

# UTILIZATION OF WUDR FUNDS IN NORTH DAKOTA: MUNICIPAL WATER AND PER CAPITA COEFFICIENTS



Jack Norland, Christina Hargiss, Nikki Ellingson, Amy Gnoinsky,

Nikki Ellingson, Joe Cleys

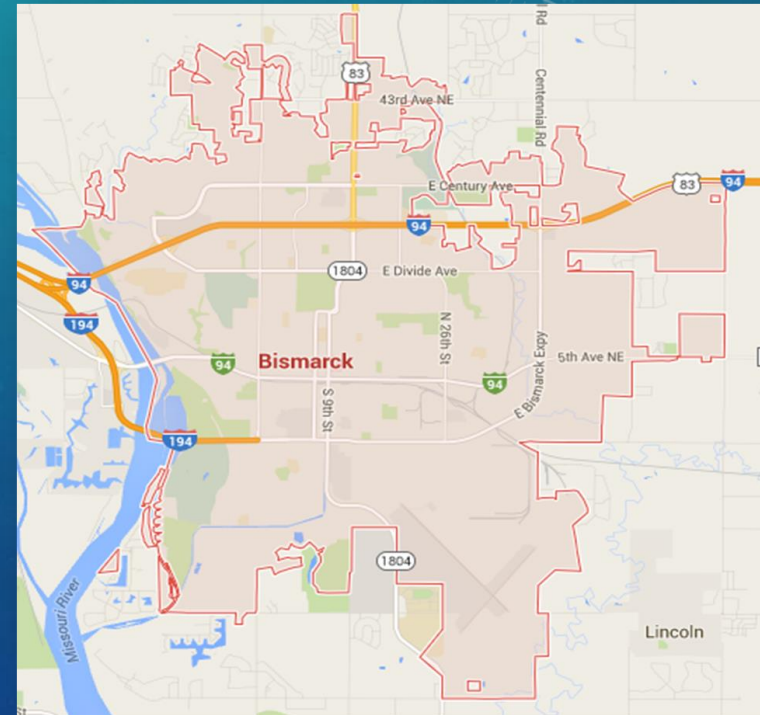
North Dakota State University

# Grants

- Project 1 – 2015-2016
  - Set priorities
  - Pilot project
- Project 2 – 2016-2018
  - Assessed cities across the state
  - Per capita coefficients
- Project 3 – 2018-2020
  - Assess pre-oil boom, boom, and post-boom municipal water use in Bakken Region (2000-2018)
  - Understand similarities and differences in municipal and industrial water use
- Project 4 – TBD based on results of project 3

# Initial Grant – 2015/2016

- Money to:
- Create work plan for USGS from ND State Water Commission/State Engineer
  - Current status of water use in ND
  - ND water use priorities and goals
- Pilot Project
  - Literature review of urban water use data
  - Urban water use profile of one municipality
    - Bismarck, ND
    - Approximately 22,000 billings for a 2 year period (2014, 2015)





# State Priorities – determined with NDSWC in Project 1

- 1. Determine how water use data is recorded and managed in municipalities across the state beyond yearly total reports to NDSWC
- 2. Estimation of public supply deliveries to customer groups or classes, such as commercial, industrial, and domestic
- 3. How much water does “normal commerce” require across categories?
- 4. Develop a better understanding of industrial water use and across the state
- 5. Determine how the oil industry and energy development impacted municipal water use?
- 6. Improvement of the domestic per capita coefficients

## Project 2: Gauging Categories of Municipal Water Use Spatially Across North Dakota in Different Size Municipalities near the Bakken Region

- Project 2: December 2016- November 2018
  - Assessed cities across the state
  - Per capita coefficients
  - Normal commerce across different size municipalities



