Community Readiness Assessment Framework for Transportation (CRAFT) for Spent Fuel by Rail

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Amy Minor and Osvaldo Pensado

Midwestern Radioactive Materials Transportation Committee (MRMTC)
Meeting at the National Transportation Stakeholders Forum
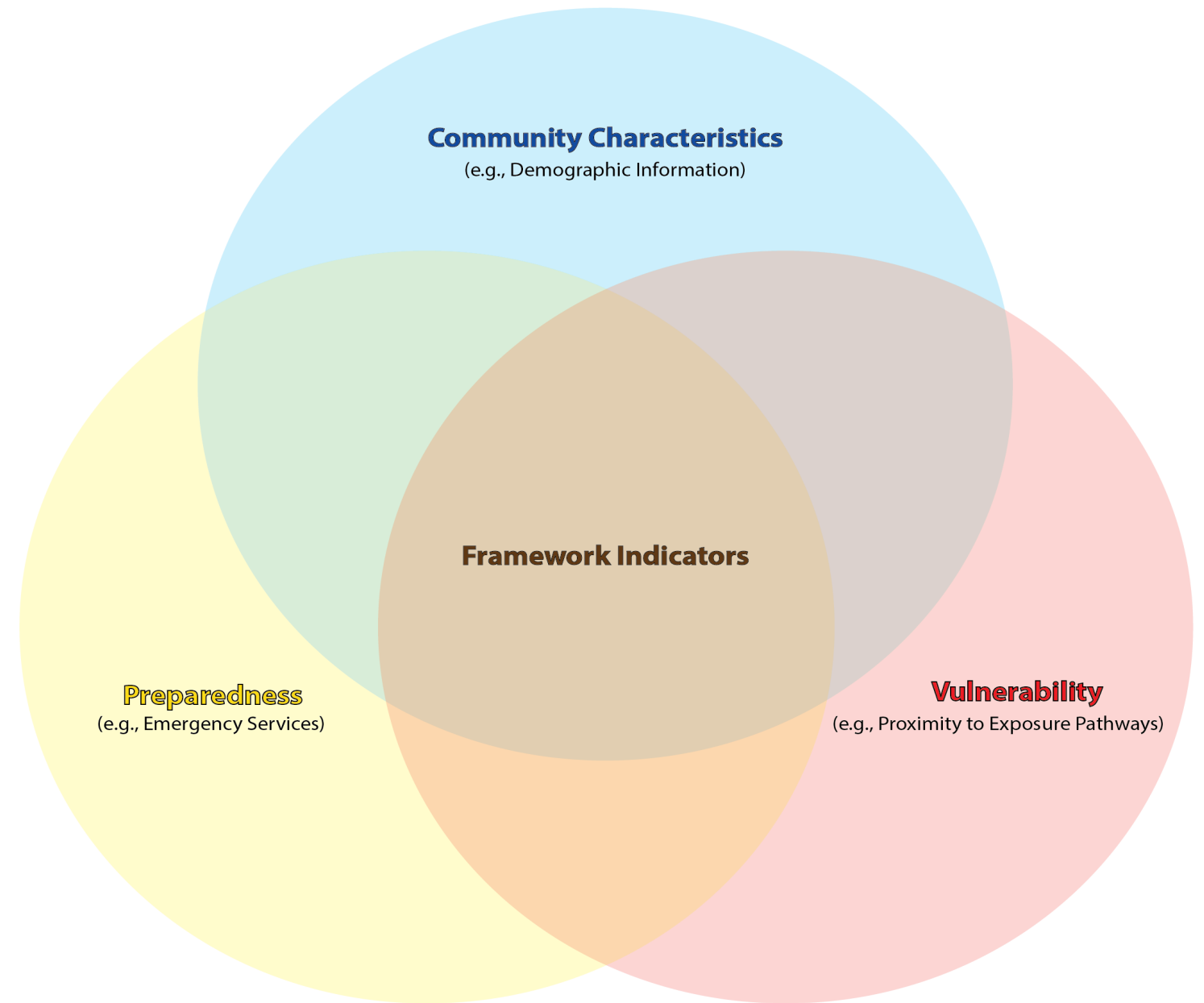May 25, 2023

Project Background

- Interest in SNF transportation and stakeholder focus
- WIEB project thru DOE-NE cooperative agreement funding Fall 2021
  - Identified indicators, developed indicator weights and grade system
  - Developed an executable tool using Excel
- Internal R&D improvements completed Feb. 2022
  - Automated half of the indicators using Visual Basic for Applications
  - Reviewed indicators, weights, and grades for U.S.
- WIEB case study (Salt Lake City, UT) completed March 2022
- CSG-Midwest benchmarking and ground-truthing work started Jan. 2023
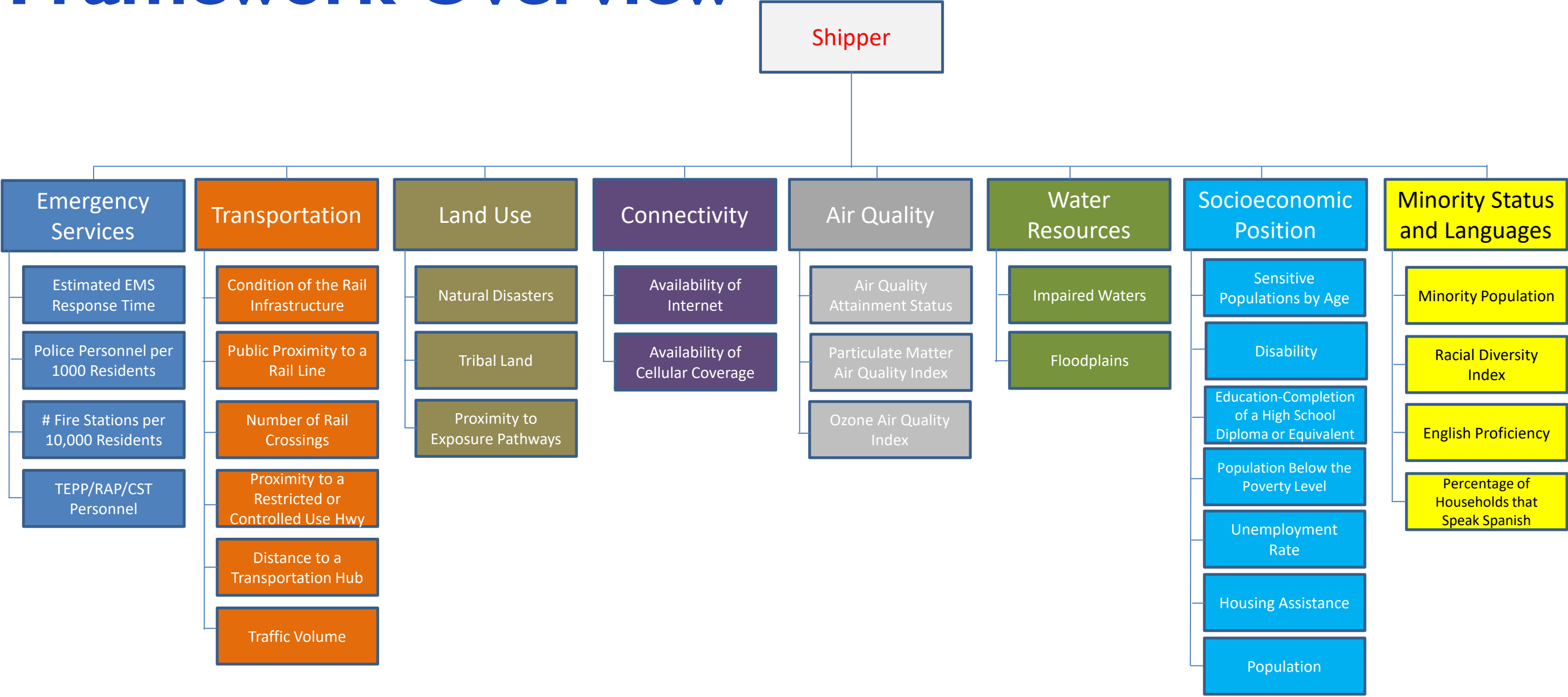- WIEB ground-truthing work planned FY23

