

# Using GIS to Assess Areas of Most Need

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Penn State MGIS Student

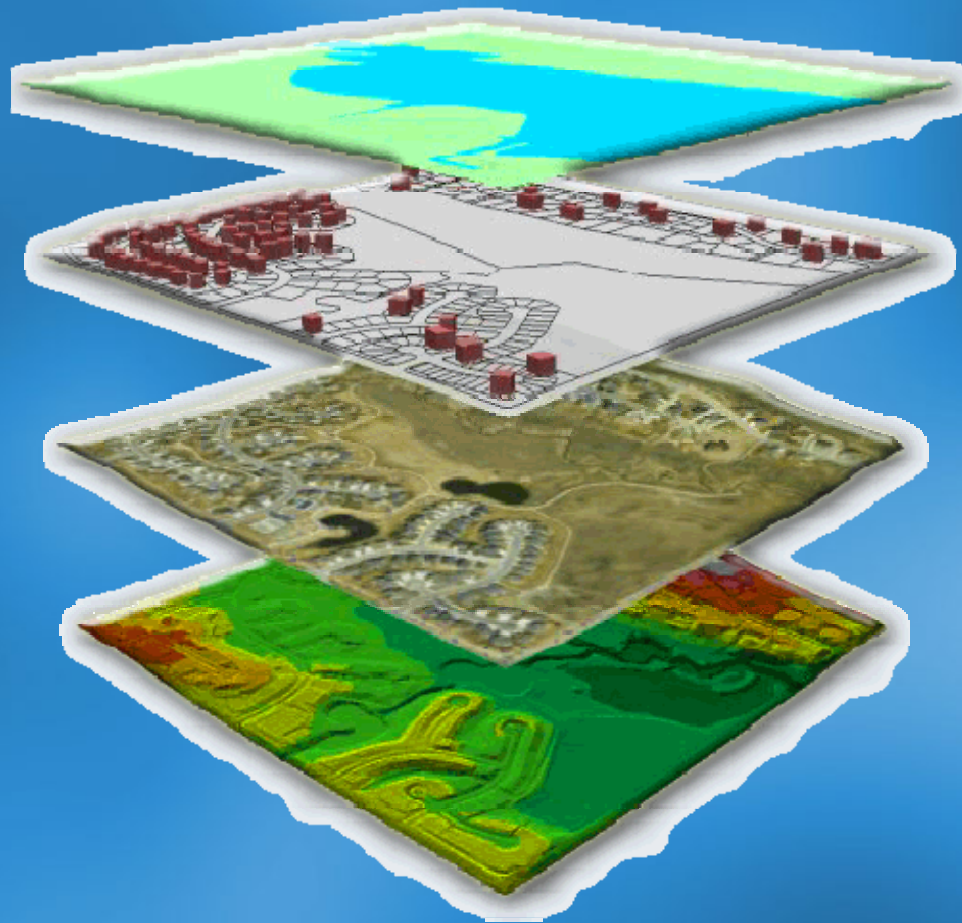
If you are going to work in a community or a country how do you decide where to start?



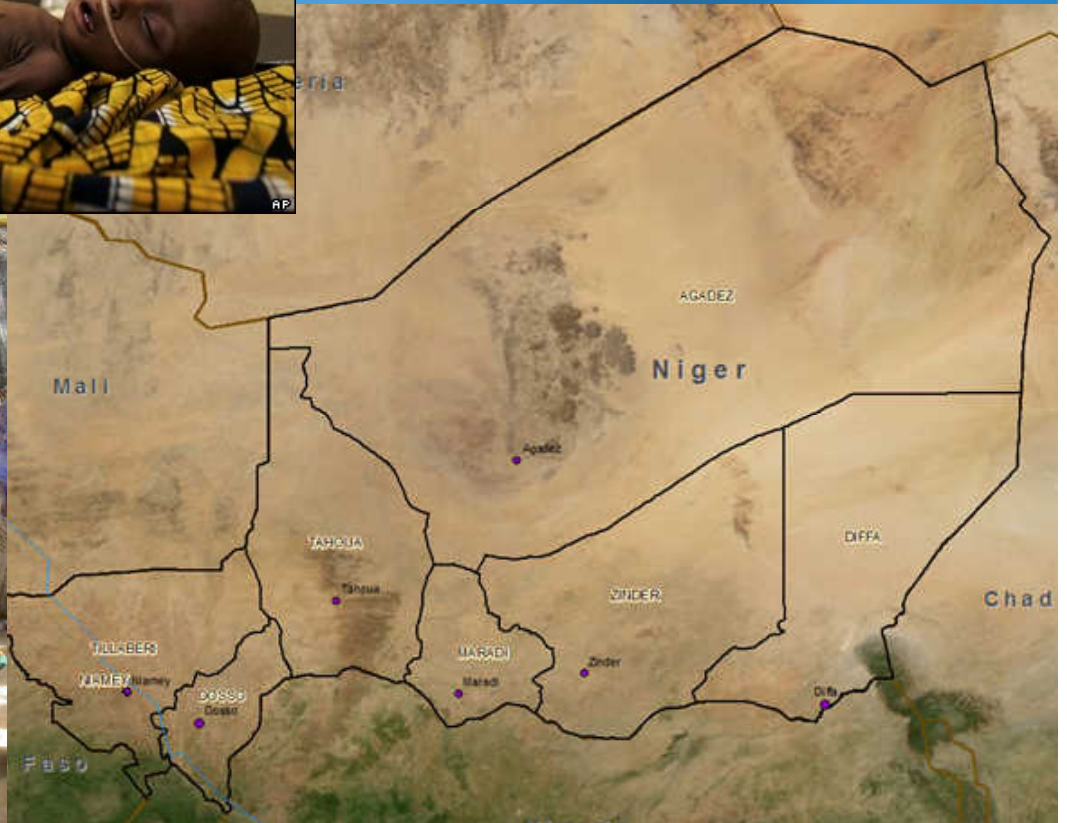
# Expensive surveys, best guess method or work with contacts?



Use GIS to assess the areas of most need



# What area in Niger should a new child sponsorship program be started?



The NGO currently provides child development aid to over 1 million children in 26 countries



What areas of Denver County can most benefit from outreach programs?



