# Unpacking "Rural"

Using Geographic Information Systems to Better Understand Rurality

Michele Walsh, Ph.D. | Kara Haberstock Tanoue

# Overview

- Background: What is "Rural" and why we care
- Demonstration of our approach
- Discussion

Frances
McClelland Institute
Children, Youth, and Families

## Defining "Rural"

- "'Rural' encompasses all population, housing, and territory not included within an urban area."

  (US Census Bureau, 2014)

- "Metro/urban areas can be defined using several criteria. Once this is done, nonmetro/rural is then defined by exclusion -- any area that is not metro/urban is nonmetro/rural."

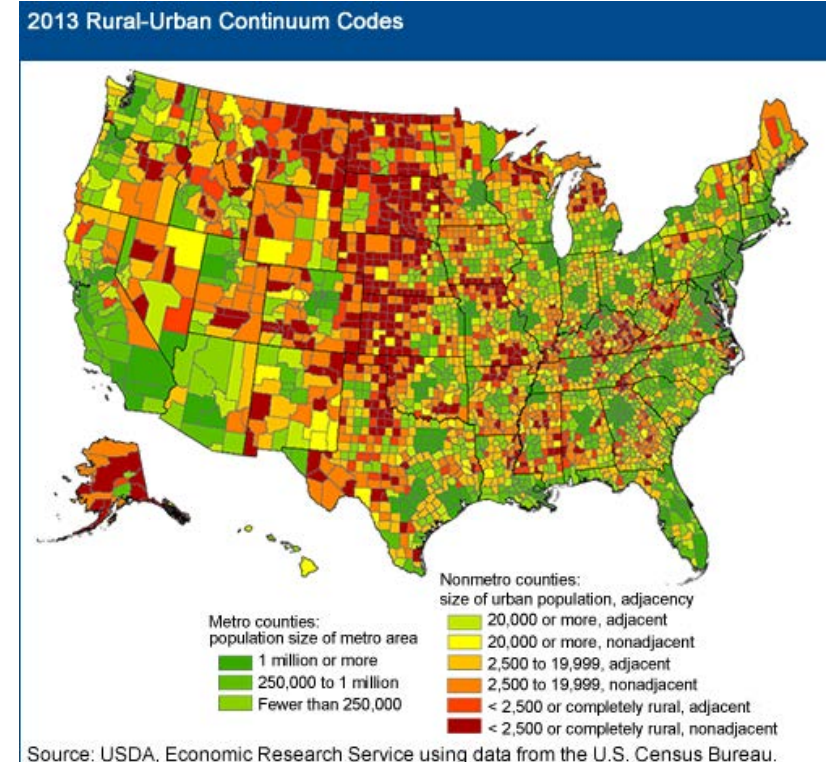  (US General Accounting Office, 1993)

- "Nonmetro counties include some combination of:
  1. open countryside,
  2. rural towns (places with fewer than 2,500 people), and
  3. urban areas with populations ranging from 2,500 to 49,999"

  (US Department of Agriculture, 2013)

Frances
McClelland Institute
Children, Youth, and Families

# Rural Classifications

## USDA Urban-Rural Continuum Codes

- Metro Counties:
  1. Counties in metro areas of >1,000,000 persons
  2. Counties in metro areas of 250,000-1,000,000 persons
  3. Counties in metro areas of >250,000

- Nonmetro Counties:
  4. Urban population of >20,000, adjacent to metro area
  5. Urban population of >20,000, not adjacent to metro area
  6. Urban population of 2,500-19,999, adjacent to metro area
  7. Urban population of 2,500-19,999, not adjacent to metro area
  8. Completely rural or urban population >2,500, adjacent to metro area
  9. Completely rural or urban population >2,500, not adjacent to metro area



2013 Rural-Urban Continuum Codes

Metro counties: population size of metro area
- 1 million or more
- 250,000 to 1 million
- Fewer than 250,000

Nonmetro counties: size of urban population, adjacency
- 20,000 or more, adjacent
- 20,000 or more, nonadjacent
- 2,500 to 19,999, adjacent
- 2,500 to 19,999, nonadjacent
- < 2,500 or completely rural, adjacent
- < 2,500 or completely rural, nonadjacent

Source: USDA, Economic Research Service using data from the U.S. Census Bureau.

Frances McClelland Institute
Children, Youth, and Families

# Rural Classifications

**Urban/Rural/Frontier Designations**

- Urban: All PCAs in Counties > 400,000 where the Census County Division (CCD) is >= 50,000

- Frontier: All PCAs < 6 persons per sq mi

- Rural: All PCAs in Counties < 400,000 population are RURAL if not FRONTIER, or INDIAN, and PCAs in Counties > 400,000 population in which the Census County Division population is < 50,000 are coded RURAL.
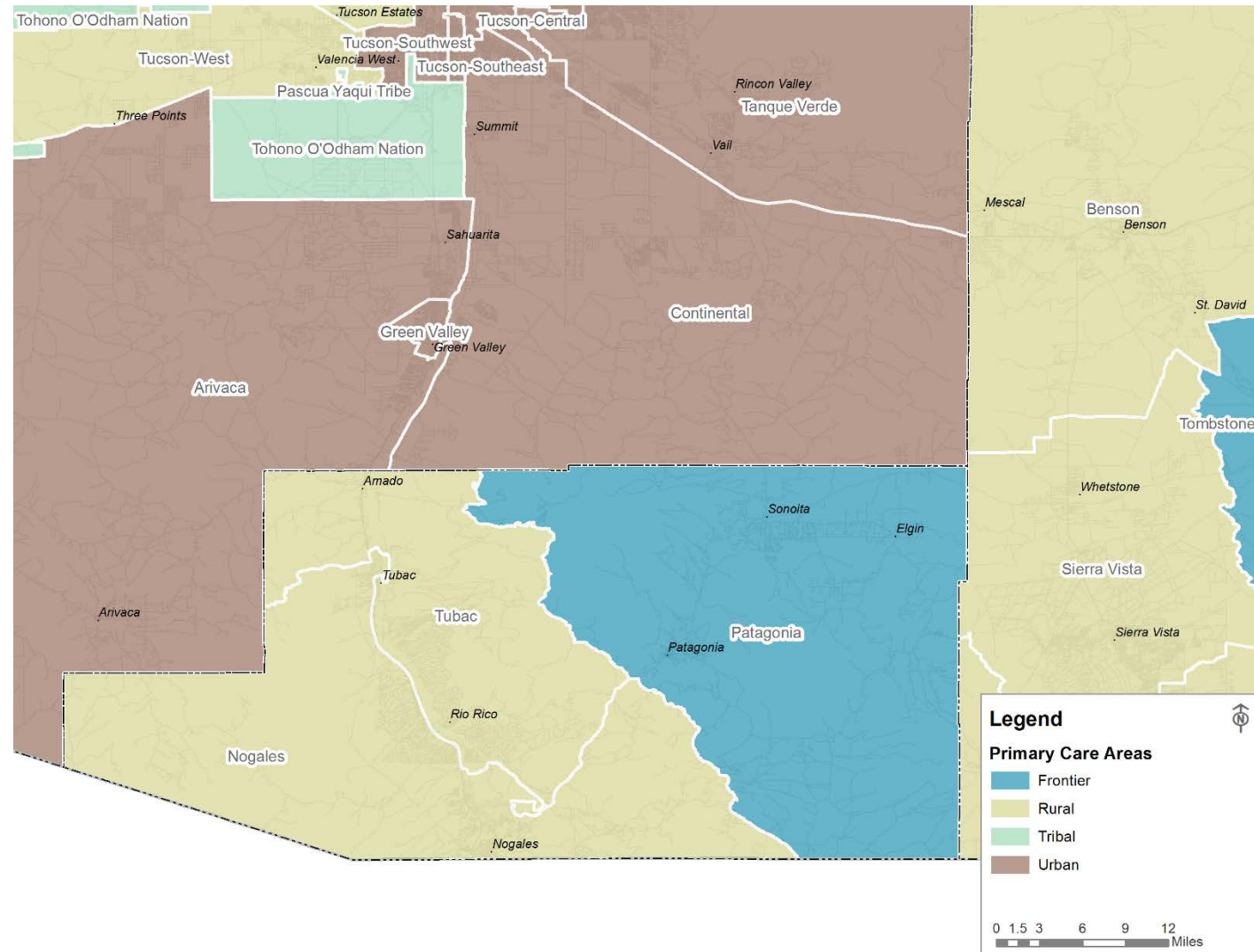
Arizona
Frontier, Rural, Urban and Indian PCAs
2013

