Pilot Decision Framework for Future SNF Transportation Campaigns

CSG-Midwest Meeting
October 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 ft² 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

- Department established in 1987 as NRC FFRDC
  - Nuclear “cradle to grave,” spent nuclear fuel (SNF) focus
  - Environmental impacts
  - Stakeholder engagement

- SwRI team:
  - Miriam Juckett: Senior Program Manager
  - Amy Minor: Ecology, Socioeconomics, Environmental Justice
  - Kristin Ulmer: GIS and VBA Coding
  - Osvaldo Pensado: Statistics and Performance Assessment
Pilot Decision Framework Tool for Future SNF Transportation Campaigns
Project Background

- Interest in SNF transportation and stakeholder focus
- WIEB project (thank you!) DOE-NE cooperative agreement funding
- Initial focus on Western states
- Project started mid-Aug., 2021
- Feedback webinar on Sept. 17, 2021
- Final report to WIEB on Sept. 30, 2021
- Internal R&D improvements completed Feb. 2022
- WIEB case study (Salt Lake City, UT) completed March 2022
- CSG-Midwest work to start October 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.

- Based on experience with stakeholder concerns
- Does not replace or duplicate other tools
- Facilitates:
  - Targeted decision-making
  - Resource allocation
  - Communication strategies
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
- Transportation occurs under a non-radiological release scenario.
Indicator Categories

- Emergency Services
  - Estimated EMS Response Time
  - Police Personnel per 1000 Residents
  - Fire Stations
  - TEPP/RAP/CST Personnel

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

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

- Connectivity
  - Availability of Internet
  - Availability of Cellular Coverage

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

- Water Resources
  - Impaired Waters
  - Floodplains

- 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

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

- Access to 180(c) Funding
  - DOE

- Shipper
Data Sources

- National
  - EPA
  - Census Bureau

- State or Regional
  - Impaired Water Segments
  - Traffic Volume

- Local
  - Rail Crossings
  - Transportation Hub Proximity
Qualitative
- Air Quality

Quantitative
- Poverty Level
- Traffic Volume

Apples vs. Oranges vs. Lemons
Scaling

- 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

<table>
<thead>
<tr>
<th>Scaled Value</th>
<th># of Fire Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most prepared/least vulnerable</td>
<td>5</td>
</tr>
<tr>
<td>2\textsuperscript{nd} most prepared/2\textsuperscript{nd} least vulnerable</td>
<td>4</td>
</tr>
<tr>
<td>Neutral</td>
<td>3</td>
</tr>
<tr>
<td>2\textsuperscript{nd} least prepared/2\textsuperscript{nd} most vulnerable</td>
<td>2</td>
</tr>
<tr>
<td>Least prepared/most vulnerable</td>
<td>1</td>
</tr>
</tbody>
</table>
## Scaling

<table>
<thead>
<tr>
<th>Scaled Value</th>
<th>Ozone Air Quality Index (AQI)</th>
<th>Impaired Waters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most prepared/least vulnerable</td>
<td>5</td>
<td>Good</td>
</tr>
<tr>
<td>$2^{nd}$ most prepared/$2^{nd}$ least vulnerable</td>
<td>4</td>
<td>---</td>
</tr>
<tr>
<td>Neutral</td>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>$2^{nd}$ least prepared/$2^{nd}$ most vulnerable</td>
<td>2</td>
<td>---</td>
</tr>
<tr>
<td>Least prepared/most vulnerable</td>
<td>1</td>
<td>Unhealthy</td>
</tr>
</tbody>
</table>
Weighting

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

<table>
<thead>
<tr>
<th>Preparedness/Vulnerability Influence</th>
<th>Weight</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most influential</td>
<td>5</td>
<td>Public Proximity to a Rail Line</td>
</tr>
<tr>
<td>Highly influential</td>
<td>4</td>
<td>Estimated EMS Response Time</td>
</tr>
<tr>
<td>Moderately influential</td>
<td>3</td>
<td>Floodplains</td>
</tr>
<tr>
<td>Less influential</td>
<td>2</td>
<td>Availability of Internet</td>
</tr>
<tr>
<td>Least influential</td>
<td>1</td>
<td>English Proficiency</td>
</tr>
</tbody>
</table>
The Framework

- Built in Excel
- Possible data values, scaling, and weighting formulas are built in
- Tabs provide instructions and input areas
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 to NOT 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:

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

Scroll to the section called “Counties” to find the State and County codes:

- **State Code:**
- **Census Tract:**
- **County Code:**

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.