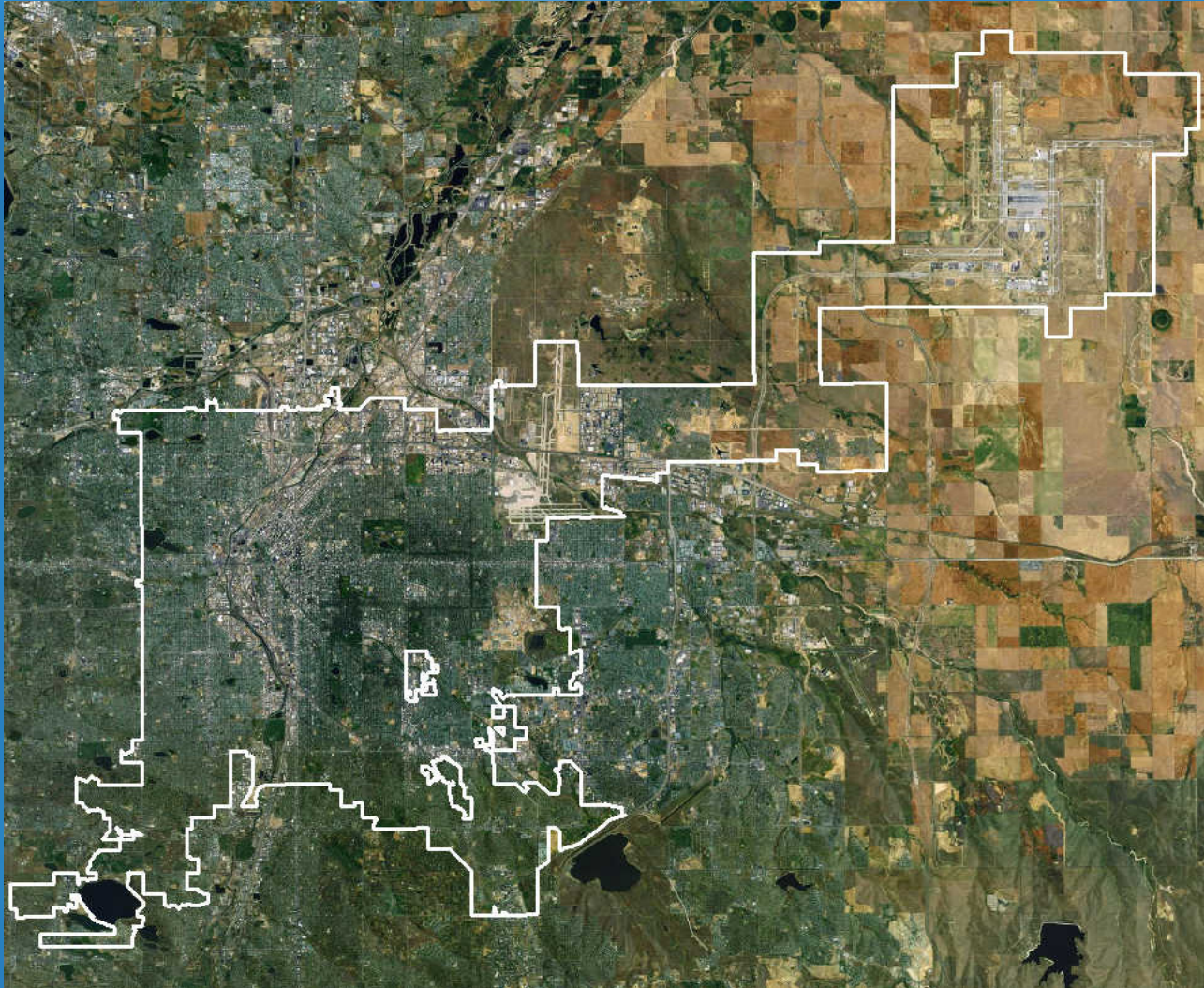
# Objectives

- Use GIS to analyze two disparate geographical regions: one in developing world and the other in a data rich region, to isolate the areas of most need for health or aid outreach.
- Use the results of the two analyses to compare the strengths of GIS and data availability in these two different study areas
- Compare the GIS approach to traditional survey or best guess approaches of traditional methodologies



# Denver County, Colorado

Located in a developed world where rich, accurate data is available for highly geographically localized areas



# Denver County Census Details

- Population of 610,345
- Land area of 153.35 square miles
- 82.7% white persons
- 10.2% black persons
- 7.1% American Indian, Asian or Pacific Islander
- 17.4% foreign born persons
- 78.9% high school graduates
- 34.5% have a bachelor's degree or higher
- 105,943 persons with disabilities
- 239,235 households
- 44.8% homeownership rate
- Median household income \$46,305
- 18% of the population is below poverty level

# Types of Need



## Desired Data

- Shelter locations
- HUD housing locations
- Church and other aid locations
- Single parent family census data
- Denver County parcel land value
- Food stamp recipient locations
- Crime hot spot analysis

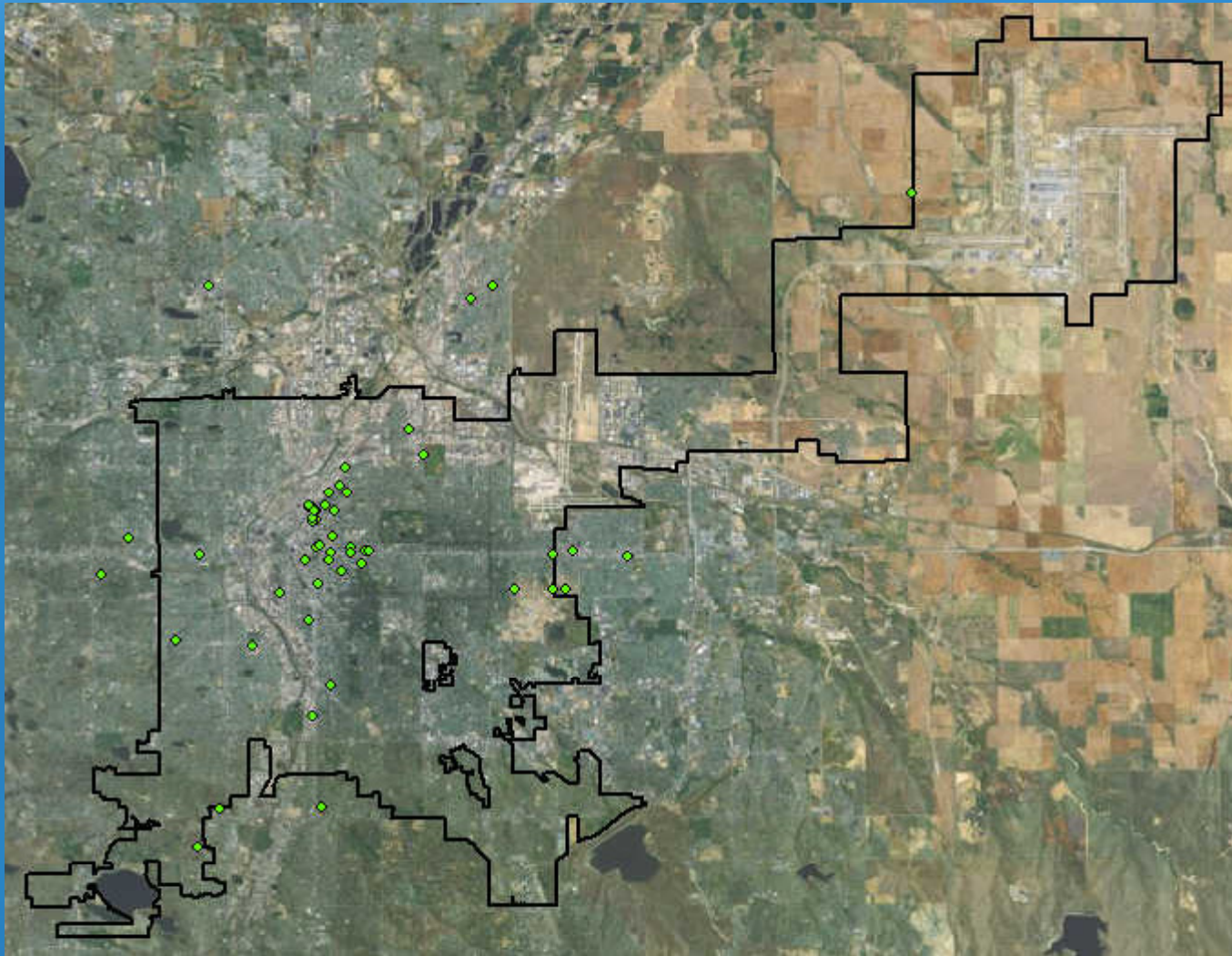
## Available Data

- Shelter locations
- HUD housing locations
- Church and other aid locations
- Single parent family census data
- Denver County parcel land value
- Crime reported by 78 neighborhoods