**Legend**

**CODE**
- FRONTIER
- INDIAN
- RURAL
- URBAN
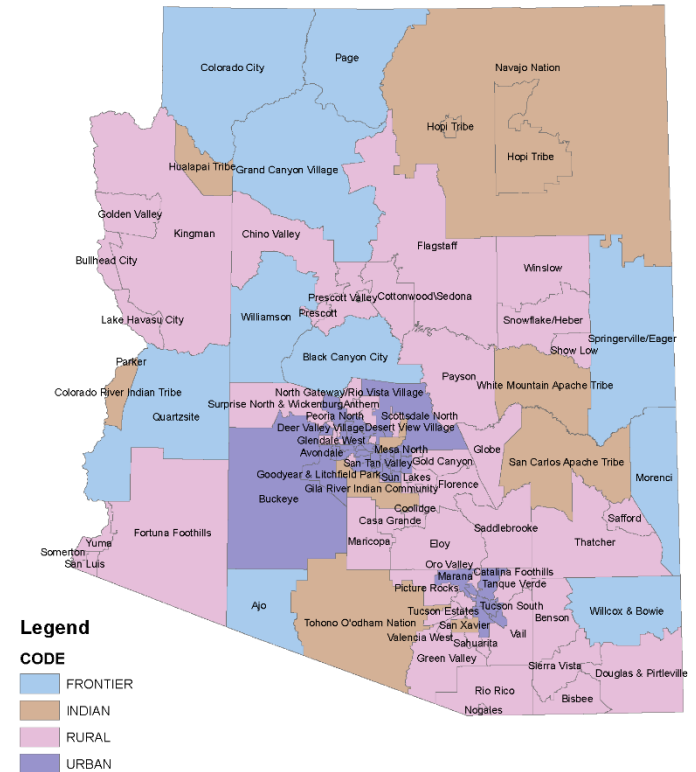
BUREAU OF HEALTH SYSTEMS DEVELOPMENT
Arizona Department of Health Services

Frances McClelland Institute
Children, Youth, and Families

# "Rural" Arizona: Primary Care Areas

Patagonia, AZ (classed FRONTIER)

Nogales, AZ (classed RURAL)



Frances McClelland Institute
Children, Youth, and Families

# "Rural" Arizona: Primary Care Areas

Patagonia, AZ (classed FRONTIER)

Nogales, AZ (classed RURAL)

| INDICATOR | PATAGONIA PCA | NOGALES PCA |
|---|---|---|
| White | 92.8% | 72.7% |
| Hispanic/Latino | 23.0% | 91.2% |
| In Poverty | 12.5% | 29.3% |
| No High School Diploma or GED | 7.2% | 33.6% |
| College or Professional Degree | 53.9% | 17.2% |
| Ratio of population to Primary Care Providers | 550:1 | 1542.7:1 |

Frances McClelland Institute
Children, Youth, and Families

# Rural as Proxy

**Subsistence**

- Income
- Insurance
- Cash flow
- Debt burden
- Government support
- Changes in job market
- Self-employment
- Prioritizing of expenses

**Medical and Social Service Use**

- Availability
- Acceptability
- Accessibility
- Communications
- Transportation

Frances
McClelland Institute
Children, Youth, and Families

# Rural as Proxy

## Structuring of Home/Neighborhood

- Safety
- Space
- Sense of place
- Neighborhood cohesion
- Geographic isolation
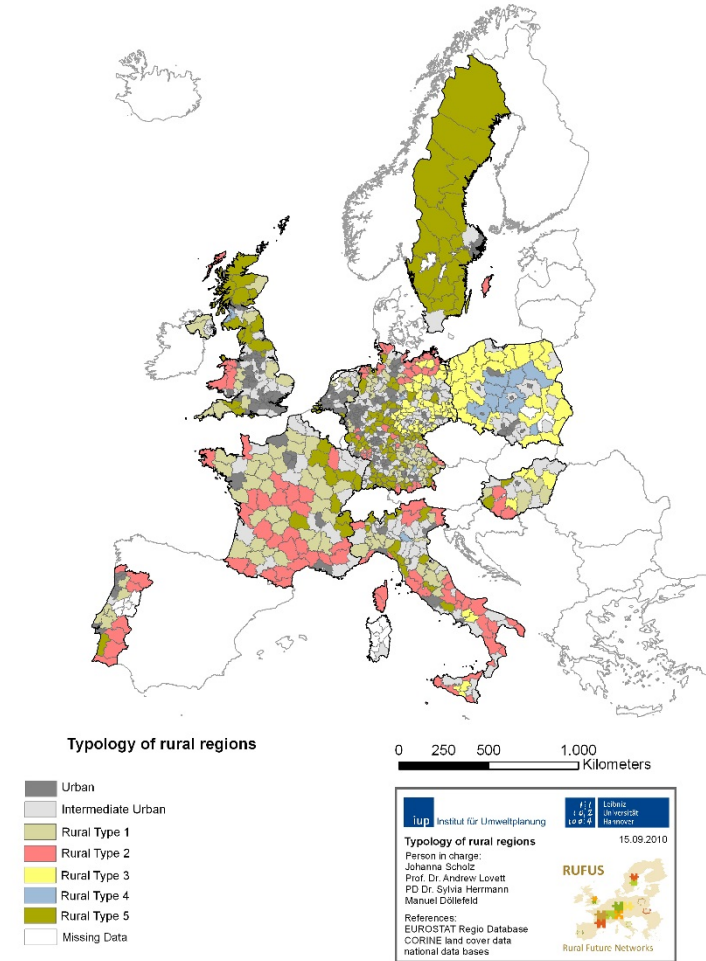- Lack of anonymity

## Values and Norms

- Self reliance
- Stoicism
- "Making do"
- Individualism
- Fatalism
- Authoritarianism
- Emphasis on hard work and mastery of the physical environment
- Emphasis on the importance of family and community ties
- Orientation toward traditional moral standards and conformity to group norms
- Community beliefs about health and illness

Frances
McClelland Institute
Children, Youth, and Families

# Exploring Rural Typologies

Rural Future Networks (RUFUS) project:

- Used land use, population densities, industry data, education, and economic indicators to develop a typology of rural areas in the EU

- Used cluster analysis to develop 5 classes of rural areas based on these variables

- Will be used in a policy handbook for 465 rural regions in Europe

Scholz and Herrmann (2010)



**Typology of rural regions**

- Urban
- Intermediate Urban
- Rural Type 1
- Rural Type 2
- Rural Type 3
- Rural Type 4
- Rural Type 5
- Missing Data

0    250    500    1.000
Kilometers

iup Institut für Umweltplanung          Leibniz Universität Hannover
Typology of rural regions          15.09.2010
Person in charge:
Johanna Scholz
Prof. Dr. Andrew Lovett
PD Dr. Sylvia Herrmann
Manuel Döllefeld
References:
EUROSTAT Regio Database
CORINE land cover data
national data bases          RUFUS
Rural Future Networks

Frances
McClelland Institute
Children, Youth, and Families

# Exploring Rurality through Unsupervised Learning

Unsupervised Learning: statistical analyses in which there is no observed outcome variable or label; often performed as a part of exploratory data analysis

K-Means Clustering: partitions a dataset into $K$ distinct, non-overlapping clusters in which the within-cluster variation is minimized

Principal Components Analysis: computes *principal components* (normalized linear combinations of sets of features that account for the majority of the variance in the data) to understand a dataset

(Hastie, Tibshirani, and Friedman, 2009)

Frances
McClelland Institute
Children, Youth, and Families

# Choosing Variables to Capture Rurality

## ACCESS
- Commute Time
- Vehicle Ownership
- Population Density
- Distance to Urban Areas

## RISK
- Income and Poverty
- Unemployment and Labor Force Participation
- Overcrowding
- Vacant Housing

## CLEAVAGES
- Age
- Race/Ethnicity
- Citizenship and Immigration
- Industry
- Population Mobility

Frances McClelland Institute
Children, Youth, and Families

# Geographic Information Systems

- Geographic Information System:

  "A geographic information system, or GIS, is a computerized data management system used to capture, store, manage, retrieve, analyze, and display spatial information" (Scurry, 1998)

- Powerful due to linkage of place, data, and spatial relationships

Frances
McClelland Institute
Children, Youth, and Families

# Generating Access Variables in ArcGIS

- Density:
  - measuring the prevalence of a given feature set with a set of administrative or statistical boundaries
  - generated through overlay analysis, such as "Identity" in ArcGIS

- Distance:
  - measuring the distances between features (usually point features)
  - generated using either path or Euclidean distances
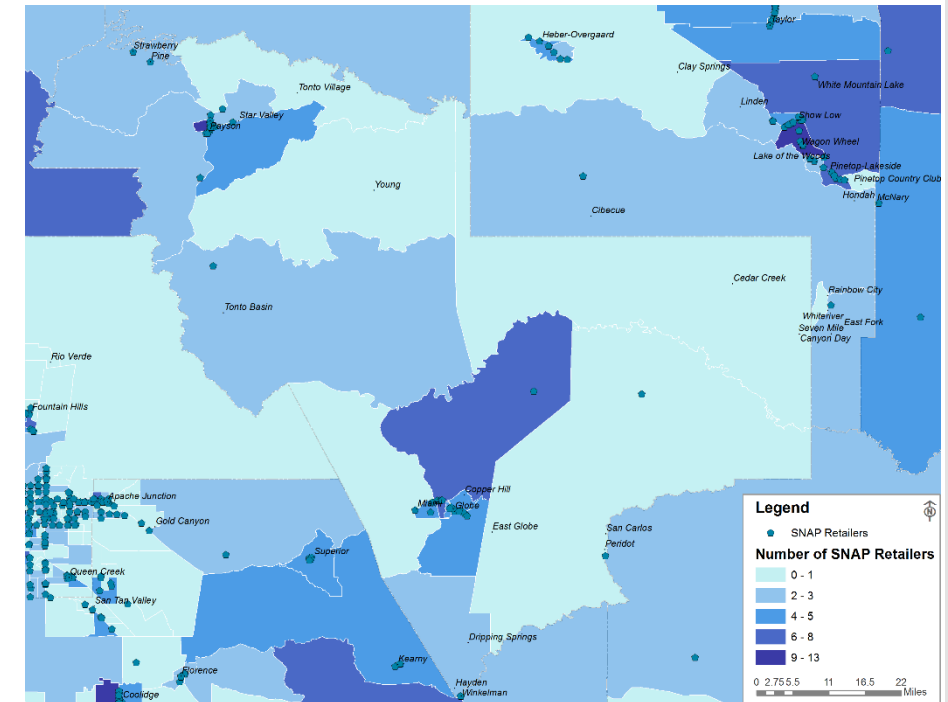


