	
Connectivity	Availability of Internet	What percentage of households in the area of analysis have broadband internet?		0	2	0	Download	
	Availability of Cellular Coverage	What percentage of the area of analysis has cellular network coverage?		0	2	0	Look Up	
Air Quality	Air Quality Attainment Status	Is the air quality in the area of analysis in attainment or not in attainment?		0	2	0	Look Up	
	Particulate Matter Air Quality Index	What is the EPA Particulate Matter ($PM_{2.5}$) Air Quality Index for the area of analysis?		0	2	0	Download	
	Ozone Air Quality Index	What is the EPA Ozone Air Quality Index for the area of analysis?		0	2	0	Download	
Water Resources	Impaired Waters	Are there Clean Water Act 303(d) impaired waters within the area of analysis?		0	2	0	Look Up	
	Floodplains	Does a 100-year or 500-year floodplain intersect with the SNF transportation route?		0	3	0	Look Up	
	Sensitive Populations by Age	What percentage of the population in the area of analysis are under the age of 5 or over 65?		0	1	0	Download	

The Overall Framework Score

- Calculated by normalizing the summed indicator weighted values
- Framework score
  - On a scale of 0 – 100
  - 100 indicates high preparedness/low vulnerability

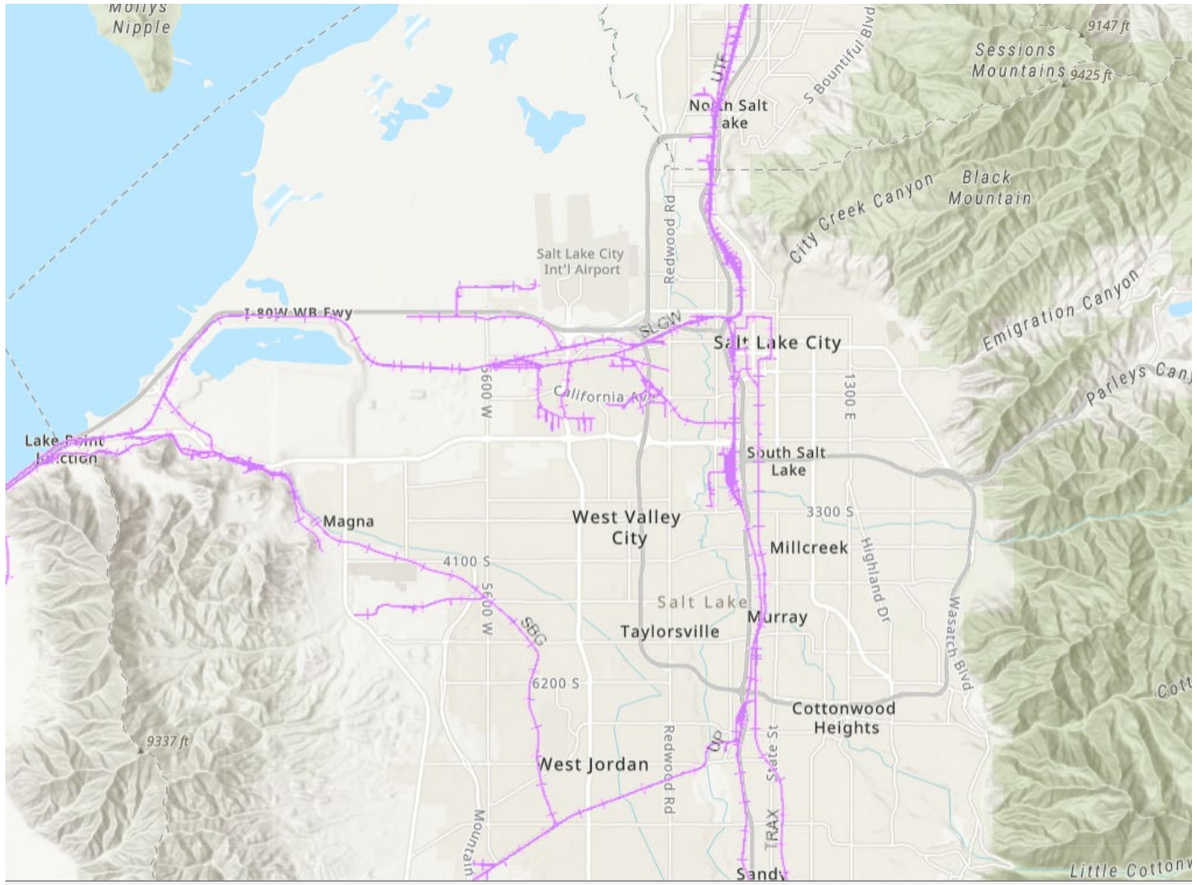


	Indicator	Question to be Answered	Data Value	Scaled Value	Weight	Weighted Value
	Shipper	*Assumed to be DOE	DOE	5	1	5
	Access to 180c Funding	*Assumed to be yes	Funding Available	5	1	5
Emergency Services	Estimated EMS Response Time	What is the estimated EMS response time?	15.1 - 60 mins.	2	4	8
	# of Police Officers per 1,000 Resident	How many police officers are there per 1,000 residents?	≥ 1.8	5	3	15
	# of Fire Stations Within 25 miles	How many fire stations are within 25 miles of the SNF transportation route?	20 - 25	4	3	12
	Transportation Emergency Preparedness Program, DOE Radiological Assistance Program, or Civil Support Team Personnel	Are there TEPP, DOE RAP, or CST Team personnel stationed in the county?	No	1	3	3
Transportation	Condition of Rail Infrastructure	What grade has the ASCE's Infrastructure Report Card given the state's rail infrastructure?	C	3	1	3
	Public Proximity to a Rail Line	At the nearest point, how far is the public to the SNF transportation route?	3.3 - 10 ft	2	5	10
	Proximity to Restricted or Controlled Use Highway	At the nearest point, how far is the SNF transportation route from restricted or controlled use highways?	> 5 miles	5	2	10
	# of Rail Crossings	How many at-grade rail crossing does the SNF transportation route cross in the area of analysis?	≤ 5	5	2	10
	Distance to Transportation Hub	How far is the community from a transportation hub?	> 0.25 miles	5	3	15
	Traffic Volume	What is the highest average annual daily traffic value for the area of analysis?	1,000 < AADT ≤ 2,500	4	2	8