# The basic steps to the Denver analysis

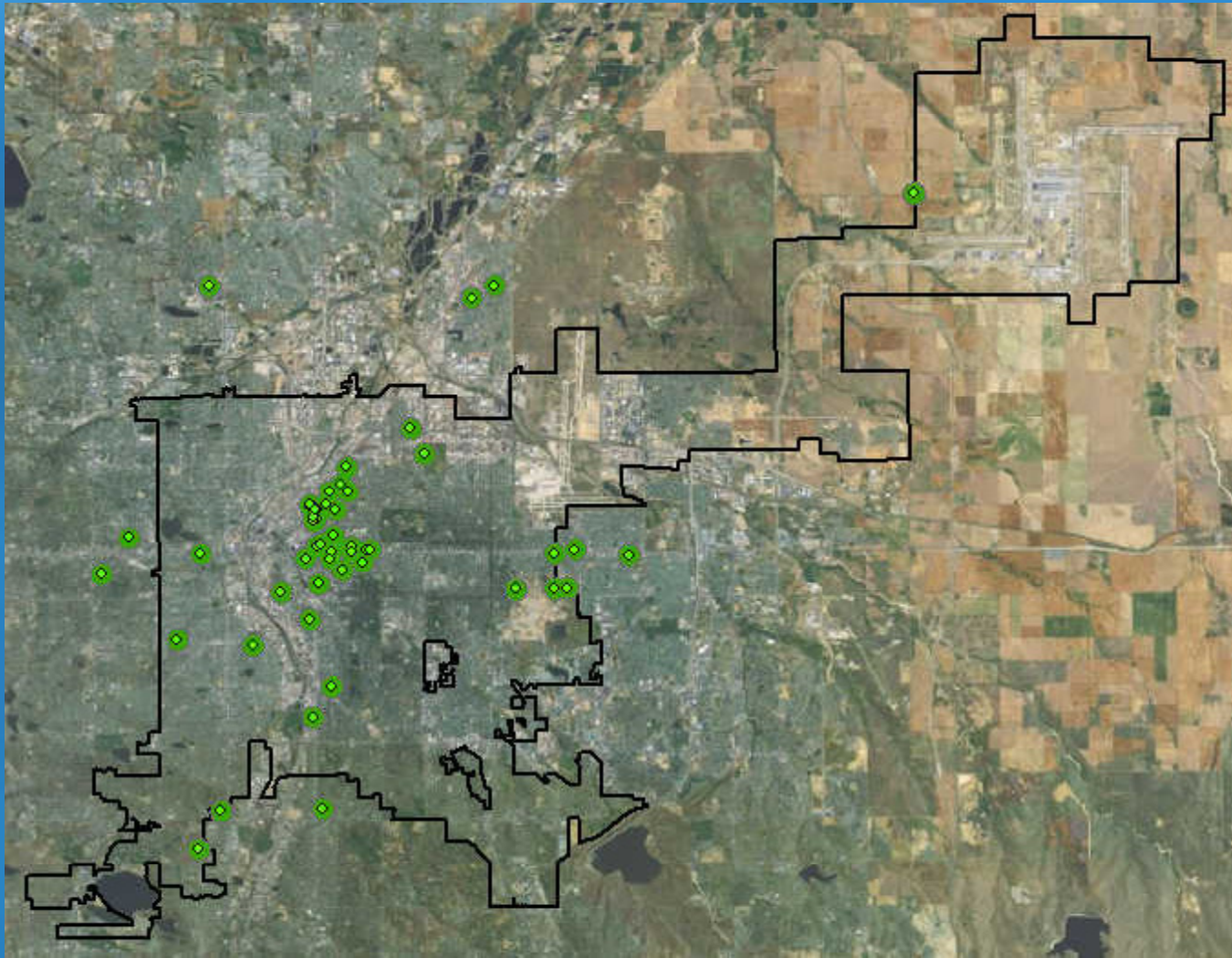
1. Buffer point data to represent the area of influence the location has
2. Clip buffer polygons to study area and merge study area polygon
3. Calculate the numbers of single parent households from 2000 Census data
4. Calculate land values for parcels and delete any non-residential parcels from the study
5. Create a spreadsheet from the crime report PDFs and join with the neighborhood shapefile
6. Symbolize polygon data into classes based on need level
7. Convert vector layers into raster layers
8. Reclassify raster layers into the classes used in step 7 above and assigned a need value
9. Calculate the areas of greatest need using the Raster Calculator and all available data layers
10. Convert the calculation into a feature class to facilitate rich symbolization to easily highlight the areas of greatest need