**Density of SNAP Retailers per Census Tract**
Generated from a point feature class of SNAP retailers and a polygon feature class of census tracts using the Identity tool in ArcGIS

Frances
McClelland Institute
Children, Youth, and Families

# Generating Access Variables in ArcGIS

- Density:
  - measuring the prevalence of a given feature set with a set of administrative or statistical boundaries
  - generated through overlay analysis

- Distance:
  - measuring the distances between features (usually point features)
  - generated using either path or Euclidean distances
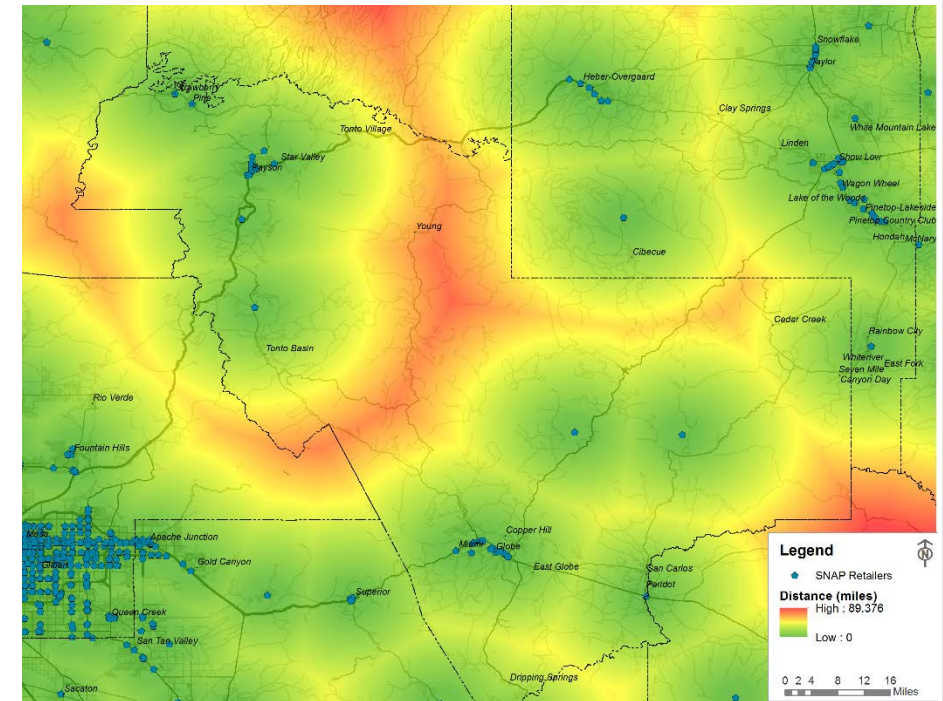


**Euclidean Distances from SNAP Retailers**
Generated from a point feature class of SNAP retailers using the Euclidean Distance tool in ArcGIS

Frances
McClelland Institute
Children, Youth, and Families

# Generating Access Variables in ArcGIS

- Density:
  - measuring the prevalence of a given feature set with a set of administrative or statistical boundaries
  - generated through overlay analysis

- Distance:
  - measuring the distances between features (usually point features)
  - generated using either path or Euclidean distances
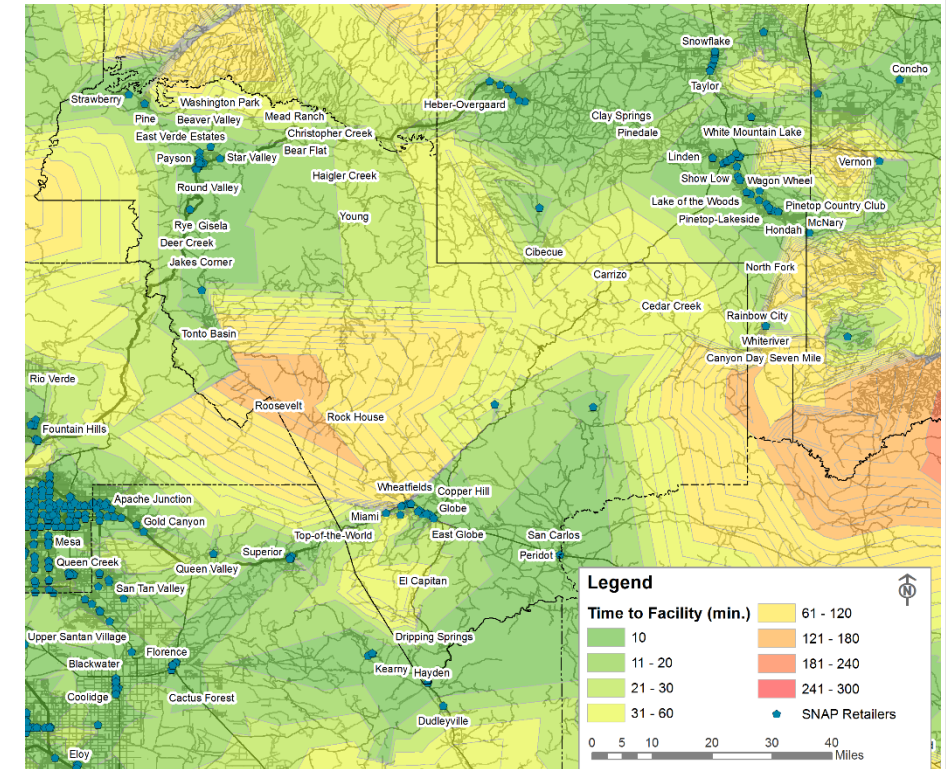


**Least Cost Path Distances from SNAP Retailers**
Generated from a point feature class of SNAP retailers using the Service Area analysis in ArcGIS Network Analyst

Frances
McClelland Institute
Children, Youth, and Families
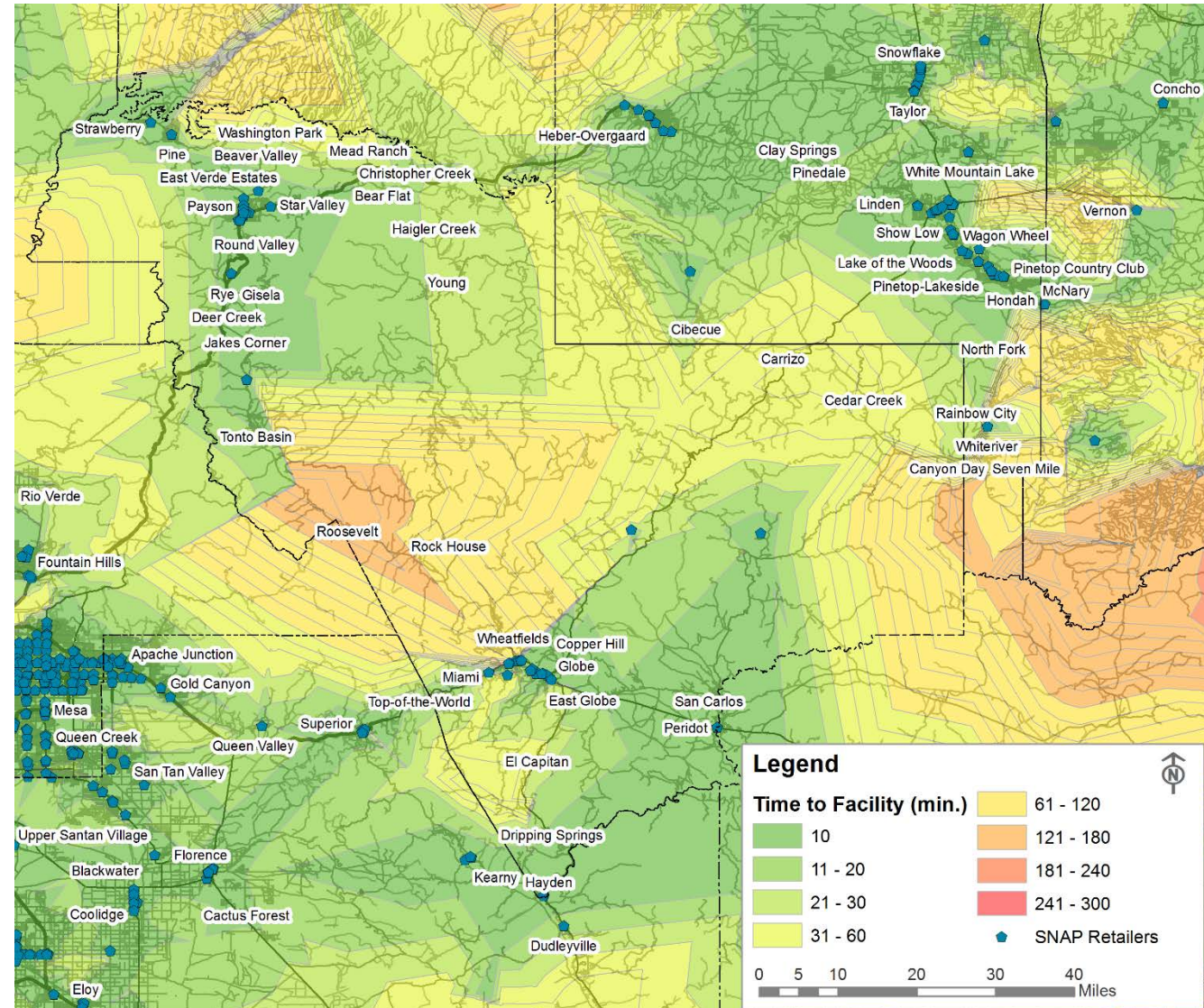
# ArcGIS Network Analyst