Land Use	Natural Disasters	How many natural disasters have there been in the area of analysis in the last 20 years?	1	4	1	4
	Tribal Land	How far is the SNF transportation route from Tribal land?	On Tribal Land	1	2	2
	Proximity to Exposure Pathways	How many potential environmental exposure pathways (e.g., Superfund sites, landfills) are located within 3 miles of the area of analysis?	1 - 3	3	2	6
Connectivity	Availability of Internet	What percentage of households in the county have broadband internet?	50 - 74%	4	2	8
	Availability of Cellular Coverage	What percentage of the area of analysis has cellular network coverage?	< 25%	1	2	2
Air Quality	Air Quality Attainment Status	Is the area of analysis in attainment or not in attainment?	In Attainment	5	2	10
	Particulate Matter Air Quality Index	What is the EPA Particulate Matter Air Quality Index for the area of analysis?	Good (AQI ≤ 50)	5	2	10
	Ozone Air Quality Index	What is the EPA Ozone Air Quality Index for the area of analysis?	Moderate (51 ≤ AQI ≤ 100)	3	2	6
Water Resources	Impaired Waters	Are there impaired waters within the area of analysis?	303(d) segments present	1	2	2
	Floodplains	Does a 100-year or 500-year floodplain intersect with the SNF transportation route?	Within 100-yr Floodplain	1	3	3
Socioeconomic Position	Sensitive Populations by Age	What percentage of the population in the area of analysis are under the age of 5 and over 65?	≤ 30%	5	1	5
	Disability	What percentage of the population in the area of analysis are disabled?	≤ 30%	5	1	5
	Education - Completion of a High School Degree or Equivalent	What percentage of people in the area of analysis have at least a high school diploma?	60 - 80%	4	2	8
	Population Below the Poverty Level	What percentage of the population in the area of analysis live in poverty?	≤ 10%	5	1	5
	Unemployment Rate	What percentage of the population in the area of analysis are unemployed?	3.1 - 5%	4	2	8
	Housing Assistance	What percentage of the population in the area of analysis rely on housing assistance?	1.1 - 2%	4	2	8
	Population	How does the Census Bureau classify the area of analysis?	City	5	3	15
Minority Status and Languages	Minority Population	What percentage of the population in the area of analysis are minority?	10.1 - 20%	4	2	8
	Racial Diversity Index	What is the Census Bureau's Racial Diversity Index of the area of analysis?	45.0 - 54.9%	3	2	6
	English Proficiency	What percentage of the population in the area of analysis speak English very well (i.e., are proficient in English)?	> 75%	5	1	5
	% of Households that Speak Spanish	What percentage of households in the area of analysis speak Spanish?	25.1 - 50%	4	2	8
	Overall Framework Score					61.2