# Shelter Point Locations

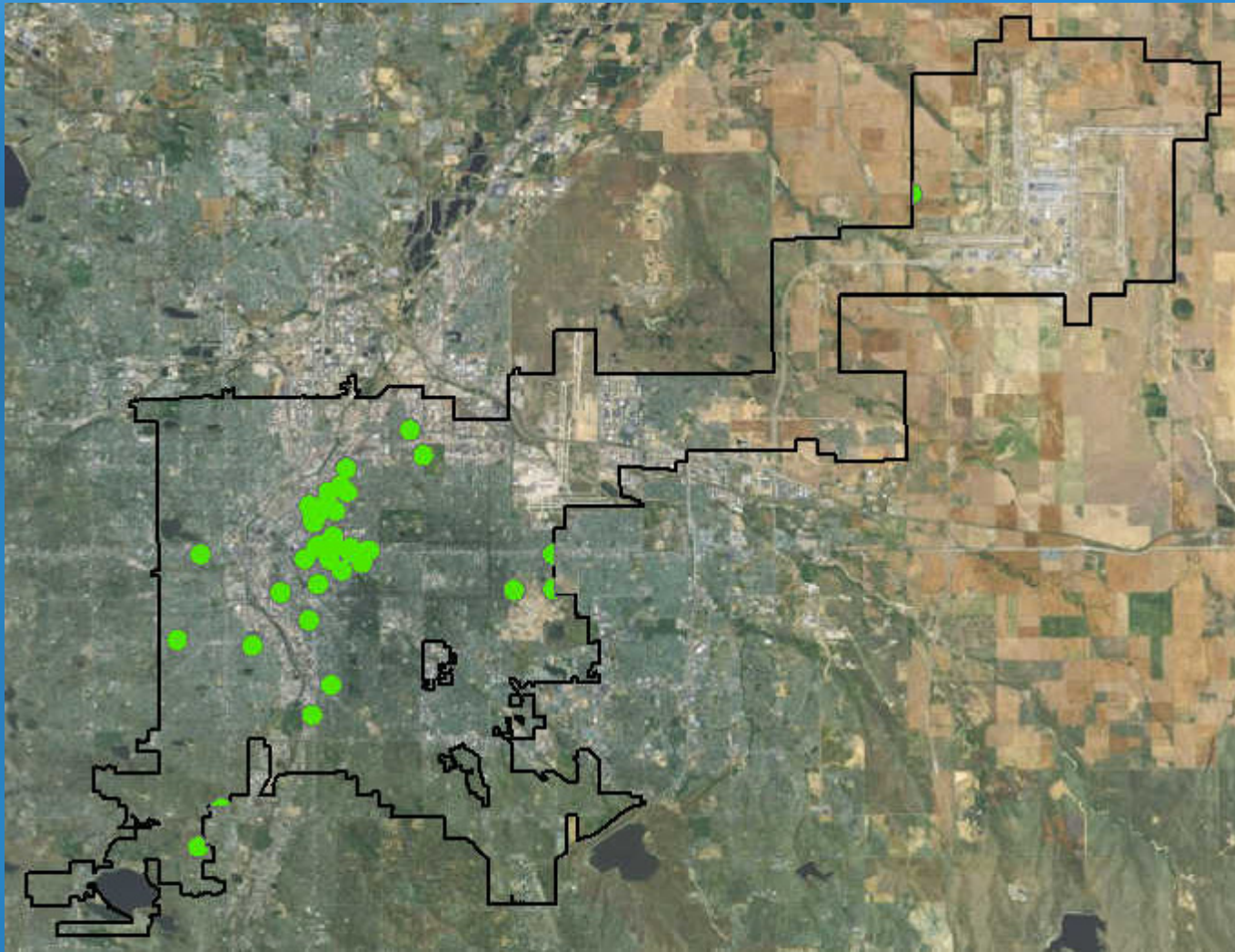


Data obtained from Google, Yellowpages.com and Reference USA

# Shelter Buffers

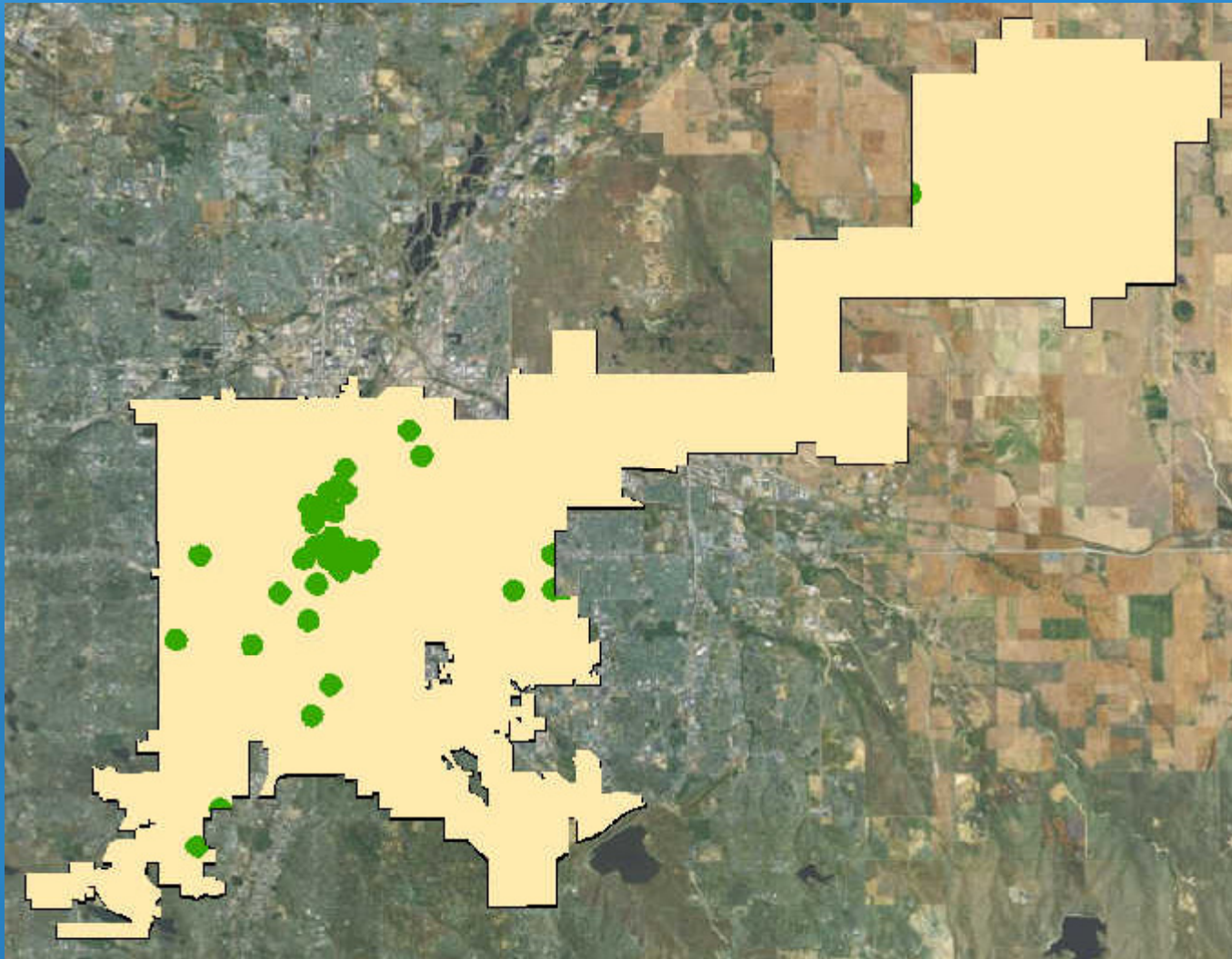


# Shelter Clipped Buffers

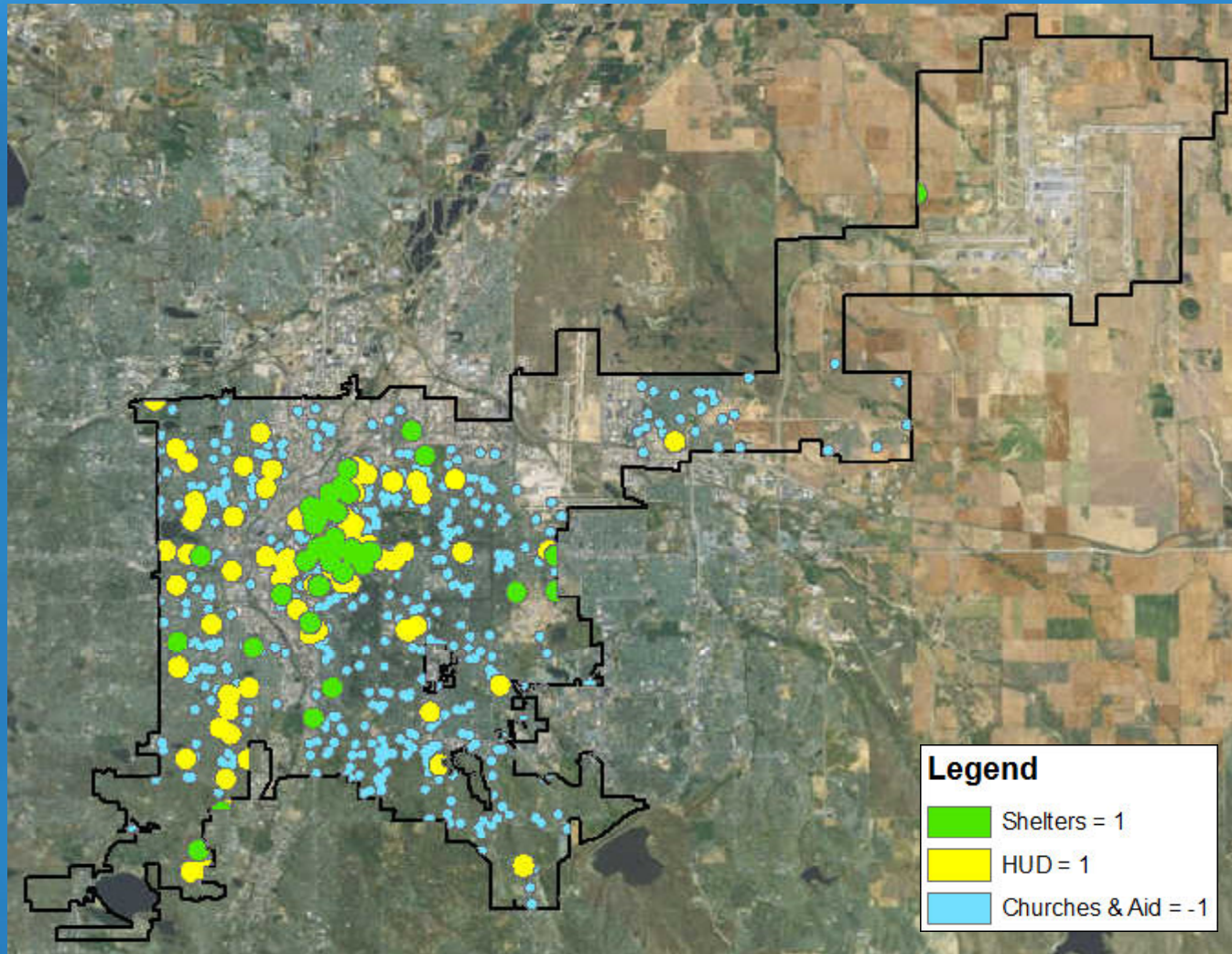




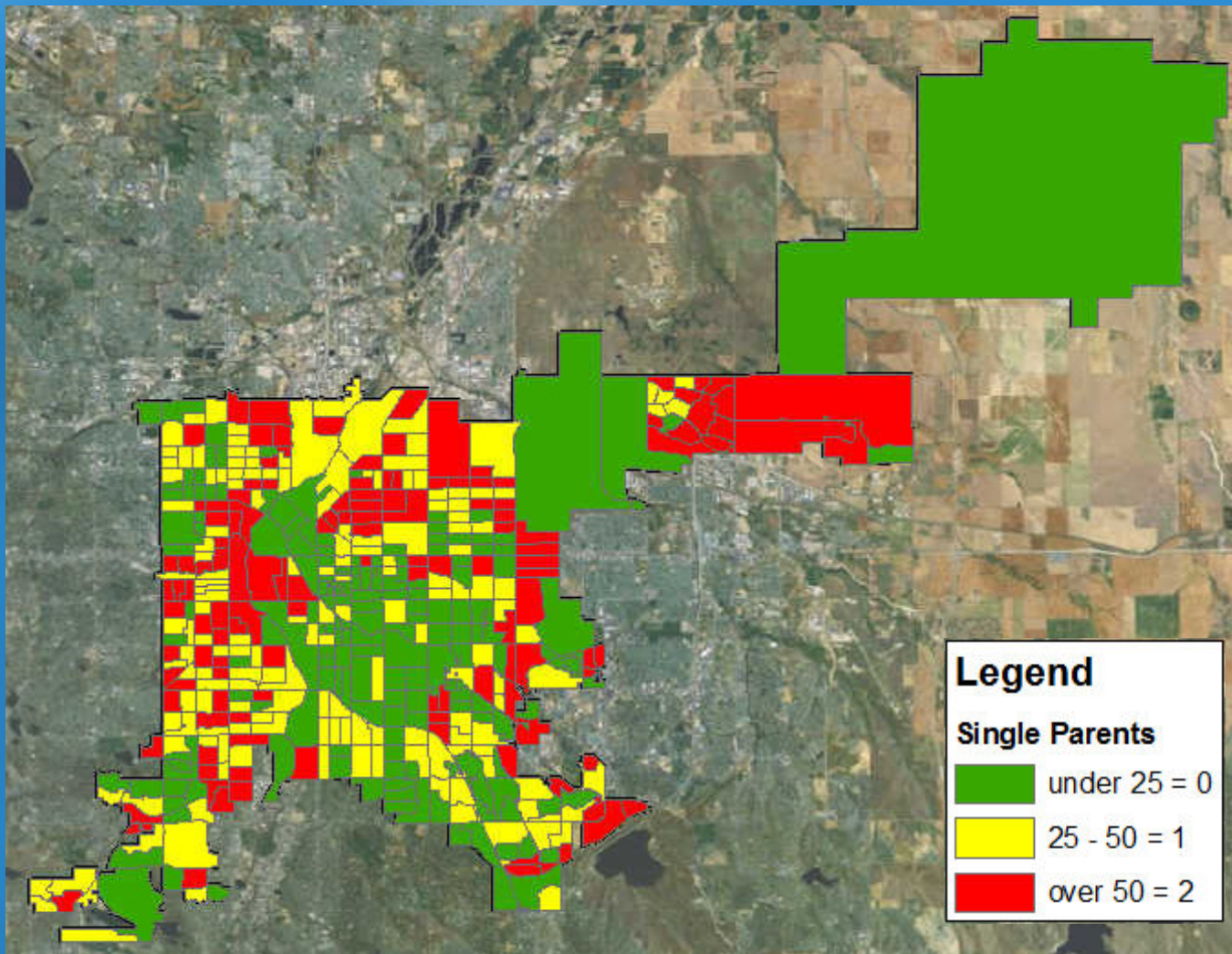
# Shelter data for the study area



# Shelter, HUD, Church & Aid Data

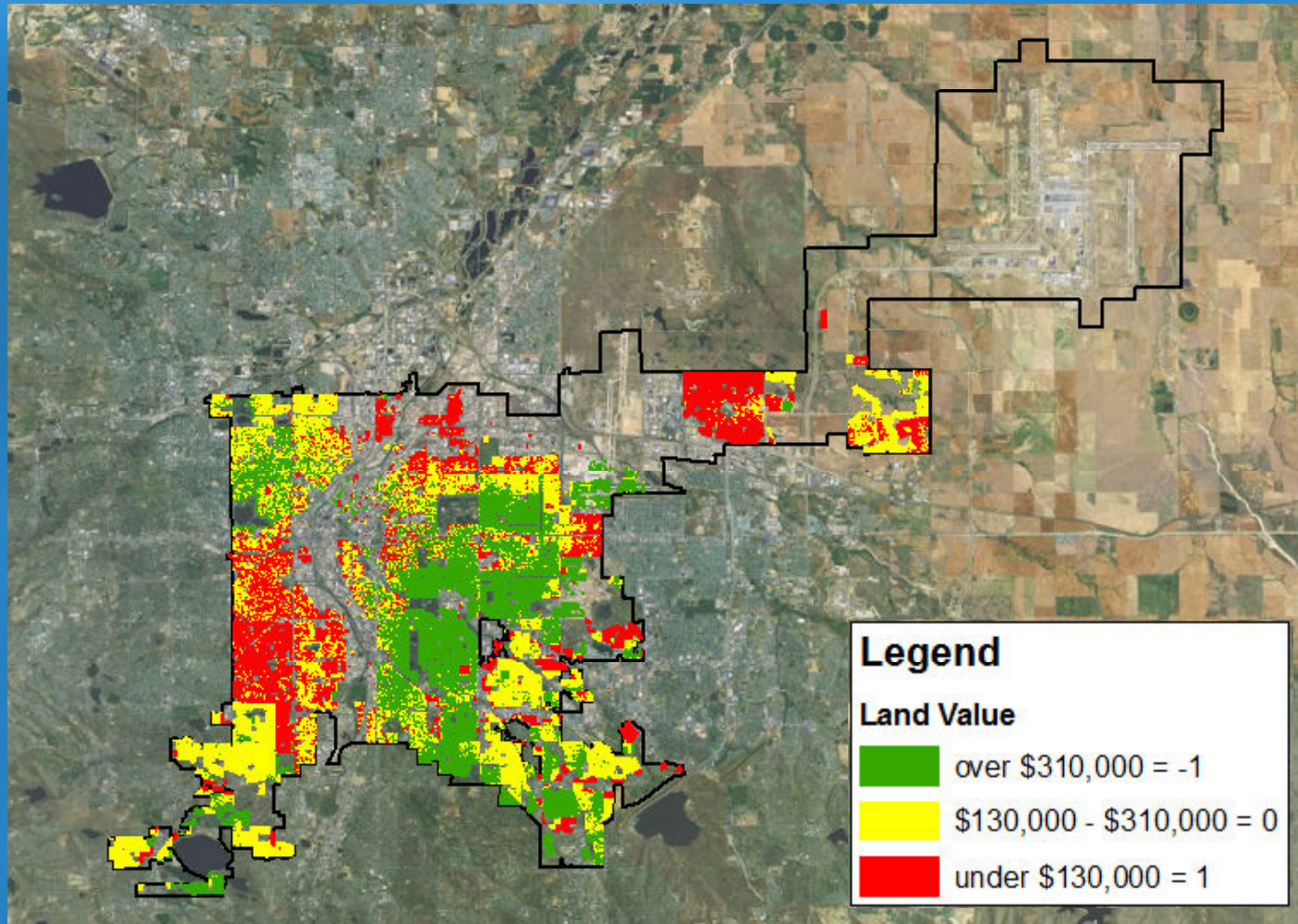


# Single Parent Households



Data obtained from the U.S. Census Bureau's 2000 census

# Residential Land Value by Housing Unit

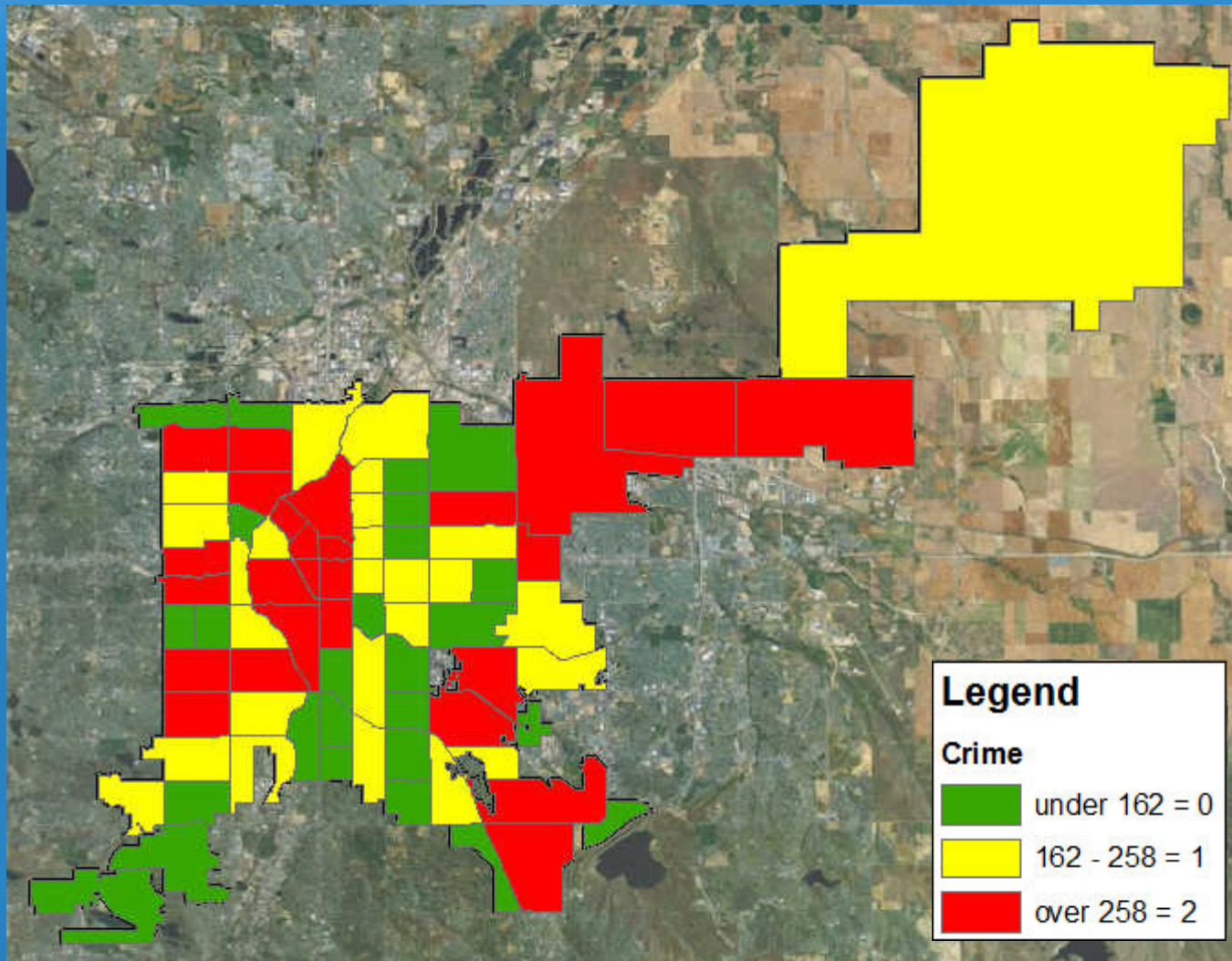


Data obtained from Denver County GIS department