- Network Analyst: analysis tool pack that allows the modeling of geometric, transportation, multimodal, and other networks in order to generate path distances for travel along those networks
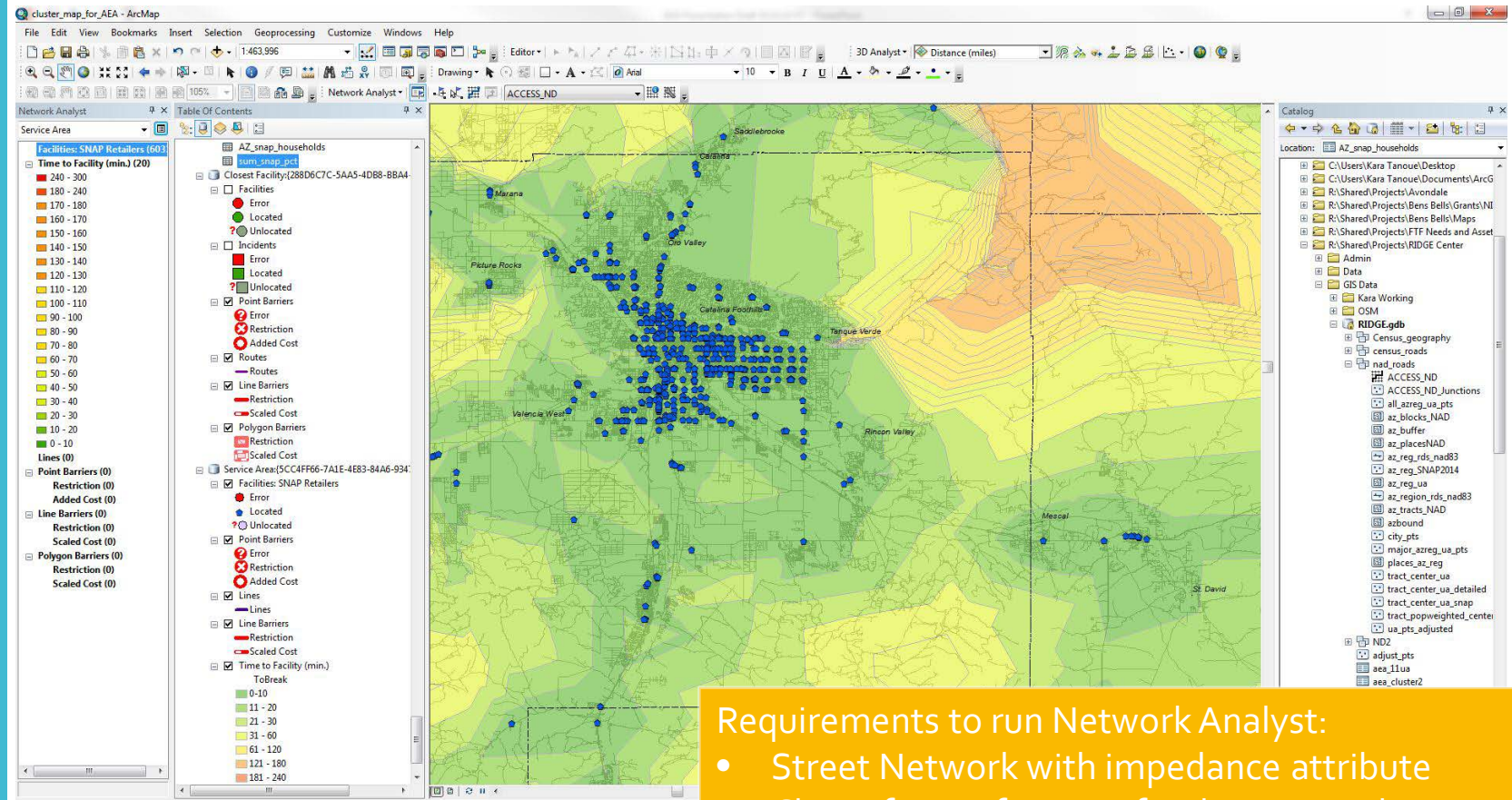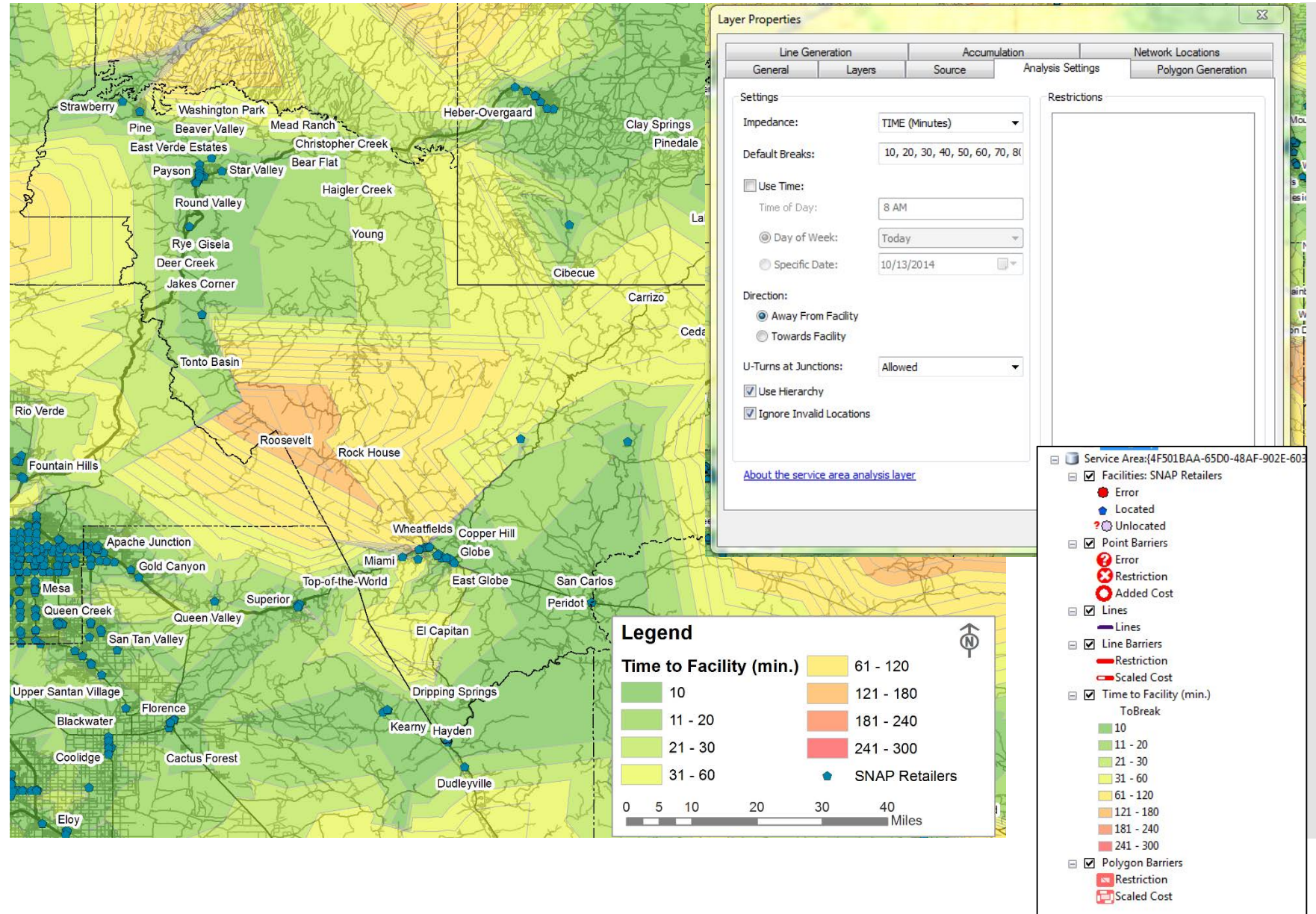