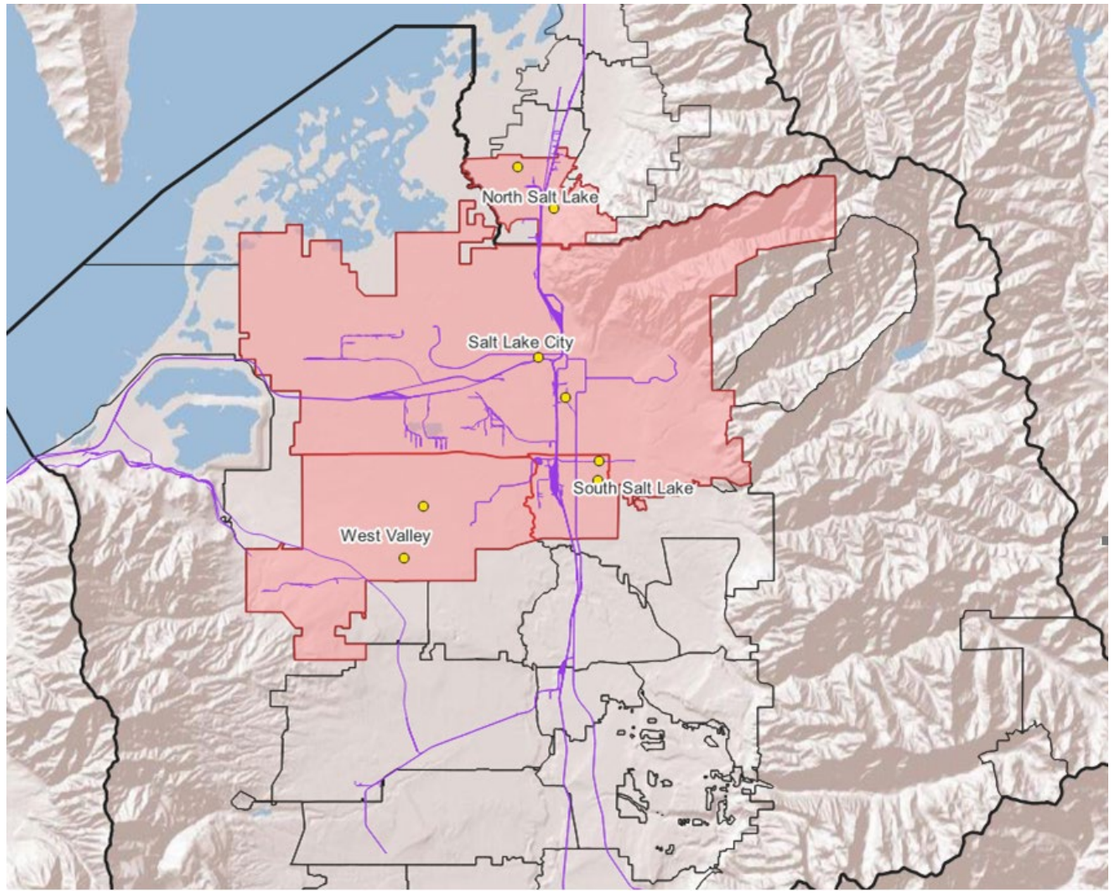
Highest Contributors

Lowest Contributors

Case Study: Salt Lake City, Utah



Rail Routes Through Salt Lake City, Utah



The Four Geographic Code Locations Included in the Case Study

Case Study: SLC - Outcomes

- Analyzed 4 geographic code locations
- Incorporated both high and low demographic indices