Framework Overview

A community-focused decision framework that incorporates various community descriptors that identify and characterize preparedness along SNF transportation routes.

- Based on experience with stakeholder concerns
- Does not replace or duplicate other performance-based tools
- Facilitates:
  - Targeted decision-making
  - Resource allocation
 - Communication strategies

Community Characteristics
(e.g., Demographic Information)

Framework Indicators

Preparedness
(e.g., Emergency Services)

Vulnerability
(e.g., Proximity to Exposure Pathways)

Framework Overview

Category	Indicator	Question	Answer	Grade	Weight	Indicator Score
Emergency Services	Estimated EMS Response Time	What is the estimated EMS response time in the area of analysis based on population?	Pop. 2,500-10,000 (15.1 - 60 min)	2	4	1.5
Emergency Services	# of Police Officers per 1,000 Residents	How many police officers are there per 1,000 residents?	≥ 1.8	5	3	4.5
Emergency Services	# of Fire Stations per 10,000 Residents	According to the Homeland Infrastructure Foundation-Level Data (HIFLD) Fire Station Database, how many fire stations per 10,000 residents are within the area of	0.8 - 2	2	3	1.1
Emergency Services	Transportation Emergency Preparedness Program (TEPP), DOE Radiological Assistance Program (RAP)	Are there Transportation Emergency Preparedness Programs (TEPP) or DOE Radiological Assistance Programs (RAP) in the county?	No	1	3	0.0
Transportation	Condition of Rail Infrastructure	What grade has the ASCE's Infrastructure Report Card given the state's rail infrastructure?	B	4	1	1.1
Transportation	Public Proximity to a Rail Line	At the nearest point, how far is the public to the SNF transportation route?	≤ 12 ft	1	5	0.0
Transportation	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	3.0
Transportation	# of Rail Crossings	How many at-grade rail crossings (i.e., where the rail crosses a road at the same elevation) does the SNF transportation route have in the area of analysis?	≥ 5	1	2	0.0
Transportation	Distance to Transportation Hub	How far is the population center of the area of analysis from a transportation hub?	> 0.25 miles	5	3	4.5
Transportation	Traffic Volume	What is the highest average annual daily traffic value for the area of analysis?	AADT ≤ 10,000	5	2	3.0
Land Use	Natural Disasters	How many natural disasters have there been in the area of analysis in the last 20 years?	3	2	1	0.4
Land Use	Tribal Land	How far are Tribal lands from the area of analysis?	Distance > 10 miles	5	2	3.0
Land Use	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?	< 5	5	2	3.0
Connectivity	Availability of Internet	What percentage of households in the area of analysis have broadband internet?	50 - 74%	4	2	2.2
Connectivity	Availability of Cellular Coverage	What percentage of the area of analysis has cellular network coverage?	75 - 100%	5	2	3.0
Air Quality	Air Quality Attainment Status	Is the air quality in the area of analysis in attainment or not in attainment?	In Attainment	5	2	3.0
Air Quality	Particulate Matter Air Quality Index	Compared to other U.S. locations, what is the ambient level for Particulate Matter (PM2.5), presented as a percentile, in the area of analysis?	< 60 %ile	5	2	3.0
Air Quality	Ozone Air Quality Index	Compared to other U.S. locations, what is the ambient level for ozone, presented as a percentile, in the area of	80-90 %ile	3	2	1.5
Water Resources	Impaired Waters	Are there Clean Water Act 303(d) impaired waters within the area of analysis?	303(d) segments present	1	2	0.0
Water Resources	Floodplains	Does a 100-year or 500-year floodplain intersect with the SNF transportation route?	Within 100-yr Floodplain	1	3	0.0

Highest Contributors

Lowest Contributors

The Total Framework Score

- Total framework score is the sum of weighted indicator grades
- On a scale of 0 – 100
- 100 indicates high preparedness/low vulnerability

0   50   100

Low Preparedness/
High Vulnerability

High Preparedness/
Low Vulnerability
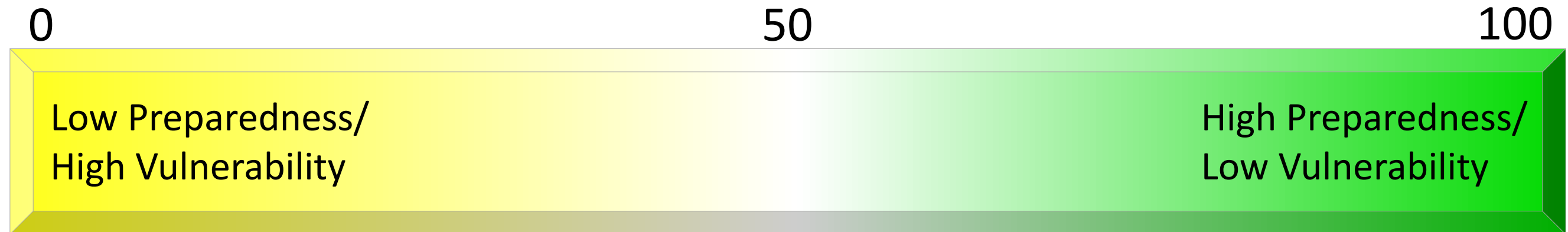
CSG-Midwest Benchmarking Purpose

- Provide context and meaning for individual site scores to identify representative variability within a region

- Identify indicators potentially requiring scaling or weighting adjustments to achieve a better representation of community characteristics

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Summary of Benchmarking Outcomes