Requirements to run Network Analyst:
- Street Network with impedance attribute
- Class of point features for destination locations
- Class of point features for origin locations

Frances
McClelland Institute
Children, Youth, and Families

# Service Areas in Network Analyst



Legend

**Time to Facility (min.)**
- 10
- 11 - 20
- 21 - 30
- 31 - 60
- 61 - 120
- 121 - 180
- 181 - 240
- 241 - 300
- SNAP Retailers

Frances
**McClelland Institute**
Children, Youth, and Families
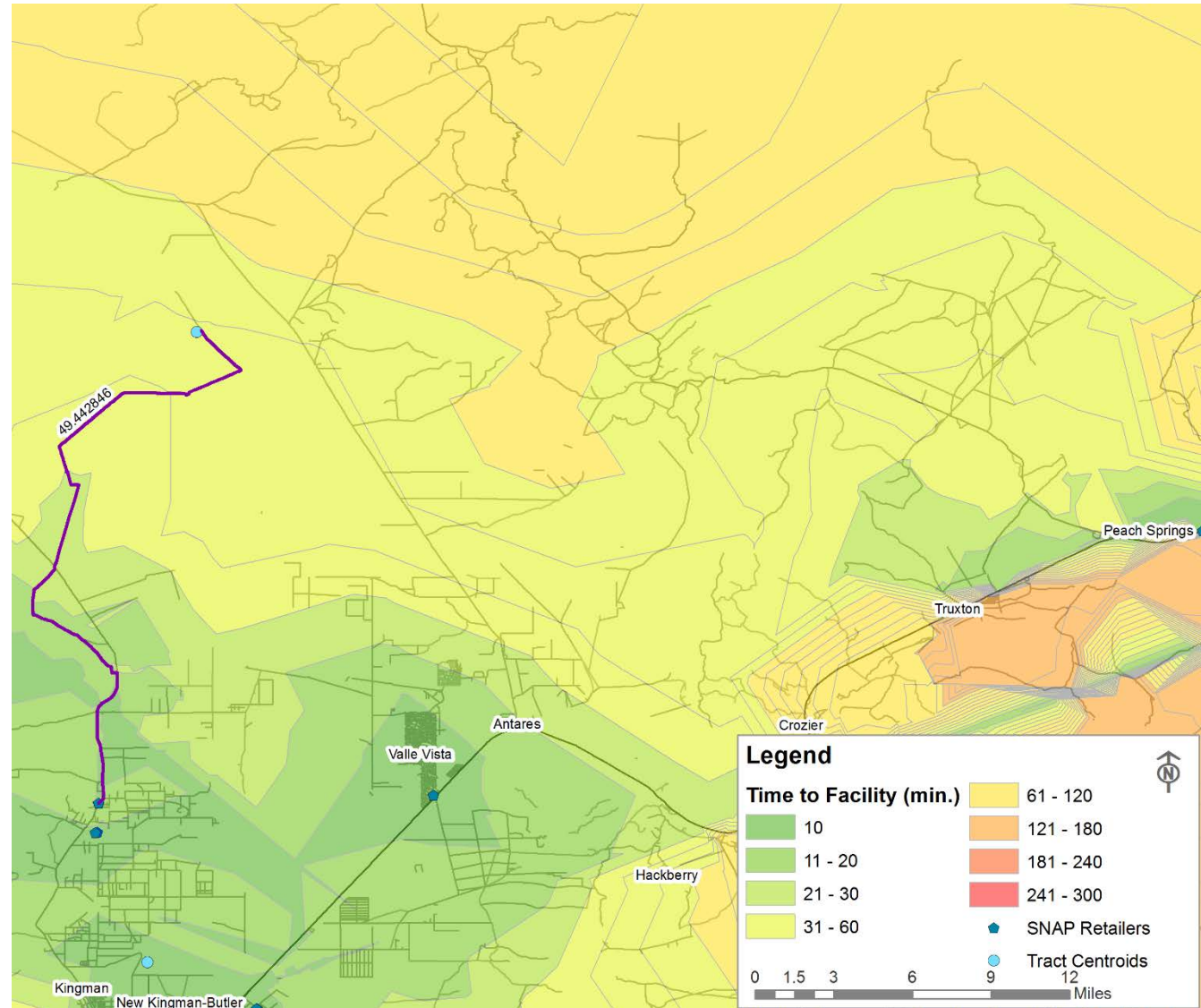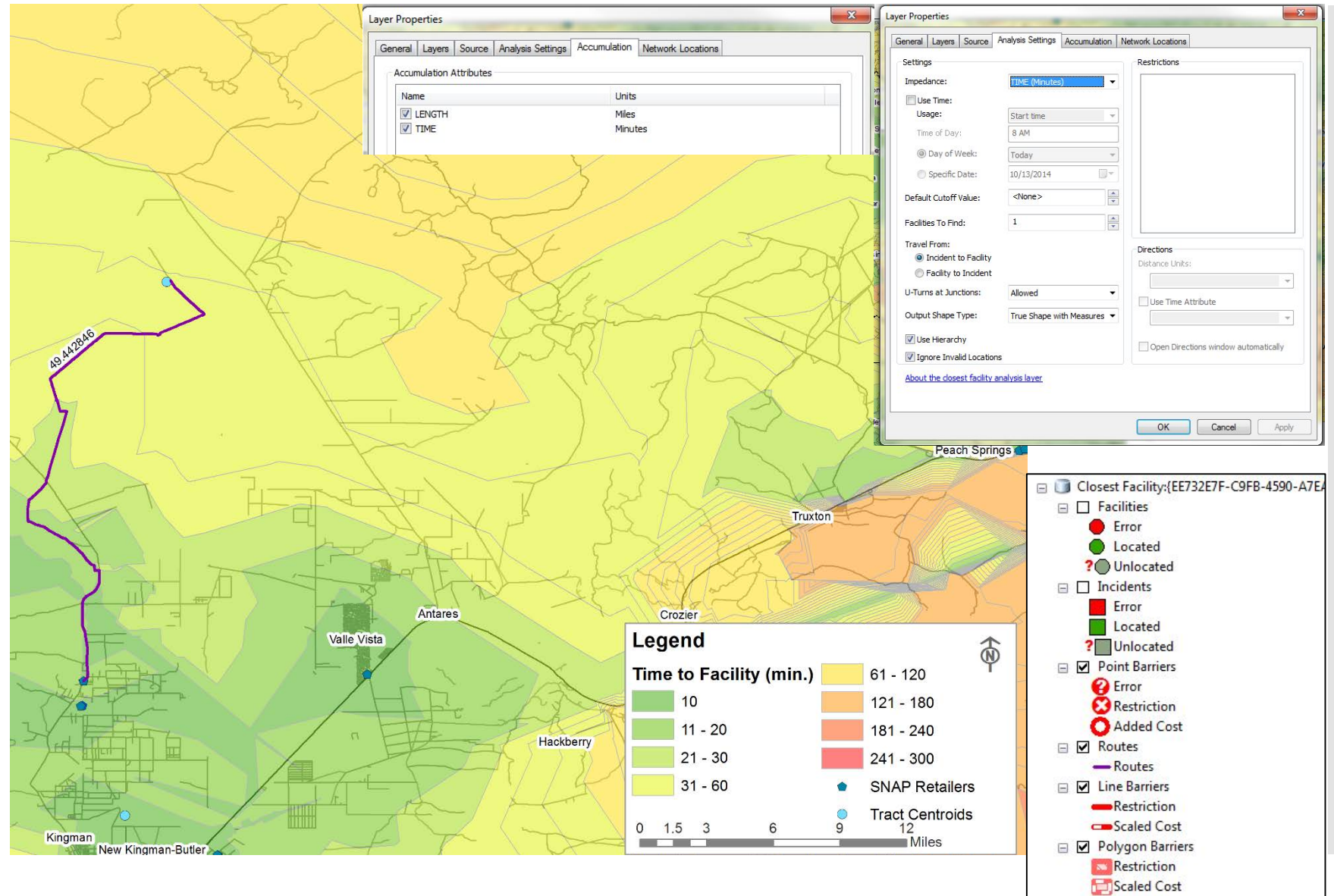
Service Areas in Network Analyst

# Closest Facility Analysis in Network Analyst

Closest Facility Analysis in Network Analyst

# Arizona's Rural Typology

We used K-Means Clustering and Principal Components Analysis to generate a typology for Arizona's rural areas based on the variables we selected.