# Crime Report Data

Offense Category	Type of Offenses
Crimes against persons	murder, assault, sex offenses, kidnapping & intimidation
Crimes against property	arson, bribery, burglary, forgery, damaged property, embezzlement, extortion, fraud, motor vehicle theft & robbery
Crimes against society	drugs, gambling, child pornography, prostitution & weapon violations
All other offenses	curfew, disorderly conduct, drunkenness, violation of restraining order, harassment, trespassing & all other offenses
Total crimes	all above crimes

# Crime Neighborhoods



# Classifications of data layers

Data	Classification	Description of need level
Shelters	0 & 1	0 = no data area 1 = point buffer area
HUD	0 & 1	0 = no data area 1 = point buffer area
Churches & Aid	-1 & 0	0 = no data area -1 = point buffer area
Single Parent Family	0, 1 & 2	0 = under 25, 1 = 25-50 & 2 = over 50 single families per block group
Land Value	-1, 0 & 1	-1 = over \$310,000, 0 = \$130,000 to \$310,000 & 1 = under \$130,000
Crime Report	0, 1 & 2	0 = under 162, 1 = 162-258 & 2 = over 258 total crimes per neighborhood

Single Parent Family and Crime Report data was classified using the quantile method.

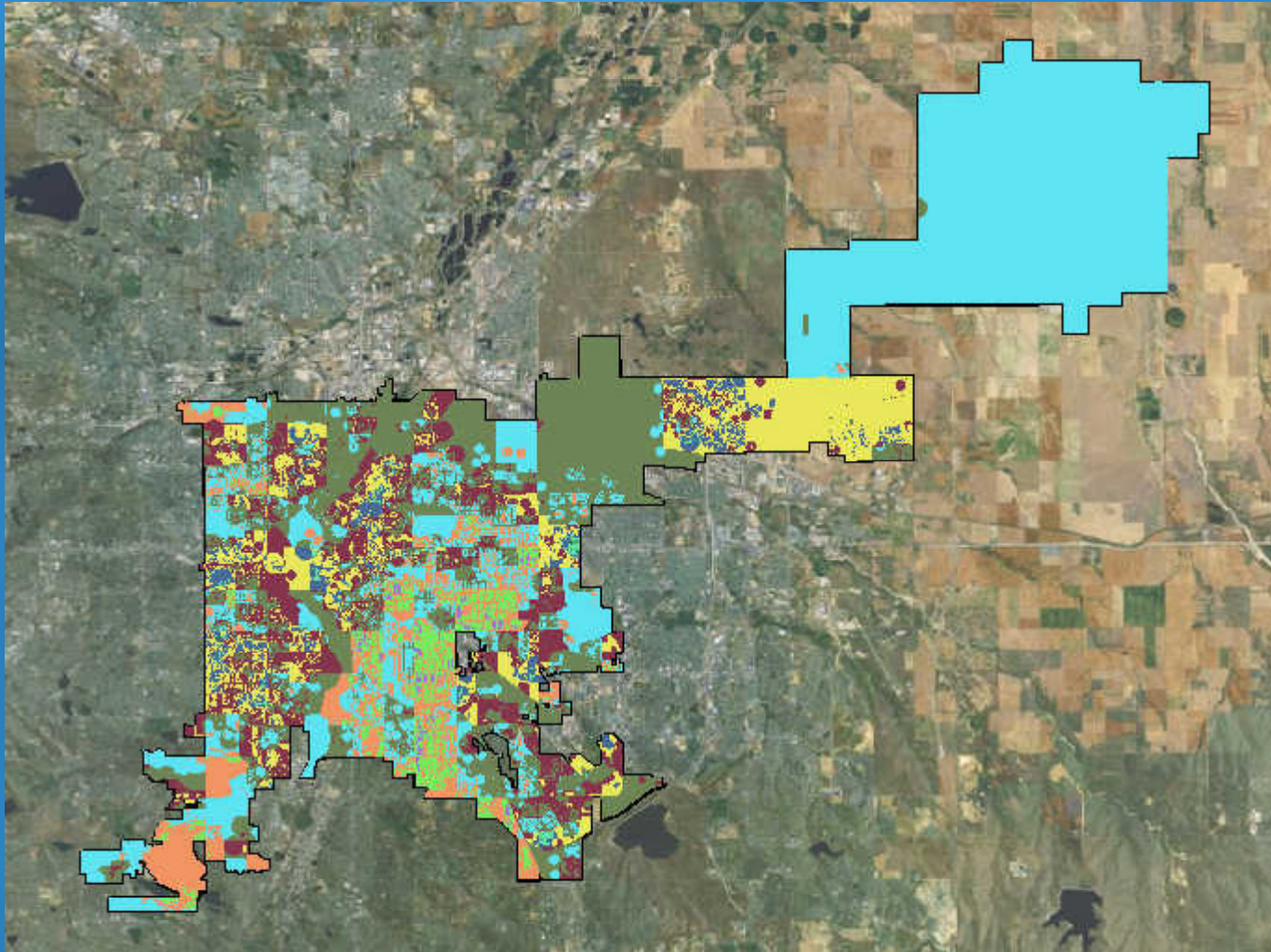
The Land Value was classified by calculating the lower and upper quartile values then rounding to the nearest \$10,000.