- CSG-Midwest benchmarking work started in January 2023

  - 24 Midwest cities

  - All but 2 cities have Class I rail lines

  - Rural vs urban / near vs away from reactor

- Findings

  - Total scores exhibit S-shaped cumulative distribution

  - Benchmarking identified the importance of individual indicators to the total city scores and city rankings

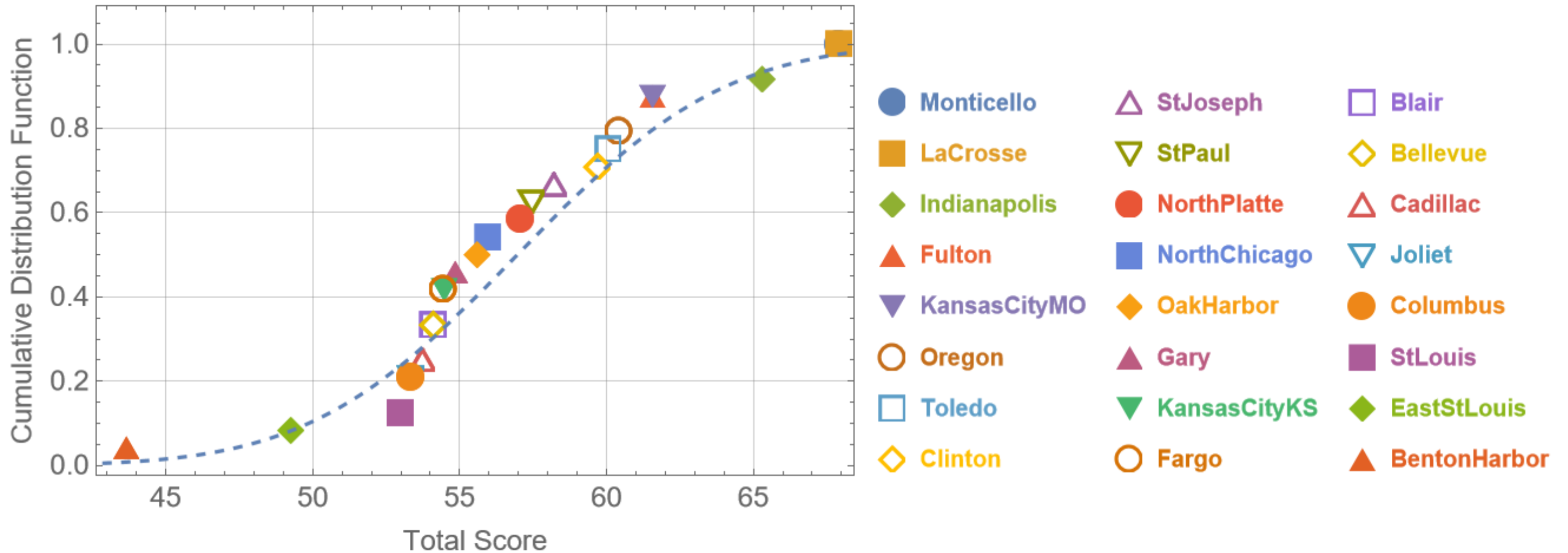 - Importance of indicator categories to the total score rankings