**Legend**

- Hispanic/Latino Immigrant
- Historically Mormon/New Suburbs
- Military
- Mining, Ag, Forestry
- Mixed Migrant
- Outlier-underpopulated
- Small Town Folk
- Snowbirds and Retirees
- Tribal
- Tribal- Underdeveloped
- Wealthy Suburbs
- Not Incuded

0 10 20 40 60 80 Miles

Frances
**McClelland Institute**
Children, Youth, and Families
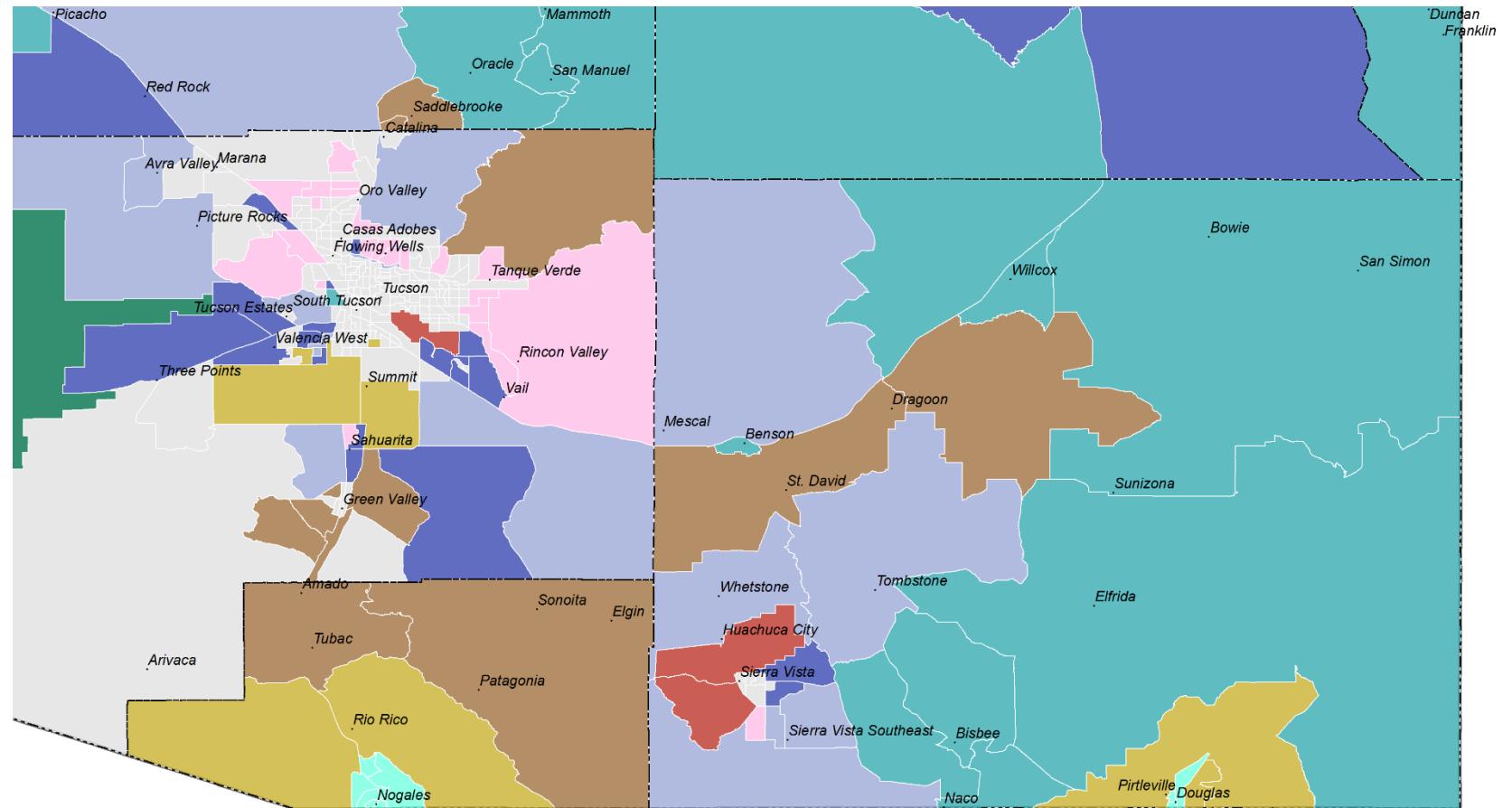
# Arizona's Rural Typology

| CLUSTER | KEY CHARACTERISTICS |
|---|---|
| HISPANIC/LATINO IMMIGRANT (17) | Majority HL(94%); high linguistic isolation (33%), noncitizen (25%) , and FB (23% pre-1990, 9% post-2000); high population density (2,752); high renter (38%), low mobility (7%), lowest educational attainment (47%), high poverty (31%) |
| HISTORICALLY MORMON/NEW SUBURB (105) | High median household income ($61K), high labor-force participation (68%), recent move-in (2005), new houses (1997), majority white (59%), |
| MILITARY (9) | Very young (22), high armed forces (58%), high civilian government employment (48%), high mobility (40%), nearly all renter (98%) |
| MINING, AG, FORESTRY (48) | High MAF employment (15%), oldest houses (1972), high renter (36%), high GED (6%), low long commute (4.5%) |
| MIXED MIGRANT (31) | High HL(58%), high linguistic isolation (11%), high noncitizen (15%), high MAF employment (7%), high mobility (17%), low educational attainment (35.2%), highest GED (9%), high poverty (28%) |

Frances
McClelland Institute
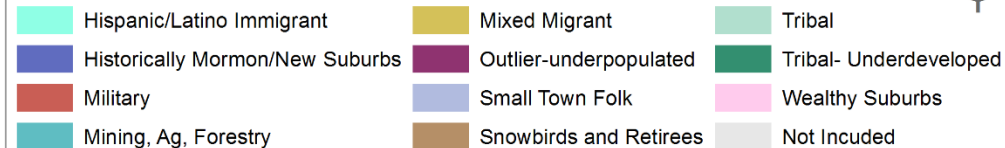Children, Youth, and Families

# Arizona's Rural Typology

| CLUSTER | KEY CHARACTERISTICS |
|---|---|
| SMALL TOWN FOLK (88) | Majority white (80%), older population (47), high EAF employment (15%), low long commute (6%) |
| SNOWBIRDS AND RETIREES (58) | Oldest population (59), majority white (84%), high veteran (21%), high home-ownership (84%), high median home values ($214K), highest self-employment (19%), low LFP (39%), low population density (196), high seasonal vacancy (30%) |
| TRIBAL (34) | Majority non-HL, non-white (94%), high poverty (40%), high linguistic isolation (14%), high government employment (52%), low median home values ($72K) and household income ($30K), early move-in (1998), high long commute (14%) |
| TRIBAL UNDERDEVELOPED (9) | Same as tribal, but with highest number of housing with no phone service (31.5%), no vehicles (18%), and vacant housing (29%) and lowest population density (21.8) and LFP (37%) |
| WEALTHY SUBURB (69) | Highest median household income ($96K), highest median home value ($410K), majority white (81%), highest home-ownership (86%) |

# Arizona's Rural Typology

We used K-Means Clustering and Principal Components Analysis to generate a typology for Arizona's rural areas based on the variables we selected.



**Legend**

- Hispanic/Latino Immigrant
- Historically Mormon/New Suburbs
- Military
- Mining, Ag, Forestry
- Mixed Migrant
- Outlier-underpopulated
- Small Town Folk
- Snowbirds and Retirees
- Tribal
- Tribal- Underdeveloped
- Wealthy Suburbs
- Not Incuded

0  5  10  20  30  40
Miles

**Frances McClelland Institute**
Children, Youth, and Families

# Next Steps

- Do these clusters differentiate patterns of service utilization? How can they be refined?

- The RIDGE Center Grant:
  - Dasymetric Mapping and another round of clustering
  - Expected vs. Actual SNAP participation
  - Cascade modelling of relationship between typologies and SNAP participation, nutritional intake, and health outcomes

- Applications for other projects:
  - Cooperative Extension
  - First Things First (Early Childhood Programming)
  - Department of Health Services

Frances
McClelland Institute
Children, Youth, and Families

# Questions
# Comments
# & Input

**Contact:**
Michele Walsh, mwalsh@email.arizona.edu
Kara Haberstock Tanoue, kalynq@email.arizona.edu

Frances
McClelland Institute
Children, Youth, and Families

# References

Hastie, Tibshirani, and Friedman (2009). The Elements of Statistical Learning. New York: Spring New York Inc.