Geographic Area	Overall Framework Score
Salt Lake City-High	62
Salt Lake City-Low	65
South Salt Lake City-High	57
South Salt Lake City-Low	57
West Valley-High	72
West Valley-Low	75
North Salt Lake City-Netural1	64
North Salt Lake City-Netural2	64

Case Study: SLC - Outcomes

Comparison of High and Low Demographics Percentile Areas for Salt Lake City

- Salt Lake City – High: 62; and Salt Lake City – Low: 65
  - The difference in the overall framework scores is the result of a varying weighted value for the *Housing Assistance* indicator, which aligns with the different demographic index
  - A high index means that there is a higher percentage of the population that have socioeconomic stressors
  - While the EPA's EJ Screen Tool demographic index averages percentage of people of color and low-income populations, the decision framework segregates socioeconomic position into seven separate indicators, which provides additional granularity for site-specific characteristics

Case Study: SLC - Outcomes

Comparison of High and Low Demographics Percentile Areas for South Salt Lake City

- South Salt Lake City – High and Low: 57
  - Overall lower score could reflect the likelihood of a population with increased socioeconomic strain
  - The South Salt Lake City run also highlighted the *Disability* and *Racial Diversity Index* indicators as potential vulnerabilities
  - Decisionmakers would mostly likely need to (re)evaluate communication strategies.
    - What forms of communication would be the most effective for the segments of the population with disabilities (e.g., hearing or vision impaired) and potential language differences.
    - Alternately, if the disabilities in the area are primarily mobility related, alternate emergency response considerations could be warranted.

Case Study: SLC - Outcomes

Comparison of High and Low Demographics Percentile Areas for West Valley

- West Valley – High: 72; and West Valley – Low: 75
  - The main differences between the West Valley and other areas is that West Valley area is not in a floodplain and has a higher minority population
  - Has the highest framework scores (for both High and Low) of the areas we reviewed; however, that does not mean that the community would not be impacted by an SNF transportation campaign. The same area also has a larger minority population, which could indicate that additional resources would benefit effective emergency preparedness plan communication.

Case Study: SLC - Outcomes

Comparison of High and Low Demographics Percentile Areas for North Salt Lake City

- North Salt Lake City – High and Low: 64
  - The EPA EJ Screen Tool did not identify varying demographic areas within North Salt Lake City.
  - Unlike the other geographic code locations in this study, the *Population Below the Poverty Level* indicator does not contribute positively or negatively to the overall framework score
  - Could indicate that the North Salt Lake City area is more affluent than the other areas included in this case study; resulting in fewer socioeconomic stressors

Instruction Manual

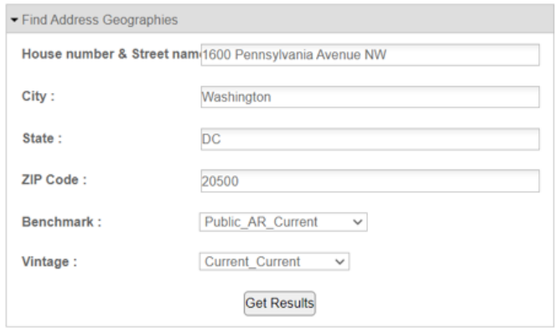
INPUTS

To use the automatic download features included in the framework tool, a user will need to find the U.S. Census Bureau's Federal Information Processing Series (FIPS) values and the Environmental Protection Agency (EPA) core-based statistical area (CBSA) value for the area of interest. The following steps outline how to do this. If the user prefers not to use the automatic download features, the user may skip this section of the User Manual.

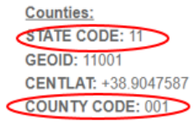
Step 1: Open the framework tool and select the "Inputs & Instructions" tab.

Step 2: Open a web browser on a desktop or laptop computer and open the following link to find geography codes for **State, County, Place, and Tract**: https://geocoding.geo.census.gov/geocoder/geographies/address?form.