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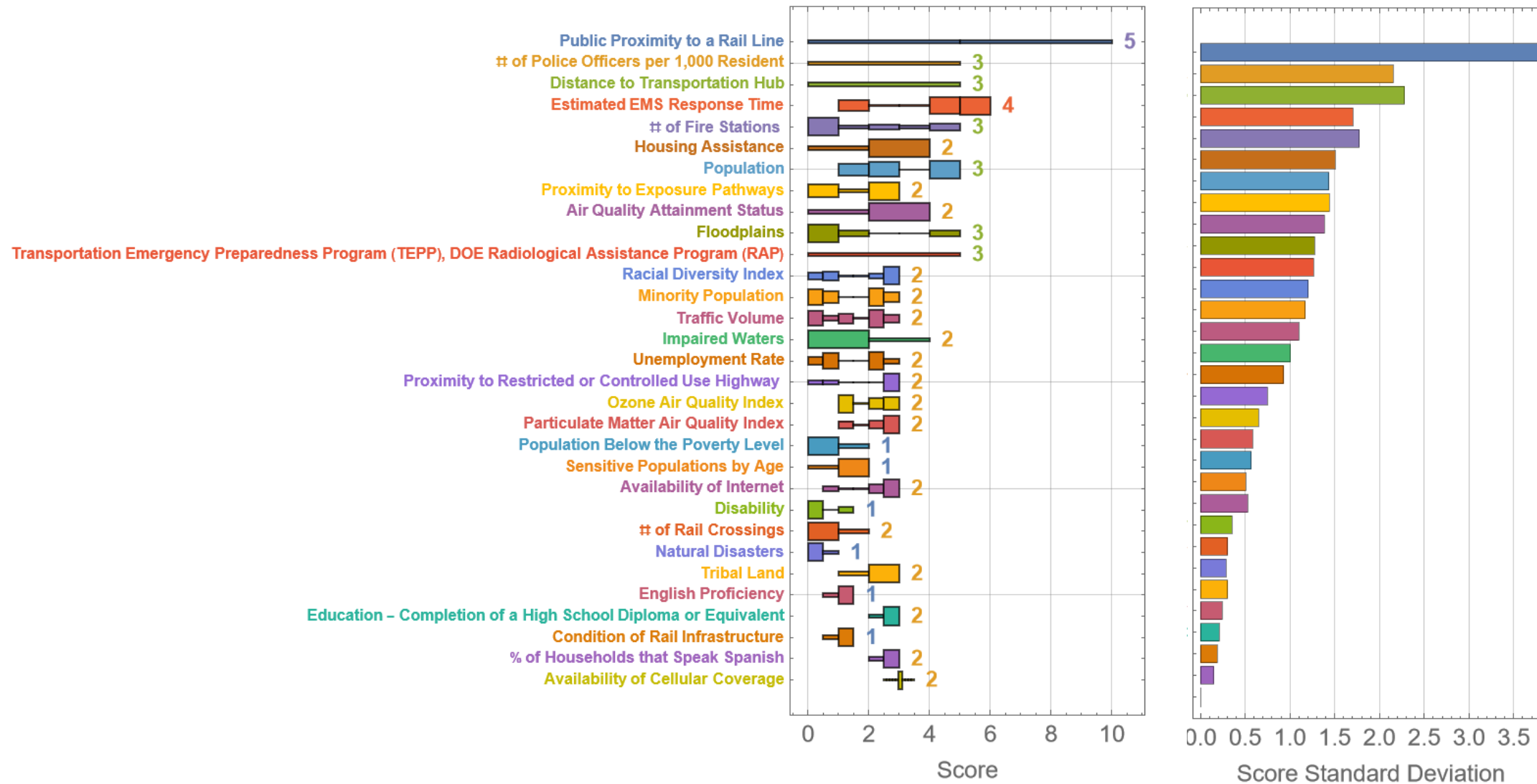
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Midwest Cities Analyzed
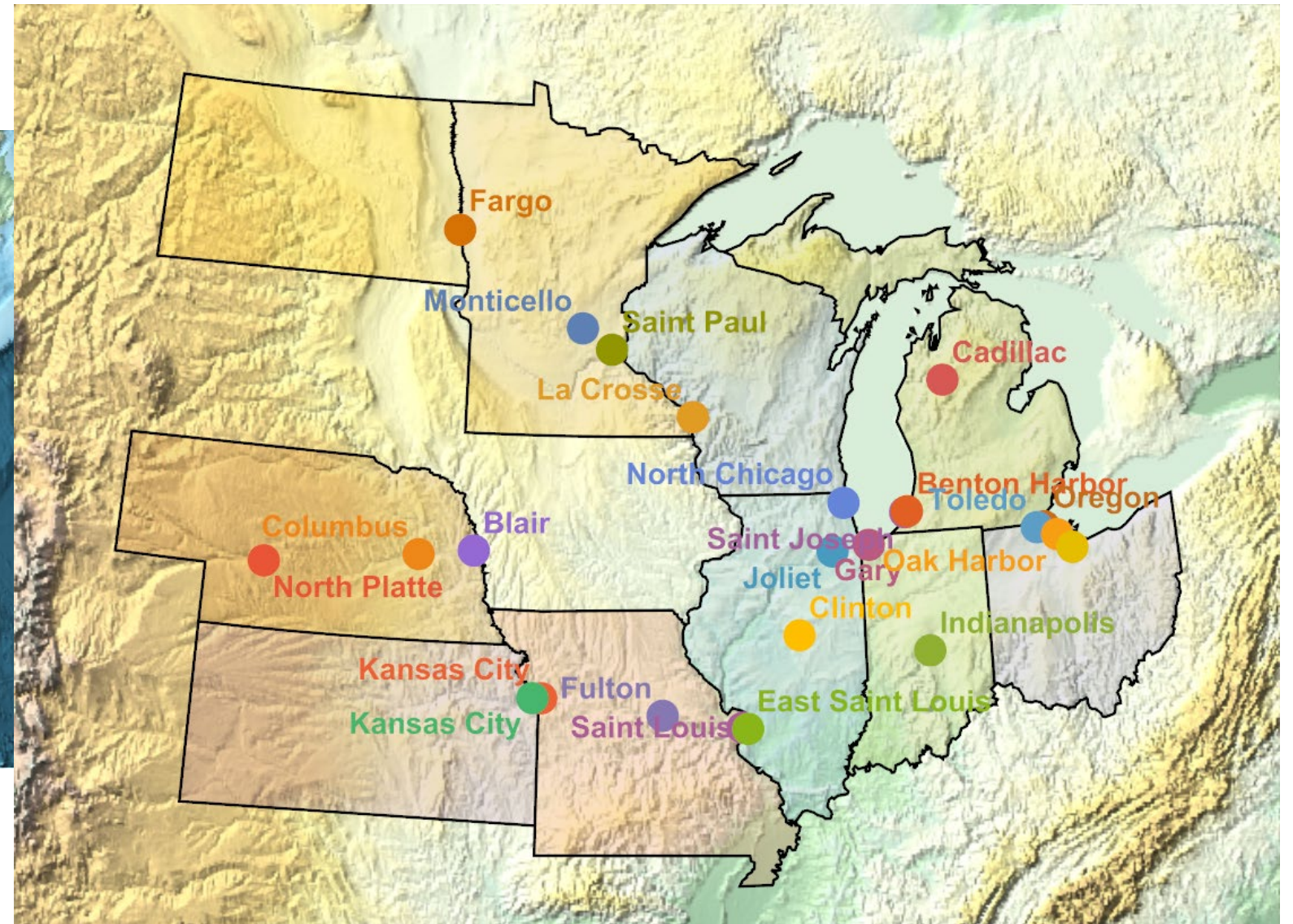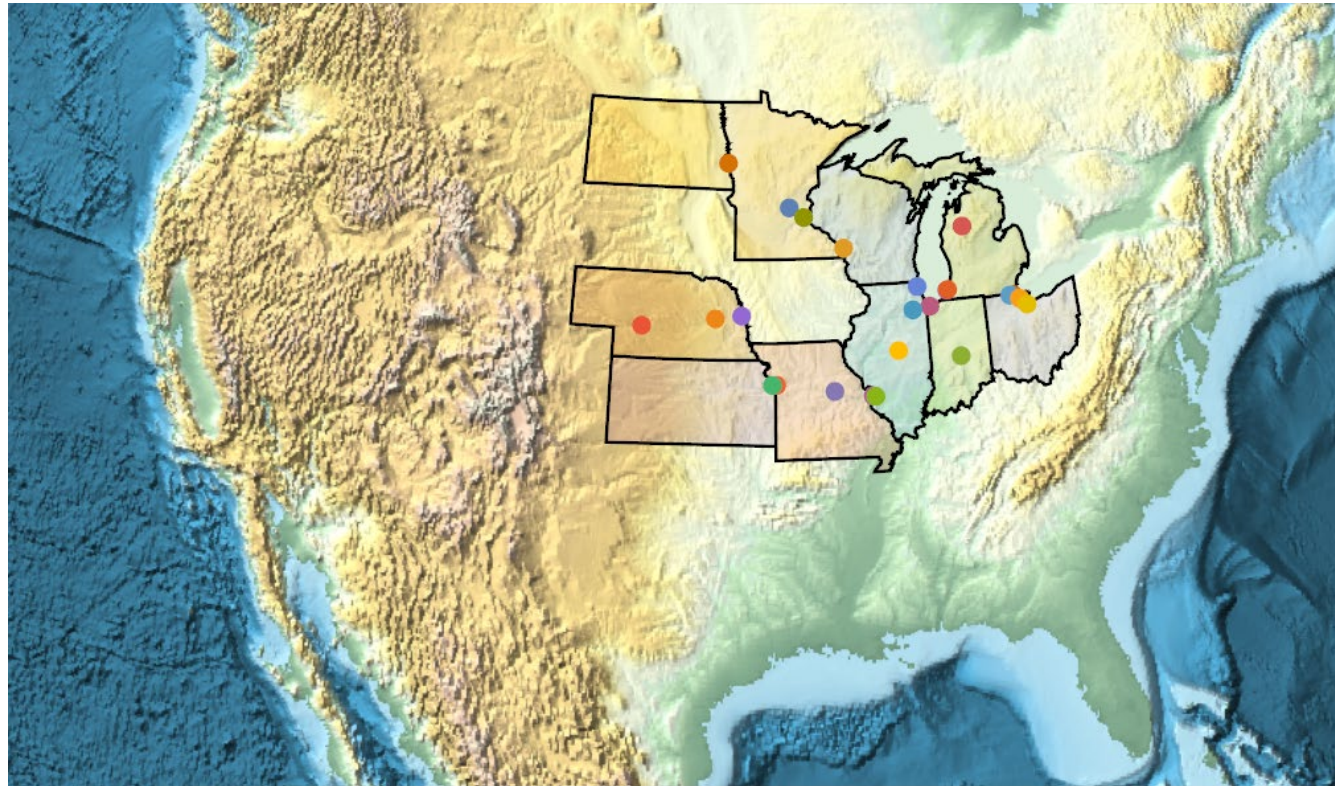
Benchmarking Approach