Scholz, J. and Herrmann, S. (2010). Rural Regions in Europe: A new typology showing the diversity of European rural regions. Retrieved from http://www.scoopproject.org.uk/1diversity-of-rural-areas-a-new-typology-for-rural-development-policy.aspx

Scurry, J. (1998). What is GIS? National Estuarine Resource Reserve, National Oceanic and Atmospheric Administration. Retrieved from http://nerrs.noaa.gov/doc/siteprofile/acebasin/html/gis_data/gisint2.htm

United States Census Bureau (2014). Urban and Rural Classification. Retrieved from http://www.census.gov/geo/reference/urban-rural.html

United States Department of Agriculture (2013). Rural Classifications. Retrieved from http://ers.usda.gov/topics/rural-economy-population/rural-classifications.aspx

United States General Accounting Office (1993). Rural Development: Profile of Rural Areas. Retrieved from http://archive.gao.gov/t2pbat6/149199.pdf

"Rural" Arizona: Median Household Income

Patagonia, AZ (classed FRONTIER)

Nogales, AZ (classed RURAL)

Legend

**Median Household Income**

- $8,958.00 - $33,246.00
- $33,246.01 - $43,309.00
- $43,309.01 - $55,174.00
- $55,174.01 - $73,563.00
- $73,563.01 - $179,306.00

Frances McClelland Institute
Children, Youth, and Families
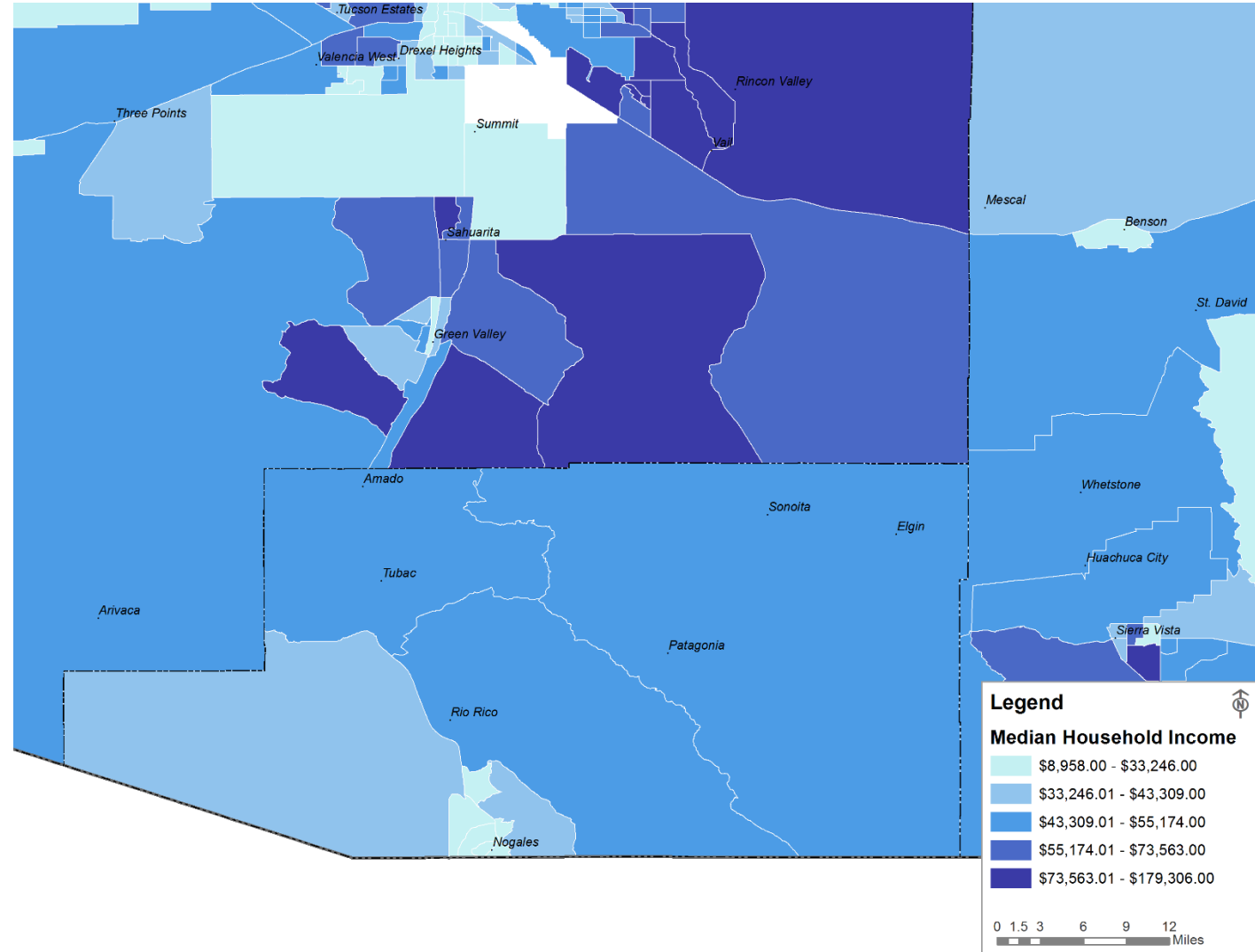
# "Rural" Arizona: Median Home Value

Patagonia, AZ (classed FRONTIER)
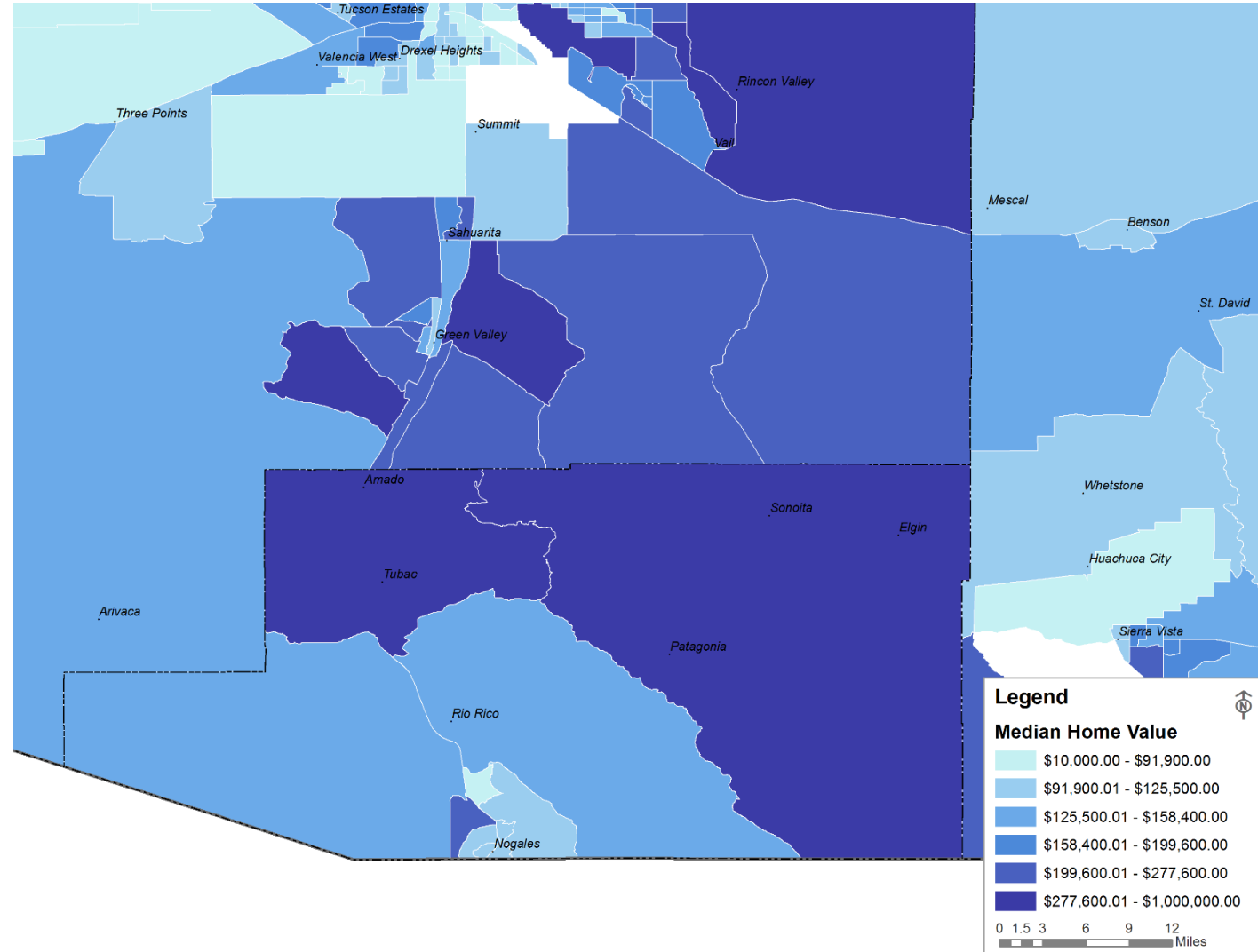
Nogales, AZ (classed RURAL)

**Legend**

**Median Home Value**

- $10,000.00 - $91,900.00
- $91,900.01 - $125,500.00
- $125,500.01 - $158,400.00
- $158,400.01 - $199,600.00
- $199,600.01 - $277,600.00
- $277,600.01 - $1,000,000.00