Enter a street address in the window and click "Get Results".



Scroll to the section called "Counties" to find the State and County codes



Indicator: # of Fire Stations

Indicator Question: According to the Homeland Infrastructure Foundation-Level Data (HIFLD) Fire Station Database, how many fire stations are within the area of analysis?

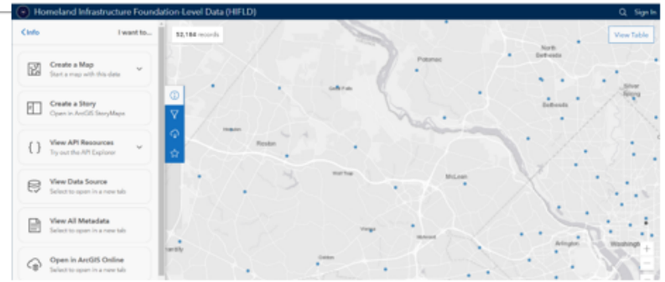
The Look Up link takes you to https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::fire-stations/explore

If the website does not load in Google Chrome or Internet Explorer, users may need to use a different browser, such as Microsoft Edge.

Enter the area of analysis using the circled search area.

Count the number of fire stations (blue dots) in the area of analysis.

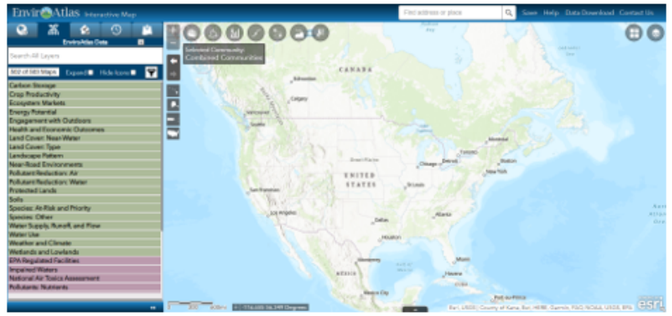
Select the appropriate data value in Column D of the framework tool.



HOW TO ADD A LAYER

This framework tool relies on information from EPA's EnviroAtlas interactive website. Follow these steps each time this manual instructs the user to "add a layer" to the interactive map.

Step 1: Open the website https://enviroatlas.epa.gov/enviroatlas/interactivemap/



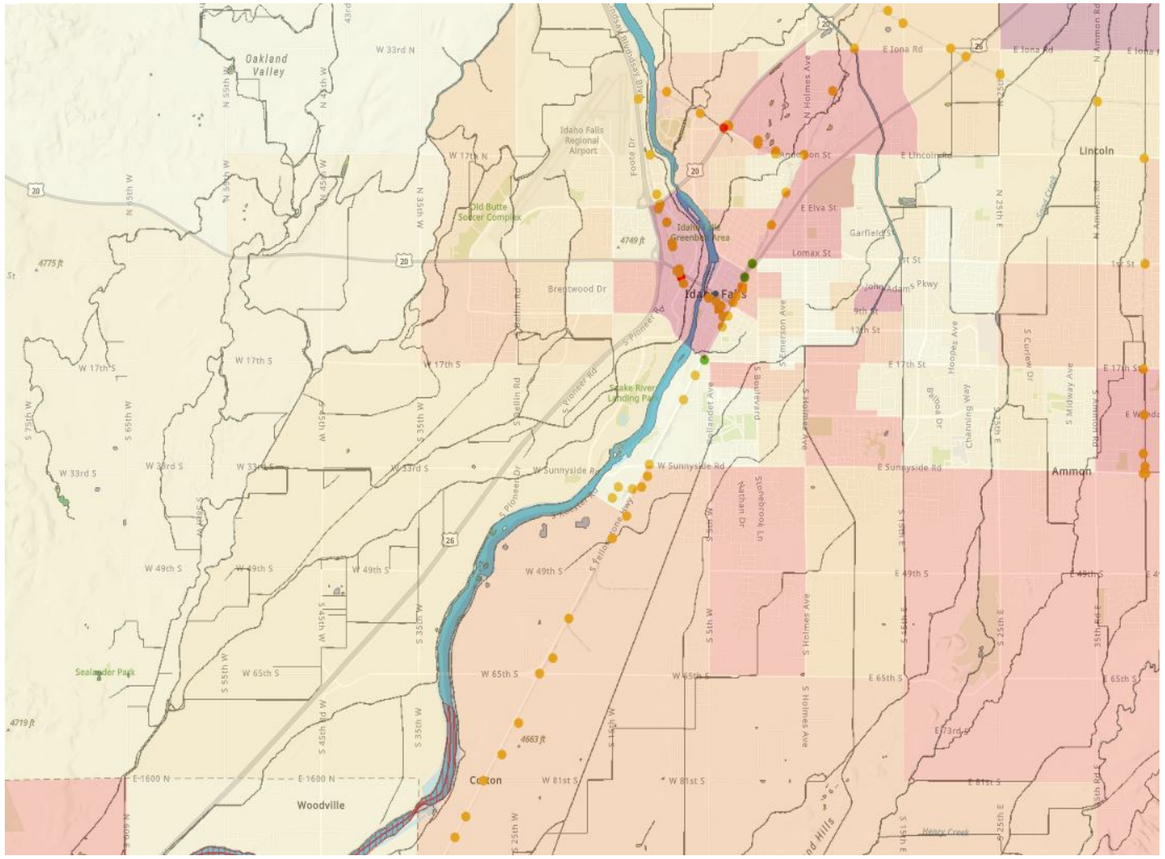
Step 2: Select the "Add Data Tool" icon in the upper left corner of the page