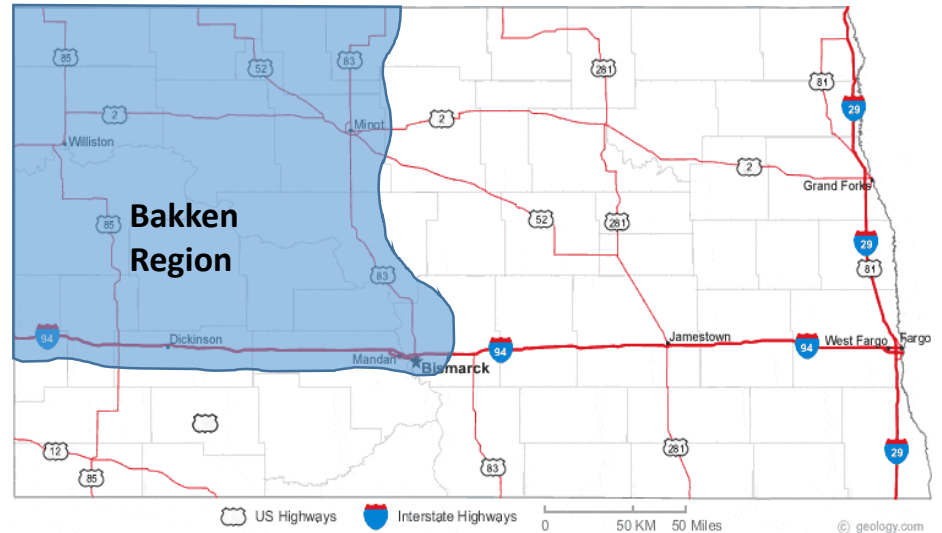


# Questionnaires

Addresses Objective #1: Determine how water-use data is collected, recorded, and stored

# Methods

- City selection
  - > 1,000 residents
  - 500 – 1,000 in Bakken region
- Groups
  - Size
    - Small: 500 – 5,000 residents
    - Medium: 5,000 – 10,000 residents
    - Large: > 10,000 residents
  - Location
    - Bakken vs. Non-Bakken



# Questionnaires

## Questionnaire #1

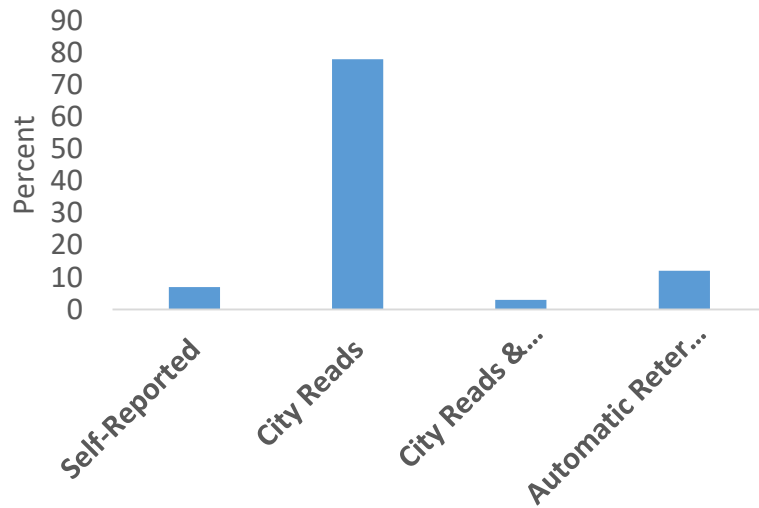
- Administered via phone
- Focused on:
  - Data storage
  - Data collection
  - Data recording
  - Department in charge
  - Public information?
- All 59 cities answers (100%)