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.
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.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Question to be Answered</th>
<th>Data Value</th>
<th>Scaled Value</th>
<th>Weight</th>
<th>Weighted Value</th>
<th>Data Source</th>
<th>Downloaded Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Disasters</td>
<td>How many natural disasters have there been in the area of analysis in the last 20 years?</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td>Download</td>
<td></td>
</tr>
<tr>
<td>Tribal Land</td>
<td>How far are Tribal lands from the area of analysis?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Look Up</td>
<td></td>
</tr>
<tr>
<td>Proximity to Exposure Pathways</td>
<td>How many potential environmental exposure pathways (e.g., Superfund sites, landfills) are located within 3 miles of the area of analysis?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Look Up</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connectivity</th>
<th>Question to be Answered</th>
<th>Data Value</th>
<th>Scaled Value</th>
<th>Weight</th>
<th>Weighted Value</th>
<th>Data Source</th>
<th>Downloaded Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of Internet</td>
<td>What percentage of households in the area of analysis have broadband internet?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Download</td>
<td></td>
</tr>
<tr>
<td>Availability of Cellular Coverage</td>
<td>What percentage of the area of analysis has cellular network coverage?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Look Up</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Air Quality</th>
<th>Question to be Answered</th>
<th>Data Value</th>
<th>Scaled Value</th>
<th>Weight</th>
<th>Weighted Value</th>
<th>Data Source</th>
<th>Downloaded Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality Attainment Status</td>
<td>Is the air quality in the area of analysis in attainment or not in attainment?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Look Up</td>
<td></td>
</tr>
<tr>
<td>Particulate Matter Air Quality Index</td>
<td>What is the EPA Particulate Matter (PM2.5) Air Quality Index for the area of analysis?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Download</td>
<td></td>
</tr>
<tr>
<td>Ozone Air Quality Index</td>
<td>What is the EPA Ozone Air Quality Index for the area of analysis?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Download</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Resources</th>
<th>Question to be Answered</th>
<th>Data Value</th>
<th>Scaled Value</th>
<th>Weight</th>
<th>Weighted Value</th>
<th>Data Source</th>
<th>Downloaded Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired Waters</td>
<td>Are there Clean Water Act 303(d) impaired waters within the area of analysis?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Look Up</td>
<td></td>
</tr>
<tr>
<td>Floodplains</td>
<td>Does a 100-year or 500-year floodplain intersect with the SNF transportation route?</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>Look Up</td>
<td></td>
</tr>
<tr>
<td>Sensitive Populations by Age</td>
<td>What percentage of the population in the area of analysis are under the age of 5 or over 65?</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td>Download</td>
<td></td>
</tr>
</tbody>
</table>
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