S-shape function approximates a normal cumulative distribution
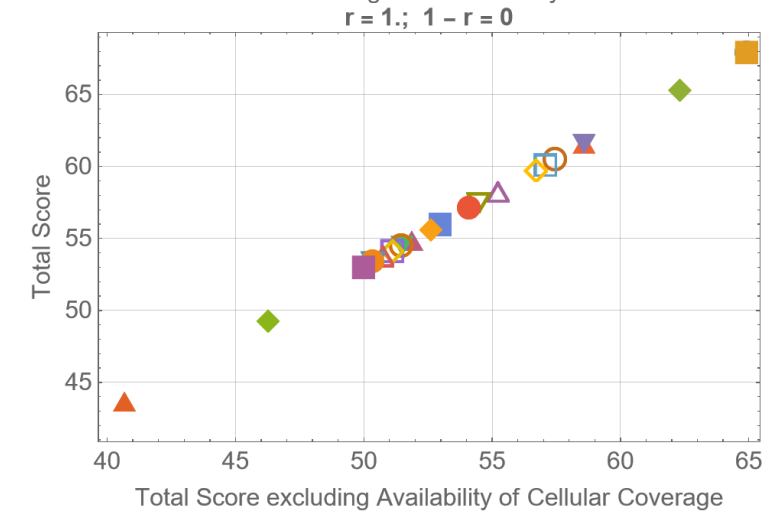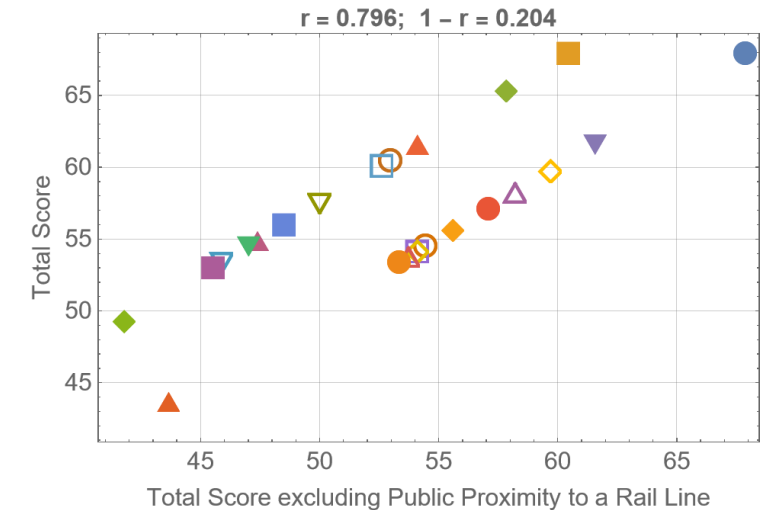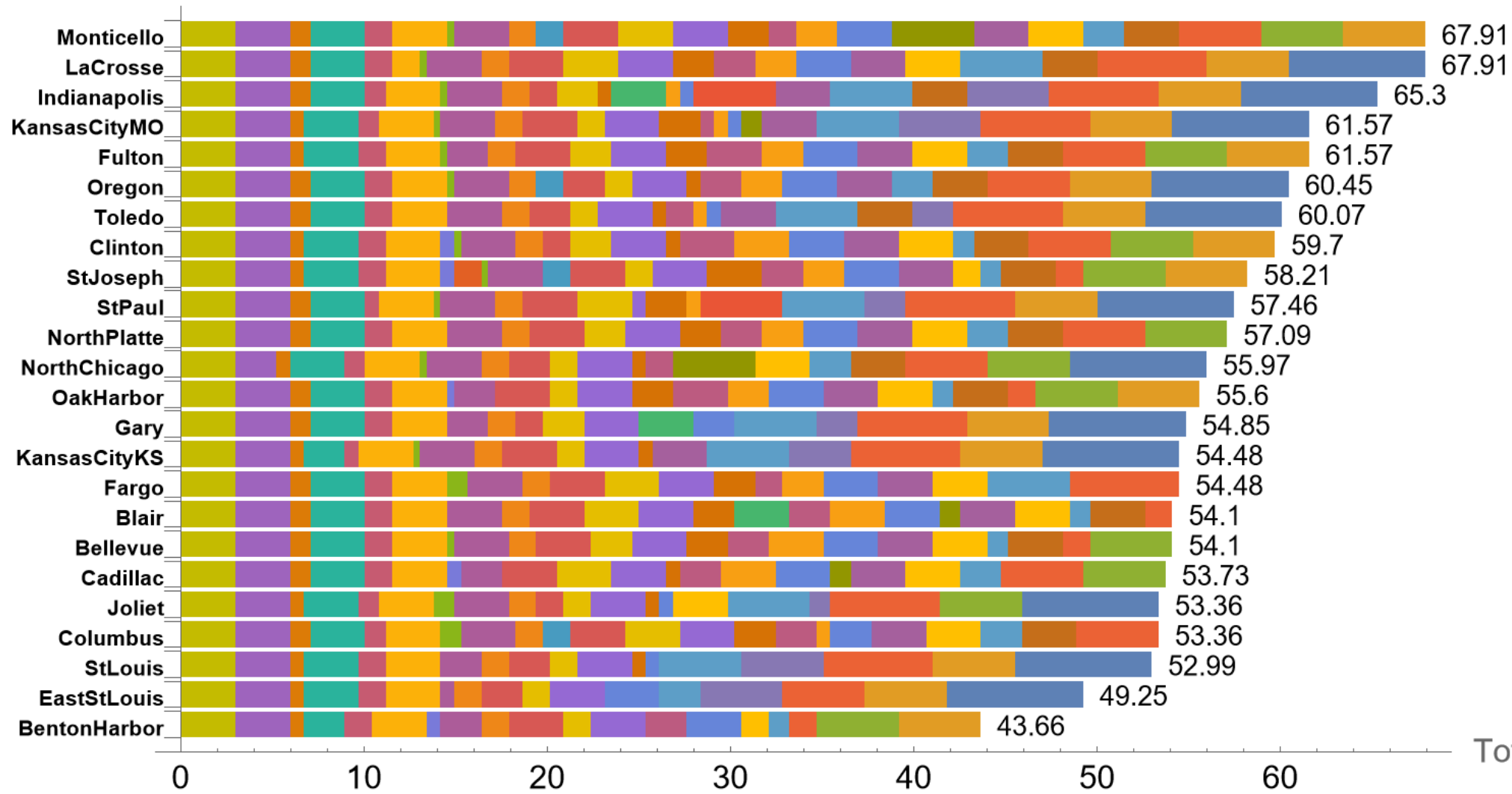
Benchmarking Approach

- The relevance of an indicator is related to its variability from city to city and to its weight

Benchmarking Approach

- What makes an indicator important to the total city score and city ranking?