## Questionnaire #2

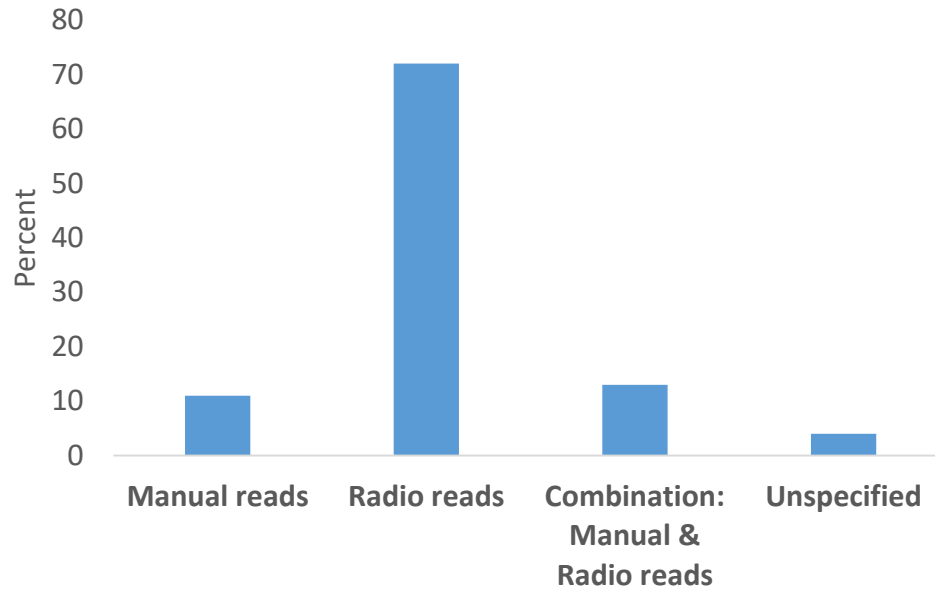
- Additional questions from USGS
- Administered via email and phone
- Focused on:
  - Buying/Selling
  - Water source
  - Water conservation
- 51 cities answered (86%)



# How are Readings Taken



# How are Readings Taken



# Storage of Data Records

- Paper records – 3% of cities
  - Small cities
- ND Century Code
  - Doesn't state length of time for water records
  - Range 4 – 7 years
- Not always accessible

| <b>Length of time data stored</b> | <b>All cities</b> |
|-----------------------------------|-------------------|
| < 5 years                         | 10%               |
| 5+ years (5-9)                    | 24%               |
| 10+ years (10-14)                 | 27%               |
| 15+ years (15-19)                 | 14%               |
| 20+ years (20-24)                 | 8%                |
| Follow ND Century Code            | 14%               |
| Lifespan of meter                 | 2%                |
| Unknown                           | 2%                |

# Storage of Data Records

- Storage location
  - City size
- Black Mountain & Banyon
  - 88% small

| <b>Software</b>               | <b>Number of Cities</b> |
|-------------------------------|-------------------------|
| Black Mountain                | 25                      |
| Banyon                        | 18                      |
| AS400                         | 2                       |
| Vanguard                      | 1                       |
| JHawk                         | 1                       |
| inhance                       | 1                       |
| UBMax                         | 1                       |
| Incode                        | 1                       |
| SCADA                         | 1                       |
| CIS New World (Fixed Network) | 1                       |
| CUBIC                         | 1                       |
| Great Plains Software         | 1                       |
| Excel                         | 1                       |
| EBill                         | 1                       |
| Unspecified                   | 1                       |

# Management Implications

- Data collection methods:
  - Radio reads most common
  - Self reported data more common in small cities
  - Automatic meters more common in medium and large cities
- Data storage location:
  - Small cities most likely use 1 of 2 software programs
  - Larger cities sometimes have software created specifically for the city
- Water conservation measures not common in North Dakota