# Convert, Reclassify and Calculate

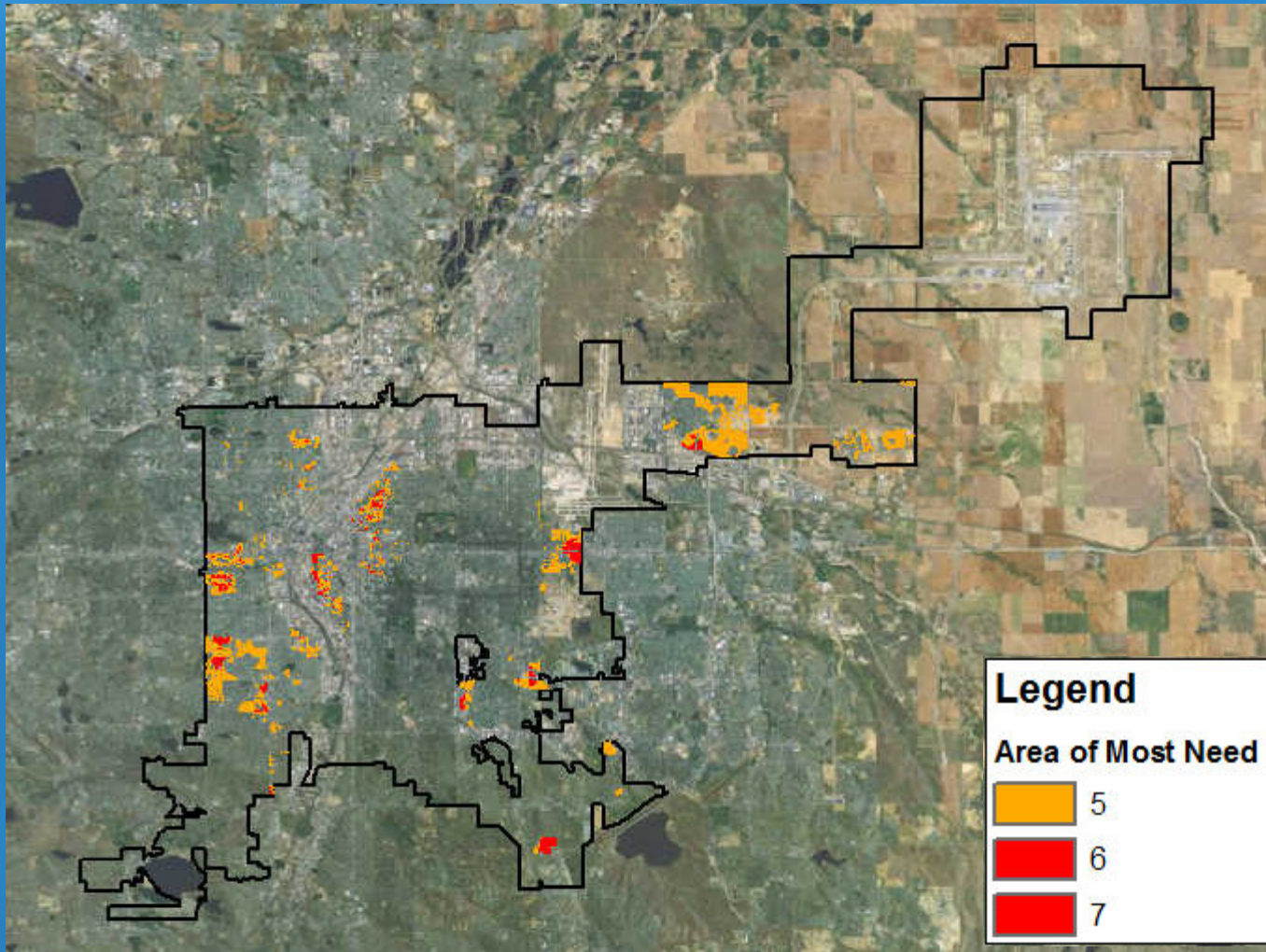
- Vectors were converted to raster layers
- Rasters were reclassified according to need level
- The areas of greatest need were calculated using the Raster Calculator addition function
- The calculation was converted to a feature class and symbolized



# Calculated Need



# Areas of Most Need



The areas in red are the two highest need levels, 6 & 7. The areas in orange are in the third highest need level, 5.



# Niger, Africa

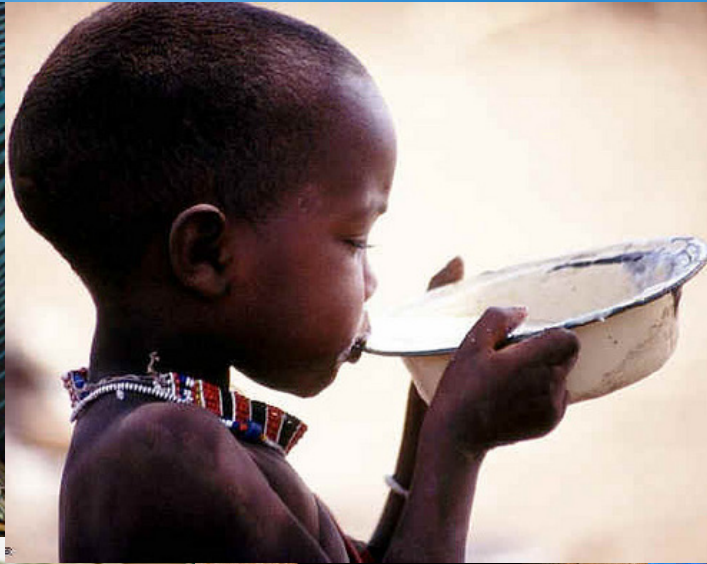
Located in the developing world where accurate data on a sub-country level is impossible, difficult, or costly to obtain



# Niger Country Profile

- Population 15.3 million
- Land area of 489,000 square miles
- Languages – French, Arabic, Hausa & Songhai
- Religions – Islam, indigenous beliefs
- Lowest country on the Human Development Index in 2009
- 60% of the population lives on less than \$1 a day
- Fertility rate of 7.1% - the highest in the region
- 82% of population involved in sustenance farming
- Extended drought are common

# Types of Need





## Desired Data

- HIV/AIDS by age and sex
- Orphan-hood
- Access to safe water
- Health facility locations

## Available Data

- Women 15-19 who know how to prevent HIV transmission
- Children 0-14 years with one or both parents deceased
- Access to safe water
- Access to sanitation
- Access to health care within 5km



## Desired Data

- Adult literacy rate
- Food security
- Population below the poverty line
- Human development Index
- Gross domestic product
- NGO activity


## Available Data

- Adult literacy rate
- Food Insecurity Severity Scale
- Population below the poverty line


# The basic steps to the Niger analysis

1. Translate data into English
2. Convert all data into percent of the region's population
3. Note which datasets represent repetitive data and will be combined
4. Calculate a Z Score to standardize data and combine repetitive datasets
5. Convert vector layers into raster layers
6. Calculate the areas of greatest need using the Raster Calculator and all available data layers
7. Convert the calculation into a feature class to facilitate rich symbolization to easily highlight the areas of greatest need

# Statistical Reports



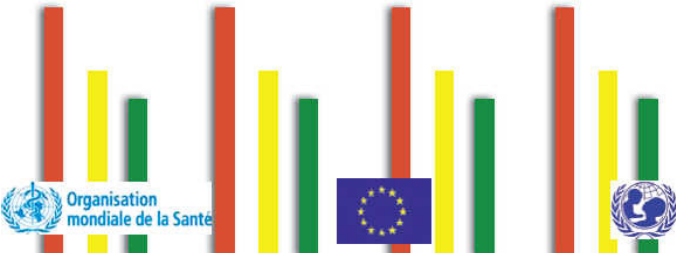
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DIRECTION DES STATISTIQUES, DE LA SURVEILLANCE ET DE LA RIPOSTE AUX ÉPIDÉMIES



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**ANNUAIRE DES  
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**ANNÉE 2008**



Organisation mondiale de la Santé

REPUBLIQUE DU NIGER



CABINET DU PREMIER MINISTRE  
SECRETARIAT PERMANENT DE LA SRP

*Stratégie de Réduction de la Pauvreté,  
Deuxième génération*

*Fraternité, Travail, Progrès*

**«La Lutte contre la Pauvreté, un Défi pour Tous»**

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**STRATEGIE DE  
DEVELOPPEMENT ACCELERE  
ET DE REDUCTION DE LA  
PAUVRETE**

**2008 – 2012**

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Octobre 2007

# Data Layers

- Childbirth Deaths and Birth Weight
- Malnutrition and Diarrhea
- Access to Safe Water and Sanitation
- School Attendance
- HIV Transmission Prevention
- Orphans
- Access to Health Care
- Literacy
- Food Insecurity
- Poverty

# Z – Score Denver

The Z - score was calculated as follows

$$Z = \frac{X - \mu}{\sigma}$$

x is a raw score to be standardized;  
μ is the mean of the population;  
σ is the standard deviation of the population.