Benchmarking Approach

- Initial importance of indicator categories from lowest (left) to highest (right)
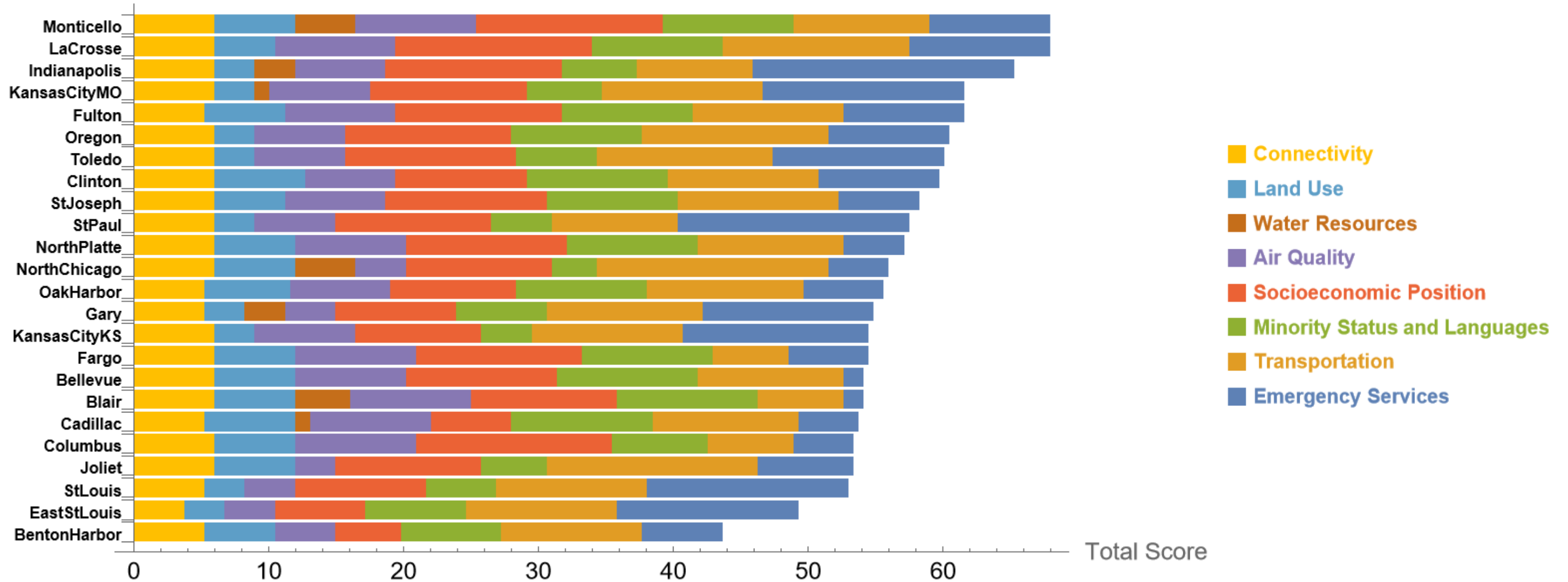
Recent Framework Adjustments

- Revised executable Excel tool to display each indicator score that sums to the total city score

- Clarified terminology (e.g., using "grade" instead of "scale")

- Normalized *# of Fire Stations per 10,000 residents*

- Changed the sources for 2 air quality indicators to provide more consistent data and to better discretize the results

- Revised the grading for *Traffic Volume* and *English Proficiency* indicators to better discretize the results

Next Phase

- Conduct and gather results from a small group meeting and roundtable discussion with community leaders
  - Ground-truth the framework and gain confidence in the framework characterization of the location
  - Discuss whether adjustments to the framework tool would be warranted
  - Discuss regional specificity or city specificity of adjustments
  - Revise framework tool and re-run the results
  - Develop final report

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Example Framework Run

St. Louis, Missouri (Urban Away)

Category	Indicator	Question	Answer	Grade	Weight	Score
Emergency Services	Estimated EMS Response Time	What is the estimated EMS response time in the area of analysis based on population?	Pop. > 50,000 (< 8 min)	5	4	20
	# 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	According to the Homeland Infrastructure Foundation-Level Data (HIFLD) Fire Station Database, how many fire stations are within the area of analysis?	≥ 26	5	3	15
	Transportation Emergency Preparedness Program (TEPP), DOE Radiological Assistance Program (RAP)	Are there Transportation Emergency Preparedness Programs (TEPP) or DOE Radiological Assistance Programs (RAP) 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?	> 12 ft	5	5	25
	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 crossings (i.e., where the rail crosses a road at the same elevation) does the SNF transportation route have in the area of analysis?	≥ 5	1	2	2
	Distance to Transportation Hub	How far is the population center of the area of analysis from a transportation hub?	≤ 0.25 miles	1	3	3
	Traffic Volume	What is the highest average annual daily traffic value for the area of analysis?	AADT > 75,000	1	2	2
Land Use	Natural Disasters	How many natural disasters have there been in the area of analysis in the last 20 years?	≥ 4	1	1	1
	Tribal Land	How far are Tribal lands from the area of analysis?	Distance > 10 miles	5	2	10
	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?	> 50	1	2	2
Connectivity	Availability of Internet	What percentage of households in the area of analysis have broadband internet?	50 - 74%	4	2	8
	Availability of Cellular Coverage	What percentage of the area of analysis has cellular network coverage?	75 - 100%	5	2	10