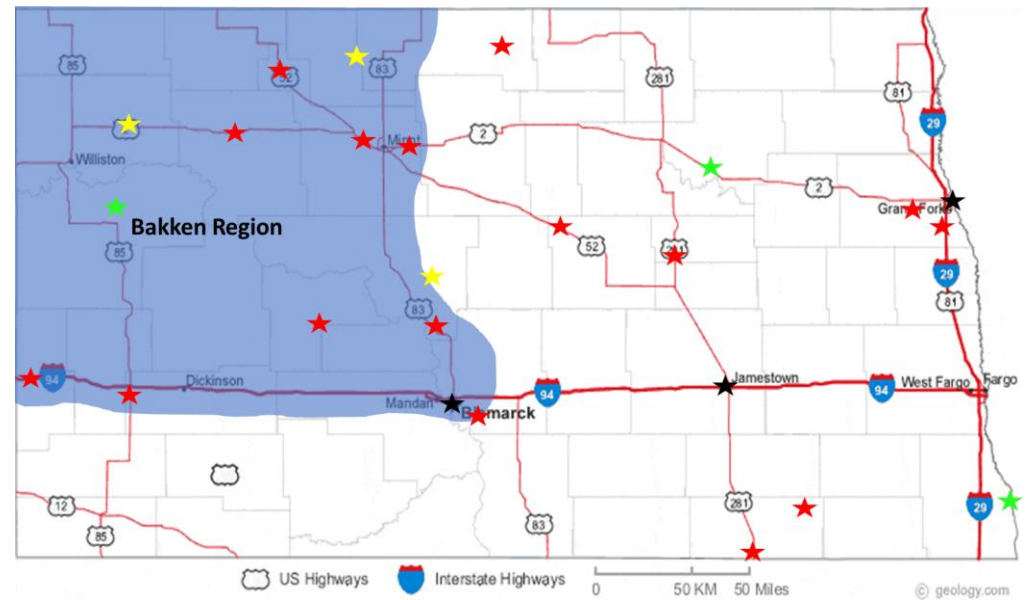


# Water Use Data Analysis

Addresses Objective #2: Create per capita coefficients for different water using entities and different sized municipalities

# Methods

- City selection
  - > 1,000 residents
  - 500 – 1,000 in Bakken region
- 25 cities – 42%
  - 3 large
  - 3 medium
  - 19 small



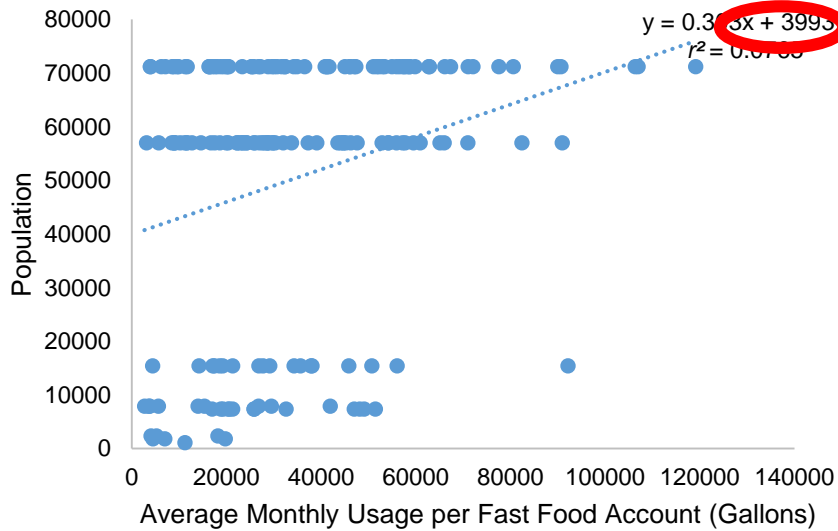
# Methods – Data Classification

- Monthly data from 2015 & 2016
  - Also received “rolling year”
- Classify based off:
  - Names
  - Addresses
- Google “drive” cities to determine multi-family dwellings