0 100 50
Low Preparedness/
High Vulnerability

High Preparedness/
Low Vulnerability
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Question to be Answered</th>
<th>Data Value</th>
<th>Scaled Value</th>
<th>Weight</th>
<th>Weighted Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to DOE Funding</td>
<td>Assumed to be DOE</td>
<td>DOE</td>
<td>100</td>
<td>3</td>
<td>300</td>
</tr>
<tr>
<td>Estimated EMS Response Time</td>
<td>Is the estimated EMS response time?</td>
<td>15.1 - 60 mins</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td># of Police Officers per 1,000 resident</td>
<td>How many police officers are there per 1,000 residents?</td>
<td>≤ 1.8</td>
<td>5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td># of Fire Stations Within 25 miles</td>
<td>How many fire stations are within 25 miles of the SNF transportation route?</td>
<td>20 - 25</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td># of Rail Crossings</td>
<td>How many at-grade rail crossings does the SNF transportation route cross in the area of analysis?</td>
<td>&gt; 5</td>
<td>5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Proximity to Exposure Pathways</td>
<td>How many potential environmental exposure pathways (e.g., superfund sites, landfills) are located within 3 miles of the area of analysis?</td>
<td>1 - 3</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Availability of Cellular Coverage</td>
<td>What percentage of the area of analysis has cellular network coverage?</td>
<td>≤ 70%</td>
<td>5</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Articulate Matter Air Quality Index</td>
<td>What is the EPA Articulate Matter Air Quality Index for the area of analysis?</td>
<td>Good (AQI ≤ 50)</td>
<td>5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>ozone Air Quality Index</td>
<td>What is the EPA Ozone Air Quality Index for the area of analysis?</td>
<td>Moderate (51 ≤ AQI ≤ 100)</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Impaired Waters</td>
<td>Are there impaired waters within the area of analysis?</td>
<td>Yes (303(d) segments present)</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Floodplains</td>
<td>Does a 100-year or 500-year floodplain intersect with the SNF transportation route?</td>
<td>Within 100-yr Floodplain</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sensitive Populations by Age Disability</td>
<td>What percentage of the population in the area of analysis are under the age of 5 and over 65?</td>
<td>10% - 30%</td>
<td>5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Education - Completion of a High School Degree or Equivalent</td>
<td>What percentage of people in the area of analysis have at least a high school diploma?</td>
<td>90% - 100%</td>
<td>5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Poverty Rate</td>
<td>Population below the poverty line</td>
<td>10% - 20%</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Housing Assistance</td>
<td>What percentage of the population in the area of analysis rely on housing assistance?</td>
<td>≤ 3% - 5%</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Minority Population</td>
<td>What percentage of the population in the area of analysis are minority?</td>
<td>≤ 3% - 20%</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Social Diversity Index</td>
<td>What is the Census Bureau's Racial Diversity Index of the area of analysis?</td>
<td>0.00 - 54.00</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>English Proficiency</td>
<td>What percentage of the population in the area of analysis speak English very well (i.e., are proficient in English)?</td>
<td>≤ 70%</td>
<td>5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>% of Households that Speak Spanish</td>
<td>What percentage of households in the area of analysis speak Spanish?</td>
<td>≤ 3.1% - 50%</td>
<td>4</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

**Highest Contributors**

**Lowest Contributors**

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**SwRI**

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**CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES**

19
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

<table>
<thead>
<tr>
<th>Geographic Area</th>
<th>Overall Framework Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt Lake City-High</td>
<td>62</td>
</tr>
<tr>
<td>Salt Lake City-Low</td>
<td>65</td>
</tr>
<tr>
<td>South Salt Lake City-High</td>
<td>57</td>
</tr>
<tr>
<td>South Salt Lake City-Low</td>
<td>57</td>
</tr>
<tr>
<td>West Valley-High</td>
<td>72</td>
</tr>
<tr>
<td>West Valley-Low</td>
<td>75</td>
</tr>
<tr>
<td>North Salt Lake City-Neutral1</td>
<td>64</td>
</tr>
<tr>
<td>North Salt Lake City-Neutral2</td>
<td>64</td>
</tr>
</tbody>
</table>
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.
Pilot Framework Current State

- This pilot framework 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.
Next Phase of Development

- Planned work with CSG-Midwest
  – thank you!
- Part 1: Benchmarking in Midwest
  - City choice: minimum 10 cities
    - Big vs small
    - Rural vs urban
    - Near vs away from reactor
  - Results comparison, trends
Next Phase of Development

- Part 2: Targeted ground-truthing
  - Work with CSG Midwest to determine city
  - Discuss indicators/scaling
- Part 3: Benchmarking outside Midwest and ground-truthing adjustments
- Planned Outcomes
  - Draft and final report
  - Presentation at meeting
Application and Refinement Opportunities

- Case studies and reporting
- Benchmarking in other areas (South, West, Northeast)
- Additional ground-truthing in other locations
- Synergies between CSG-Midwest work and others
Future Development Opportunities

- 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 Development Opportunities

- Could be further customized as a complement to already existing decision frameworks or tools used by both Federal and State agencies
- Tool concept could be adapted for other purposes such as other hazardous materials
- Framework indicators could be adjusted for road transport instead of rail
Thank you!

Get in touch with us!

mjuckett@swri.org or aminor@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.gizmogrrind.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