Conclusions

- This pilot tool compiles community characteristics from various data sources to disclose and highlight preparedness factors and vulnerabilities relevant to an SNF transportation campaign
- Factors contributing most to overall score highlighted
- Overall score provides information and comparison capability
- Case study demonstrates applicability and validity

Future Work

- Aggregate data versus community-specific information
  - Example: capture additional minority populations
- Utilizing the processing power and mapping capabilities of GIS programs
  - Improve readability and visualization of the decision framework
  - Ability to scale indicators over a gradient
  - Incorporation of climate change considerations



Future Work

- With additional development, this tool could be customized as a plug-in to already existing decision frameworks used by both Federal and State agencies
- Additional validation of the accuracy of the tool assessment would be bolstered by the creation of a community panel or working group that could customize the tool or verify whether results accurately reflect specific known community characteristics
- Tool concept could be adapted for other purposes such as other hazardous materials

Thank you!

Additional questions or comments can be sent to marla.morales@swri.org or mjuckett@swri.org.

Specific Indicators

- Emergency Services
  - Estimated EMS Response Time
  - # of Police Officers per 1,000 Residents
  - # of Fire Stations
  - Transportation Emergency Preparedness Program, DOE Radiological Assistance Program, or Civil Support Team Personnel

Source: https://stadiummedical.com/ambulance

Specific Indicators - continued

- Transportation
  - Condition of Rail Infrastructure
  - Public Proximity to a Rail Line
  - Proximity to Restricted or Controlled Use Highway
  - # of Rail Crossings
  - Distance to Transportation Hub
  - Traffic Volume

Specific Indicators - continued

- Land Use
  - Natural Disasters
  - Tribal Land
  - Proximity to Exposure Pathways

Specific Indicators - continued

- Connectivity
  - Availability of Internet
  - Availability of Cellular Coverage

Source: https://www.gizmogrind.com/blog/are-cell-phone-towers-dangerous/

Specific Indicators - continued

- Air Quality
  - Air Quality Attainment Status
  - Particulate Matter Air Quality Index
  - Ozone Air Quality Index

Specific Indicators - continued

- Water Resources
  - Impaired Waters
  - Floodplains

Specific Indicators - continued

- Socioeconomic Position
  - Sensitive Populations by Age
  - Disability
  - Education - Completion of a High School Diploma or Equivalent
  - Population Below the Poverty Level
  - Unemployment Rate
  - Housing Assistance
  - Population

Specific Indicators - continued

- Minority Status and Languages
  - Minority Population
  - Racial Diversity Index
  - English Proficiency
  - % of Households that Speak Spanish