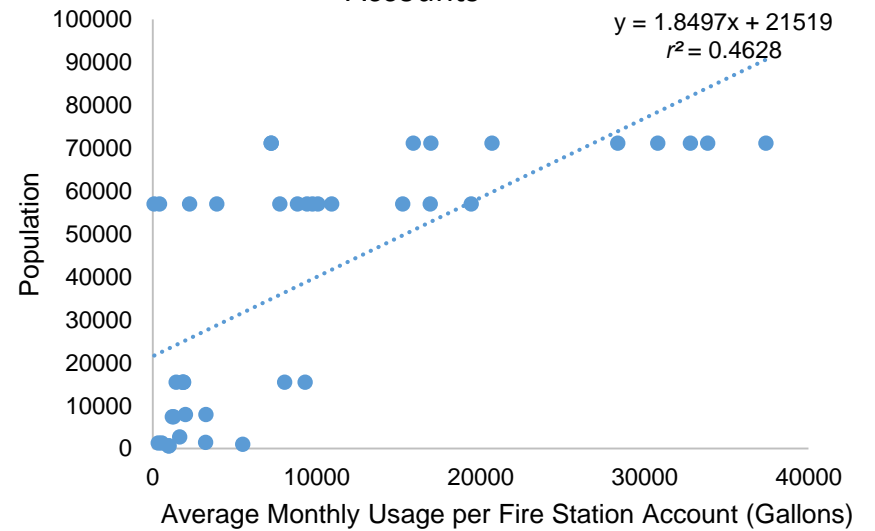


# Scatter Plots

### Fast Food Accounts



### Fires Station Accounts



# Residential Water Use

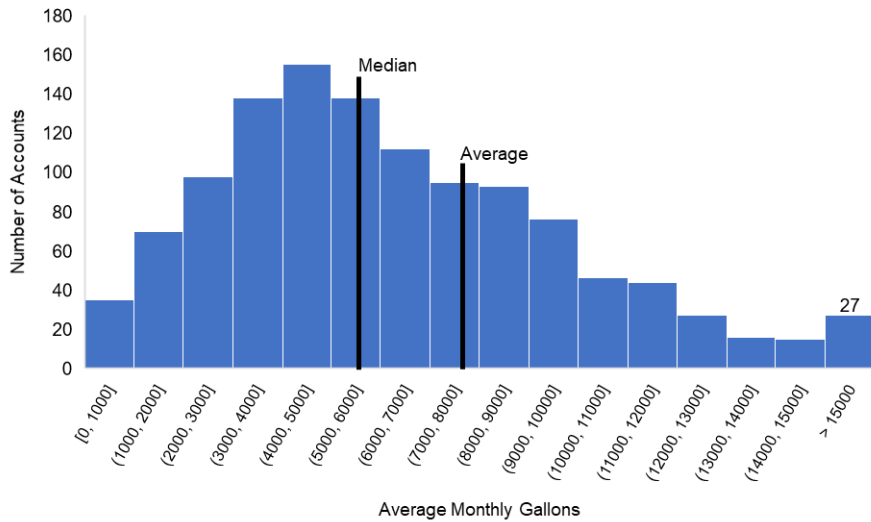
| Category           | All Cities | Large Cities | Medium Cities | Small Cities |
|--------------------|------------|--------------|---------------|--------------|
| Apartment          | 2,109 (19) | 3,026 (2)    | 2,557 (2)     | 1,927 (15)   |
| Duplex             | 3,094 (16) | 3,439 (2)    | 2,883 (2)     | 3,071 (12)   |
| Single Family Home | 4,330 (18) | 5,624 (2)    | 4,112 (2)     | 4,176 (14)   |
| Townhome           | 2,631 (13) | 3,346 (2)    | 2,855 (2)     | 2,422 (9)    |
| Trailer Park       | 2,711 (13) | 4,410 (2)    | 4,544 (3)     | 1,925 (8)    |

- Water use per individual unit (gallons/month)
- Weak trend between city size and apartment units ( $r^2=0.12$ ) and townhome units ( $r^2=0.11$ )