Category	Indicator	Question	Answer	Grade	Weight	Score
Air Quality	Air Quality Attainment Status	Is the air quality in the area of analysis in attainment or not in attainment?	Non-Attainment	1	2	2
	Particulate Matter Air Quality Index	Compared to other U.S. locations, what is the ambient level for Particulate Matter (PM2.5), presented as a percentile, in the area of analysis?	60-80 %ile	4	2	8
	Ozone Air Quality Index	Compared to other U.S. locations, what is the ambient level for ozone, presented as a percentile, in the area of analysis?	80-90 %ile	3	2	6
Water Resources	Impaired Waters	Are there Clean Water Act 303(d) 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 or over 65?	≤ 30%	5	1	5
	Disability	What percentage of the population in the area of analysis are disabled?	> 15%	1	1	1
	Education - Completion of a High School Diploma or Equivalent	What percentage of the population age 18 and over in the area of analysis have at least a high school diploma or equivalent?	> 80%	5	2	10
	Population Below the Poverty Level	What percentage of the population in the area of analysis live in poverty?	> 10%	1	1	1
	Unemployment Rate	What percentage of the population in the area of analysis are unemployed?	5.1 - 10%	2	2	4
	Housing Assistance	Does the area of analysis qualify for low-income housing tax credit (LIHTC)?	Yes	1	2	2
	Population	What is the population in the area of analysis?	> 50,000	5	3	15
Minority Status and Languages	Minority Population	What percentage of the population in the area of analysis are racial minorities?	> 50%	1	2	2
	Racial Diversity Index	What is the Census Bureau's Racial Diversity Index for the area of analysis?	55.0 - 64.9%	2	2	4
	English Proficiency	What percentage of the population in the area of analysis over age 5 speak English very well (i.e., are proficient in	95-100%	5	1	5
	% of Households that Speak Spanish	What percentage of the population in the area of analysis over the age of 5 speak Spanish?	≤ 25%	5	2	10
		Overall Framework Score				53

Indicator Grades

	A	Indicator	Question	5	4	3	2	1
						Grade		
2	Emergency Services	Estimated EMS Response Time	What is the estimated EMS response time?	Pop. >50,000 (< 8 mins)	Pop. 10,000-50,000 (8 - 15 mins)		Pop. 2,500-10,000 (15.1 - 60 mins)	Pop < 2,5000 (>60 mins)
3		# of Police Officers per 1,000 Resident	How many police officers are there per 1,000 residents?	≥ 1.8				< 1.8
4	Emergency Services	# of Fire Stations Within 25 miles	According to the Homeland Infrastructure Foundation-Level Data (HIFLD) Fire Station Database, how many fire stations are within the area of analysis?	≥ 26	20 - 25	14 - 19	8 - 13	≤ 7
5		Transportation Emergency Preparedness Program, DOE Radiological Assistance Program, or Civil Support Team Personnel	Are there Transportation Emergency Preparedness Programs (TEPP) or DOE Radiological Assistance Programs (RAP) in the county?	Yes				No
6	Transportation	Condition of Rail Infrastructure	What grade has the ASCE's Infrastructure Report Card given the state's rail infrastructure?	A	B	C	D	E
7		Public Proximity to a Rail Line	At the nearest point, how far is the public to the SNF transportation route?	> 12 ft				≤ 12 ft
8		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 miles	Intersects
9		# of Rail Crossings	How many at-grade rail crossings (i.e., where the rail crosses a road at the same elevation) does the SNF transportation route have in the area of analysis?	0		<5		≥ 5
10		Distance to Transportation Hub	How far is the population center of the area of analysis from a transportation hub?	> 0.25 miles				≤ 0.25 miles
11		Traffic Volume	What is the highest average annual daily traffic value for the area of analysis?	AADT ≤ 10,000	10,000 < AADT ≤ 25,000	25,000 < AADT ≤ 50,000	50,000 < AADT ≤ 75,000	AADT > 75,000
12	Land Use	Natural Disasters	How many natural disasters have there been in the area of analysis in the last 20 years?	0	1	2	3	≥ 4
13		Tribal Land	How far are Tribal lands from the area of analysis?	Distance > 10 miles		Distance ≤3 miles		On Tribal Land
14		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?	< 5	5 - 15	15 - 30	30 - 50	> 50
15	Connectivity	Availability of Internet	What percentage of households in the area of analysis have broadband internet?	75 - 100%	50 - 74%		25 - 49%	< 25%
16		Availability of Cellular Coverage	What percentage of the area of analysis has cellular network coverage?	75 - 100%	50 - 74%		25 - 49%	< 25%
17	Air Quality	Air Quality Attainment Status	Is the air quality in the area of analysis in attainment or not in attainment?	In Attainment				Non-Attainment
18		Particulate Matter Air Quality Index	Compared to other U.S. locations, what is the ambient level for Particulate Matter (PM2.5), presented as a percentile, in the area of analysis?	< 60 %ile	60 - 80 %ile	80 - 90 %ile	90 - 95 %ile	95 - 100 %ile
19		Ozone Air Quality Index	Compared to other U.S. locations, what is the ambient level for ozone, presented as a percentile, in the area of	< 60 %ile	60 - 80 %ile	80 - 90 %ile	90 - 95 %ile	95 - 100 %ile

Indicator Grades

	A	B (Indicator)	C (Question)	L (Grade 5)	M (Grade 4)	N (Grade 3)	O (Grade 2)	P (Grade 1)
20	Water Resources	Impaired Waters	Are there impaired waters within the area of analysis?	No 303(d) segments				303(d) segments present
21		Floodplains	Does a 100-year or 500-year floodplain intersect with the SNF transportation route?	No Floodplain			500-yr Floodplain	100-yr Floodplain
22	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%				>30%
23		Disability	What percentage of the population in the area of analysis are disabled?	<5%	5 - 10.9%		11 - 14.9%	>15%
24		Education - Completion of a High School Diploma or Equivalent	What percentage of the population age 18 and over in the area of analysis have at least a high school diploma or equivalent?	>80%	60 - 80%		40 - 59%	<40%
25		Population Below the Poverty Level	What percentage of the population in the area of analysis live in poverty?	≤10%				>10%
26		Unemployment Rate	What percentage of the population in the area of analysis are unemployed?	≤3%	3.1 - 5%		5.1 - 10%	>10%
27		Housing Assistance	Does the area of analysis qualify for low-income housing tax credit (LIHTC)?	No				Yes
28		Population	What is the population in the area of analysis?	>50,000	30,000 - 50,000	10,000 - 30,000	2,500 - 10,000	<2,500
29	Minority Status and Languages	Minority Population	What percentage of the population in the area of analysis are racial minorities?	≤10%	10.1 - 20%		20.1 - 50%	>50%
30		Racial Diversity Index	What is the Census Bureau's Racial Diversity Index of the area of analysis?	<35.0%	35.0 - 44.9%	45.0 - 54.9%	55.0 - 64.9%	≥65.0%
31		English Proficiency	What percentage of the population in the area of analysis over age 5 speak English very well (i.e., are proficient in English)?	95 - 100%	85 - 95%	75 - 85%	50 - 75%	<50%
32		% of Households that Speak Spanish	What percentage of the population in the area of analysis over the age of 5 speak Spanish?	≤25%	25.1 - 50%		50.1 - 75%	>75%