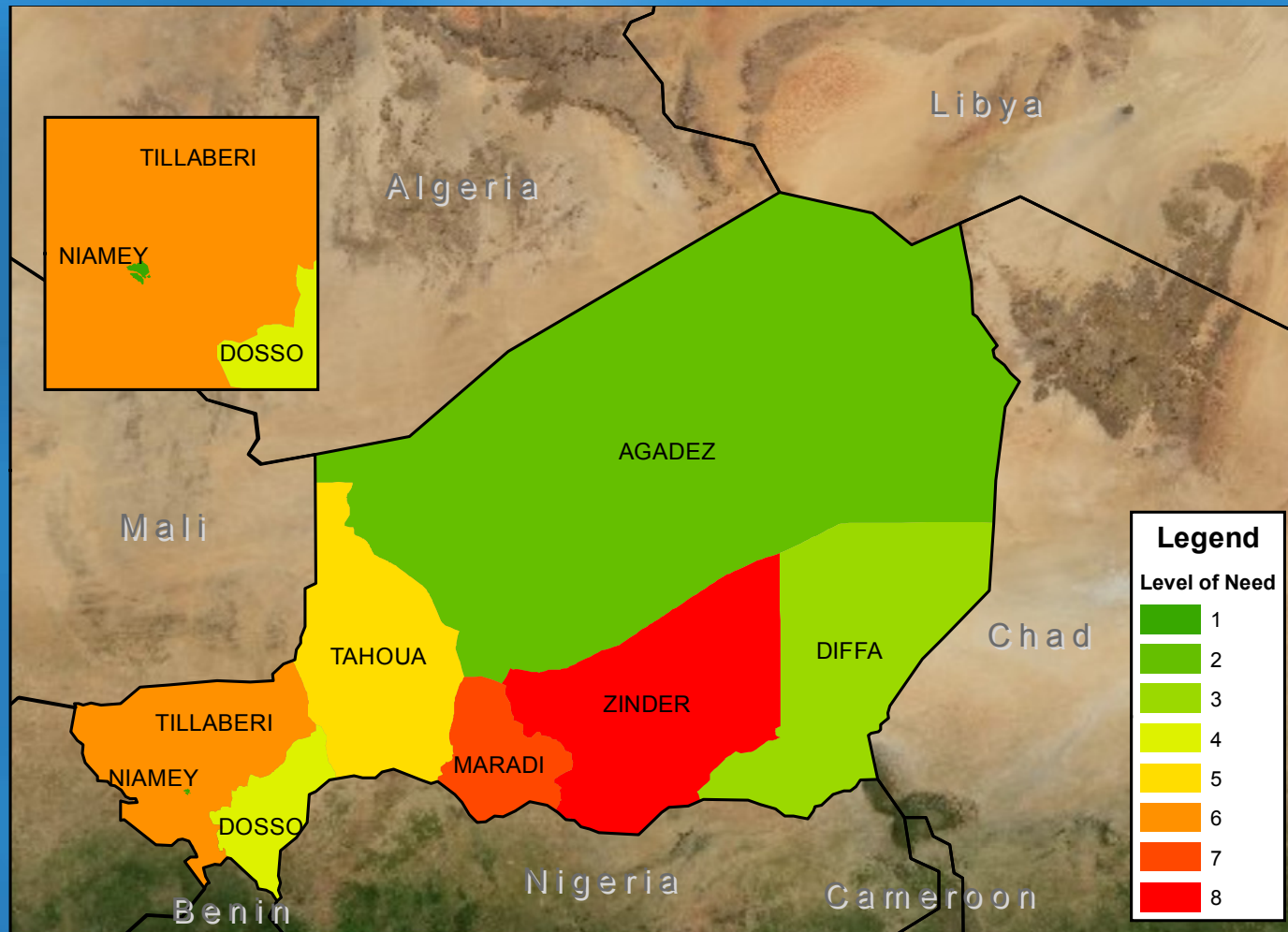
# Combined datasets and Z-scores

Region	Childbirth Death & Weight	Malnutrition & Diarrhea	School	HIV	Orphan	Water & Sanitation	Health Care	Literate	Food	Poverty
Agadez	1.32	-1.11	-1.42	-0.68	-0.42	-1.55	-0.56	-1.17	-0.20	0.58
Diffa	-1.09	0.40	-0.18	-0.47	-1.36	0.29	-0.21	-0.44	1.43	-1.82
Dosso	-0.57	0.05	0.36	-0.22	0.42	0.61	0.68	0.75	-1.02	0.33
Maradi	0.90	0.52	0.44	-0.77	-1.01	0.59	0.80	0.49	1.02	-0.70
Niamey	0.02	-0.67	-1.61	-1.23	1.36	-1.53	-1.82	-1.69	-1.43	-0.70
Tahoua	-0.91	0.92	1.01	1.15	1.25	0.48	-0.72	1.12	0.20	1.31
Tillaberi	0.53	-0.23	0.54	0.66	0.30	0.71	0.84	0.70	-0.61	0.67
Zinder	-0.20	0.09	0.85	1.56	-0.53	0.40	0.99	0.25	0.61	0.33

# Convert and Calculate

- Vectors were converted to raster layers
- The areas of greatest need were calculated using the Raster Calculator addition function
- The calculation was converted to a feature class and symbolized

# Calculated Need





# What are the strengths of these two analyses in relation to data availability?

	Denver	Niger
Accuracy of results	Good	Good
Quality of the analysis	Good data = high level of accuracy and spatial precision	Poor, generalized data = generalized overview highlighting areas that need further investigation
Quality of results	Allowed for key areas of need to be identified	Limited data can be used to indicate need but not quantify actual need
Outcome of analysis	Results will be used to target areas of need in Denver starting with areas categorized as 6 & 7	Results were general. However, they highlight the key Regions to focus on in Niger. Within these regions ground surveys will be conducted in the future.

# GIS in comparison to traditional survey methods

- Limited time and money need to be invested
- Can be used in any study area using any definition of need
- GIS analysis surpasses best guess approaches even in areas of poor data quality and availability
- Takes a more objective approach than conventional means

# Questions?

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Special thanks to Penn State  
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Dr. Justine Blanford

Slides available at [http://lesliezolman.com/Projects/Zolman\\_Oct2010.pd](http://lesliezolman.com/Projects/Zolman_Oct2010.pd)

# Picture and Graphic References

## Slide 2

<http://www.worldtimeserver.co/Cities/Chicago.aspx>  
[http://www.the-lebanon.com/lebanon\\_country/map/lebanon.jpg](http://www.the-lebanon.com/lebanon_country/map/lebanon.jpg)

## Slide 3

<http://www.phha.mlanet.org/blog/>  
<http://www.ezdiyelectricity.com/?p=550>  
<http://www.fotosearch.com/CSP361/k3615820/>

## Slide 4

<http://www.carolcodygis.com/>

## Slide 5

<http://www.life.com/image/53349828>  
[http://www.onemanonebikeonefight.com/About\\_Us.html](http://www.onemanonebikeonefight.com/About_Us.html)  
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## Slide 6

<http://www.compassion.com/>

## Slide 7

[http://www.bylandwaterandair.com/photos/aerial\\_photograph\\_downtown\\_denver.php](http://www.bylandwaterandair.com/photos/aerial_photograph_downtown_denver.php)

## Slide 11

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[http://acrosstheboard.blogspot.com/2007\\_11\\_11\\_archive.html](http://acrosstheboard.blogspot.com/2007_11_11_archive.html)  
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## Slide 31

<http://www.watrust.co.uk/health.html>  
[http://fieldnotes.unicefusa.org/2009/02/from\\_dc\\_to\\_niger\\_1.html](http://fieldnotes.unicefusa.org/2009/02/from_dc_to_niger_1.html)  
<http://caroschoice.blogspot.com/>  
[http://photo.net/photodb/photo?photo\\_id=4154523](http://photo.net/photodb/photo?photo_id=4154523)  
<http://forum.globaltimes.cn/forum/showthread.php?p=16630>