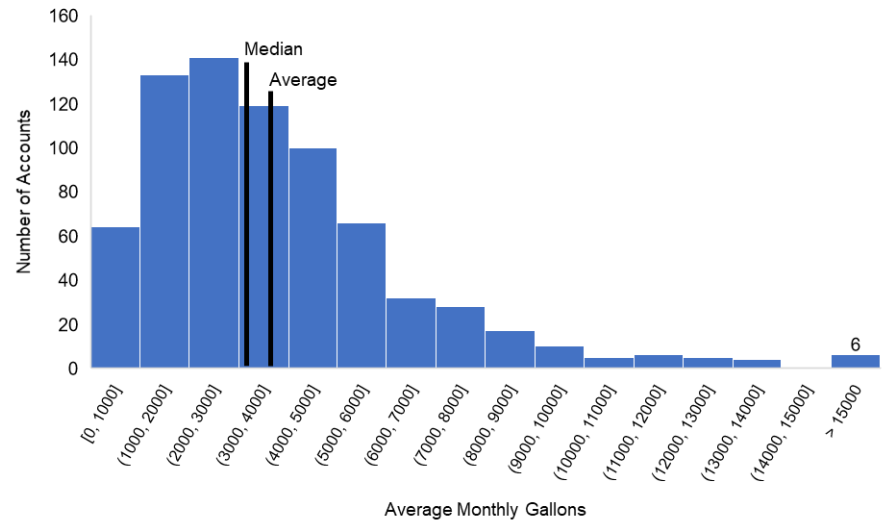


# Residential Water Use – Single Family Homes

Lincoln Monthly Average - Based on 12 months



Harvey Monthly Average - Based on 12 months



# Residential Water Use – Single Family Homes

- Median monthly water use  
2,000 – 4,000 gallons
- Top 10% - consumed 25%

| City        | Top 10% | Bottom 10% | Average Monthly Use (Gallons) |
|-------------|---------|------------|-------------------------------|
| Wahpeton    | 26.35   | 2.43       | 4,057                         |
| Turtle Lake | 24.34   | 1.54       | 3,282                         |
| Thompson    | 22.79   | 2.79       | 3,825                         |
| Surrey      | 22.49   | 2.86       | 3,718                         |
| Stanley     | 25.42   | 1.37       | 3,437                         |
| Ray         | 38.72   | 0.94       | 5,147                         |
| Oakes       | 28.51   | 1.98       | 4,423                         |
| Lincoln     | 35.99   | 1.66       | 7,716                         |
| Larimore    | 22.23   | 1.84       | 3,615                         |
| Harvey      | 26.89   | 1.66       | 3,876                         |
| Grand Forks | 24.45   | 2.68       | 4,204                         |
| Ellendale   | 28.43   | 0.65       | 3,001                         |
| Devils Lake | 24.11   | 2.05       | 4,164                         |
| Burlington  | 24.37   | 2.32       | 4,411                         |
| Bismarck    | 23.99   | 2.09       | 7,022                         |
| Beulah      | 26.46   | 1.42       | 5,386                         |
| Belfield    | 28.53   | 0.55       | 3,412                         |

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# Residential Water Use – Single Family Homes

- Median monthly water use  
2,000 – 4,000 gallons
- Top 10% - consumed 25%
- Bottom 10% - consumed 1-2%

| City        | Top 10% | Bottom 10% | Average Monthly Use (Gallons) |
|-------------|---------|------------|-------------------------------|
| Wahpeton    | 26.35   | 2.43       | 4,057                         |
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# Commercial Water Use – Large Users

|    | Large Cities                   | Medium Cities                  | Small Cities                   |
|----|--------------------------------|--------------------------------|--------------------------------|
| 1  | Food Processing                | Manufacturer                   | College                        |
| 2  | Commercial Irrigation          | Food Processing                | Assisted Living & Nursing Home |
| 3  | College                        | College                        | Gas Station with carwash       |
| 4  | Hotel with pool                | Hotel with pool                | Hotel with pool                |
| 5  | Military                       | Assisted Living & Nursing Home | Hotel                          |
| 6  | Hospital                       | Combo                          | Public School                  |
| 7  | Office                         | Public School                  | Jail                           |
| 8  | Jail                           | Gas Station with carwash       | Oilfield                       |
| 9  | Assisted Living & Nursing Home | Hospital                       | Multi-business                 |
| 10 | Laundromat/Laundry Service     | Multi-Business                 | Carwash                        |