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Indicator Sources

Indicator	Data Source
Estimated EMS Response Time	Census Bureau population Table B01001
# of Police Officers per 1,000 Residents	Federal Bureau of Investigation Crime Data Explorer website https://crime-data-explorer.app.cloud.gov/pages/le/pe
# of Fire Stations per 10,000 Residents	Homeland Infrastructure Foundation-Level Data (HIFLD) Fire Station Database https://www.epa.gov/enviroatlas/enviroatlas-interactive-map
Transportation Emergency Preparedness Program (TEPP), DOE Radiological Assistance Program (RAP)	TEPP: https://teppinfo.com/24-hour-emergency-contacts DOE RAP: https://remm.hhs.gov/RAP.htm CTS: manual online search
Condition of Rail Infrastructure	American Society of Civil Engineer's (ASCE's) Infrastructure Report Card https://infrastructurereportcard.org/state-by-state-infrastructure/
Public Proximity to a Rail Line	requirements for Type B packaging are addressed in 49 Code of Federal Regulation (CFR) 173.411, 49 CFR 173.413, and 10 CFR Part 71
Proximity to Restricted or Controlled Use Highway	National Hazardous Materials Route Registry https://www.fmcsa.dot.gov/regulations/hazardous-materials/national-hazardous-materials-route-registry-state
# of Rail Crossings	EnviroAtlas FRA Highway Rail Grade Crossing" layer
Distance to Transportation Hub	Manual map search
Traffic Volume	general search of the AADT values in your area of analysis
Natural Disasters	https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties
Tribal Land	EnviroAtlas "Federal American Indian Reservations" layer

Indicator Sources

Indicator	Data Source
Proximity to Exposure Pathways	EnviroAtlas • FAC - ACRES Brownfields (EPA) • EPA Facility Registry Service – RCRA Hazardous Waste Treatment, Storage, and Disposal (RCRA_TSD) • Superfund National Priorities List (NPL) Sites with Status Information
Availability of Internet	Census Table DP02
Availability of Cellular Coverage	EnviroAtlas "FCC Form 477 4G LTE Dead Zones" layer
Air Quality Attainment Status	EPA Criteria Pollutant Nonattainment Summary https://www3.epa.gov/airquality/greenbook/ancl3.html
Particulate Matter Air Quality Index	https://ejscreen.epa.gov/mapper/ (Source: EPA Office of Air and Radiation
Ozone Air Quality Index	https://ejscreen.epa.gov/mapper/ (Source: EPA Office of Air and Radiation
Impaired Waters	EPA How's My Waterway https://mywaterway.epa.gov/
Floodplains	FEMA's website https://msc.fema.gov/portal/home
Sensitive Populations by Age	Census Table S0101
Disability	Census Table DP02
Education - Completion of a High School Diploma or Equivalent	Census Table S1501
Population Below the Poverty Level	Census Table DP03
Unemployment Rate	Census Table DP03
Housing Assistance	Department of Housing and Urban Development (HUD). https://hudgis-hud.opendata.arcgis.com/datasets/HUD::qualified-census-tracts/about
Population	Census Table B01001
Minority Population	Census Table B03002
Racial Diversity Index	Census Table B03002
English Proficiency	Census Table DP02
% of Households that Speak Spanish	Census Table DP02

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 grade indicators over a gradient
  - Incorporation of climate change considerations
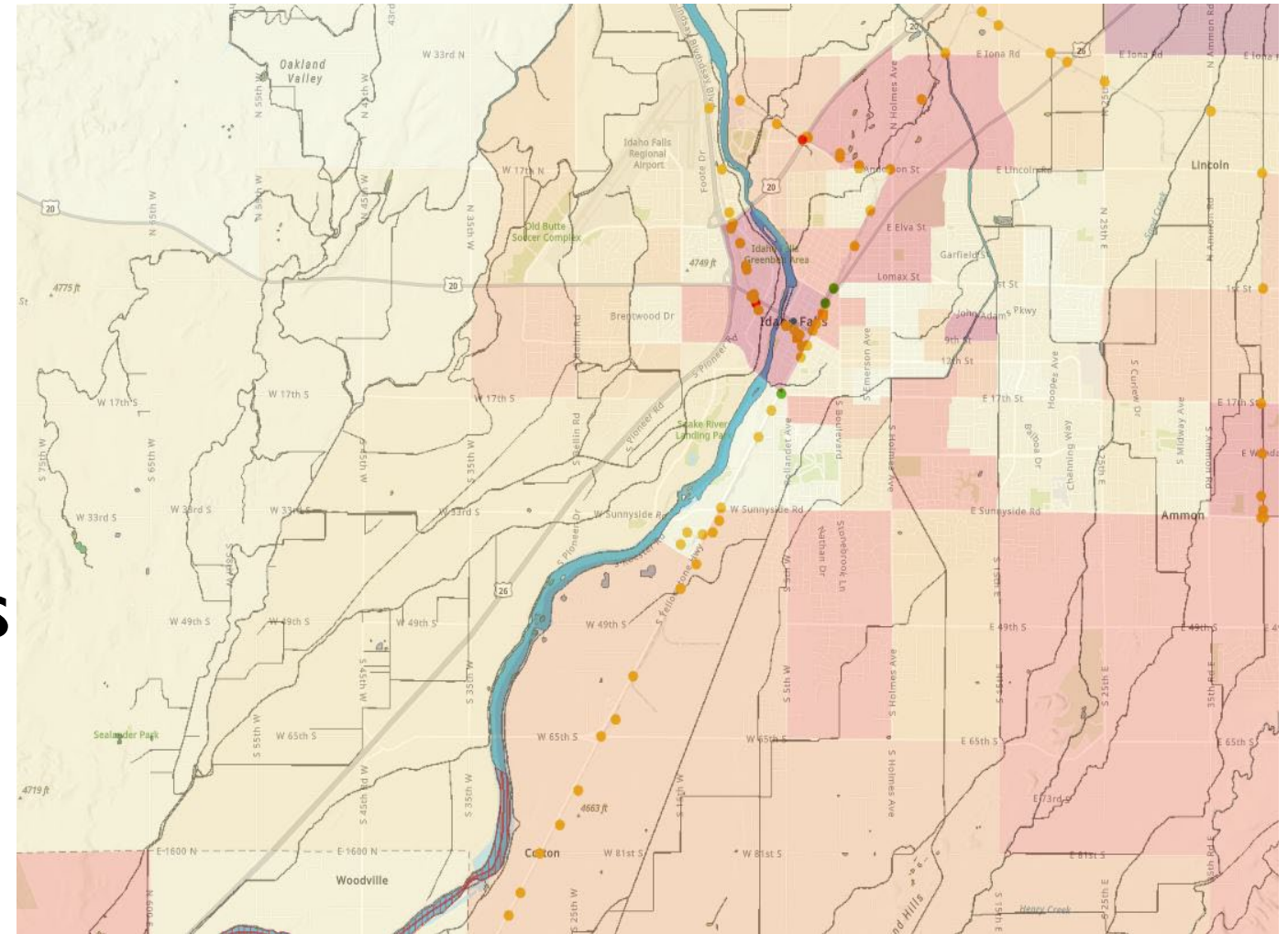
Future Development Opportunities

- 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

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