Frances McClelland Institute
Children, Youth, and Families
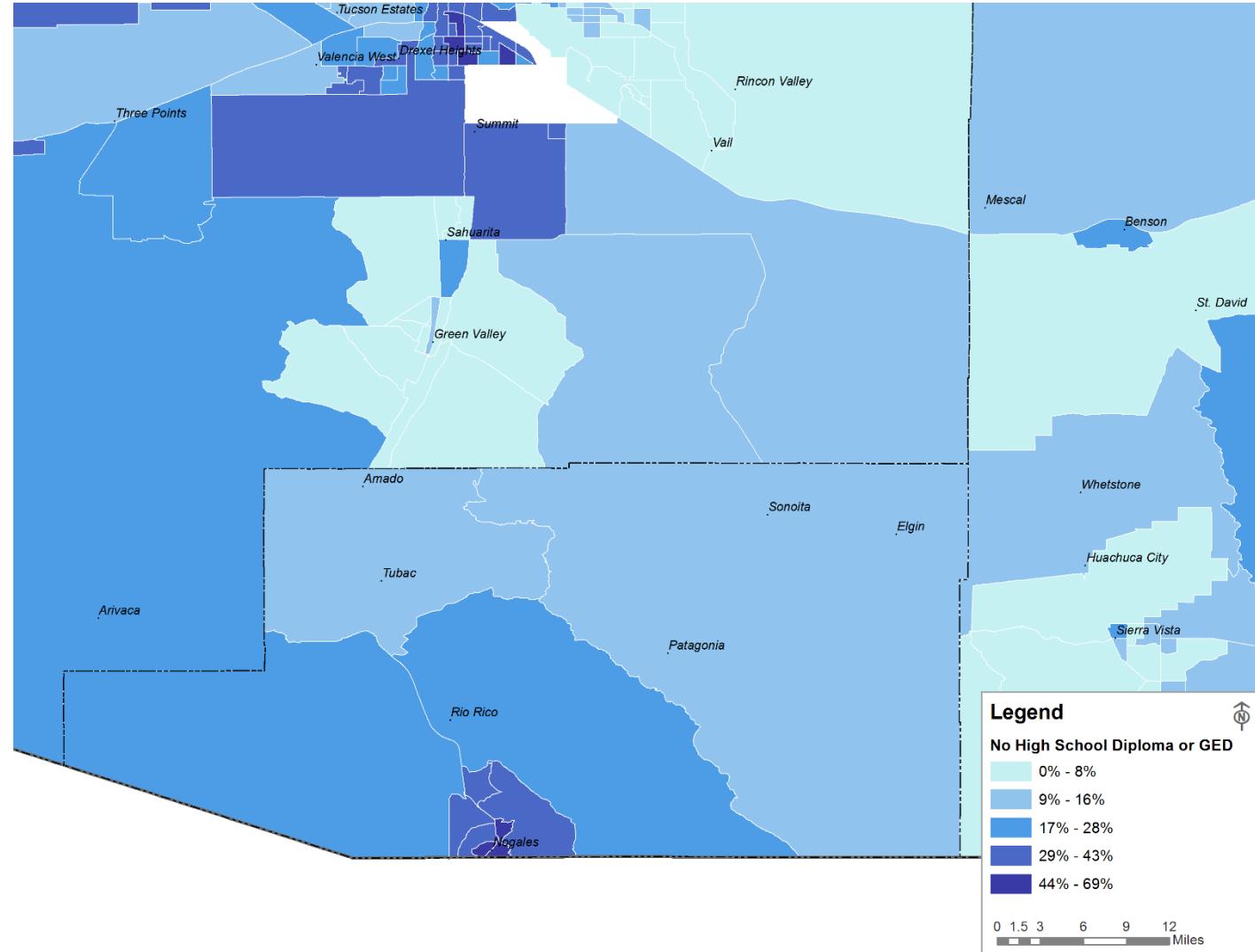
# Internet Access in Arizona

Map of advertised internet speeds available for both wireless and broadband service (excludes satellite internet)
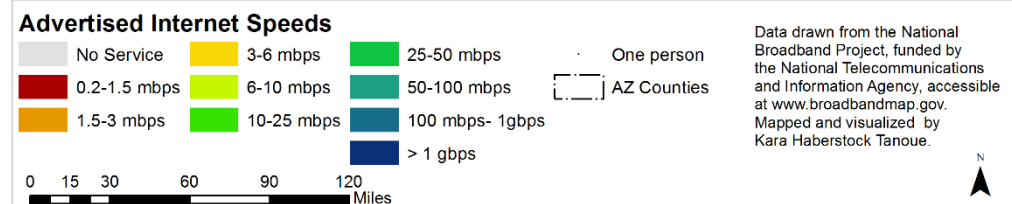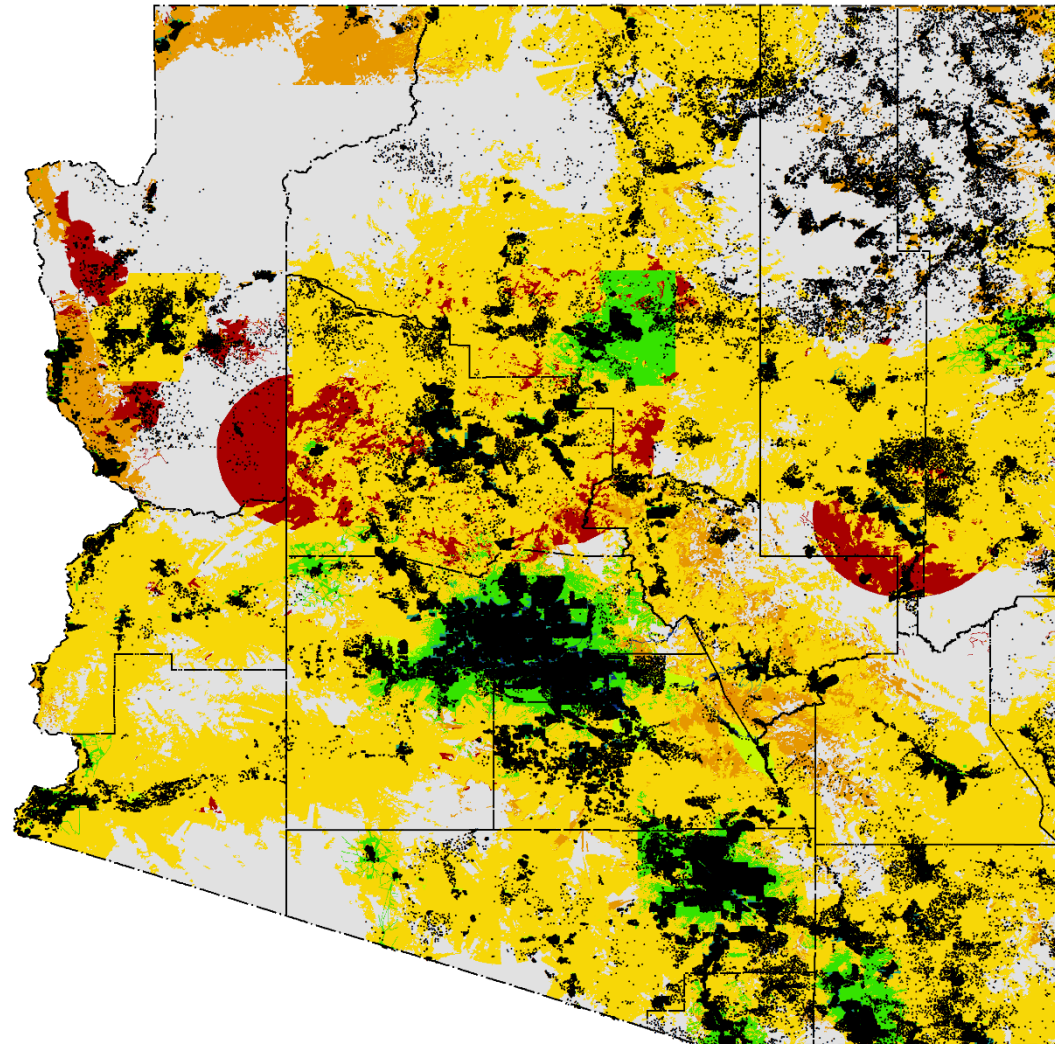
Much of the state of Arizona has very little infrastructure to support broadband or wireless internet at high speeds.

**Advertised Internet Speeds**

| | | | |
|---|---|---|---|
| No Service | 3-6 mbps | 25-50 mbps | · One person |
| 0.2-1.5 mbps | 6-10 mbps | 50-100 mbps | AZ Counties |
| 1.5-3 mbps | 10-25 mbps | 100 mbps- 1gbps | |
| | > 1 gbps | | |

Data drawn from the National Broadband Project, funded by the National Telecommunications and Information Agency, accessible at www.broadbandmap.gov. Mapped and visualized by Kara Haberstock Tanoue.

0  15  30   60    90    120
Miles

Frances
McClelland Institute
Children, Youth, and Families

# Rural Typologies and SNAP Utilization

## AVERAGE DRIVING TIME TO SNAP RETAILER (MIN.)

| Typology | Minutes |
|---|---|
| Tribal | 57.6 |
| Outlier-underpopulated | 50.0 |
| Tribal- Underdeveloped | 42.2 |
| Mining, Ag, Forestry | 37.3 |
| Small Town Folk | 21.5 |
| Retirees and Snowbirds | 19.8 |
| Hispanic/Latino Immigrant | 18.8 |
| Military | 18.0 |
| Mixed Migrant | 17.1 |
| Historically Mormon/New Suburbs | 16.3 |
| Wealthy Suburbs | 11.6 |
| Not Included (Urban) | 11.3 |

Frances
McClelland Institute
Children, Youth, and Families