**Large – 60%**

**Medium – 63%**

**Small – 50%**



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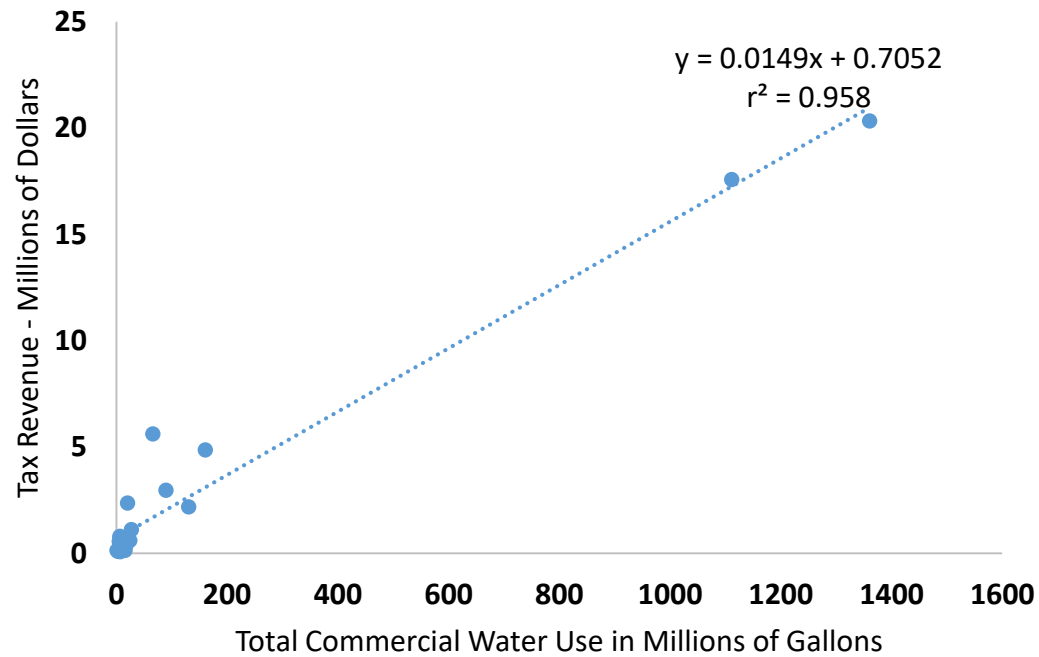
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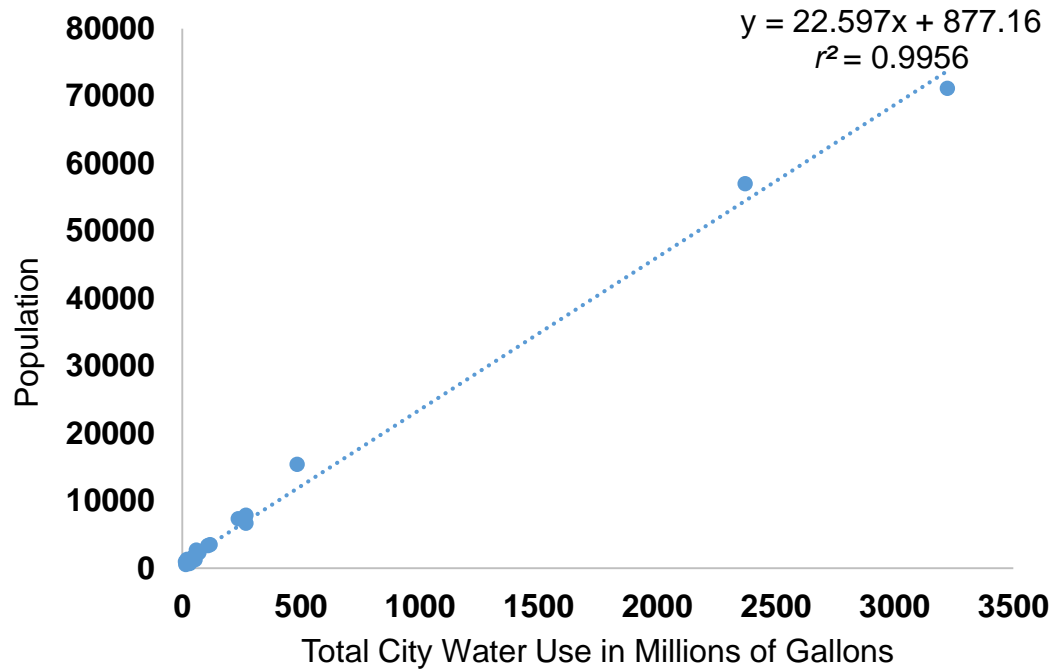
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**Medium – 63%**
**Small – 50%**

# Total Water Use vs. Tax Revenue



# Total Water Use



# Management Implications

- Cities, on average, use the most water in the residential sector
- Top 10% of single family homes use approximately 25% of the water
- Common large water users:
  - Colleges
  - Assisted living and nursing home facilities
  - Hotels with pools
- Top 10 commercial water users use over 50% of commercial water
- Strong relationship between water use and city size

# Project 3: Improve understanding of municipal and industrial water-use and water use related to oil boom in Bakken region

- Created 2 surveys
  - Municipal and industry
  - Survey all municipalities with more than 1,000 residents willing to participate
  - Survey all industrial permit holders in the state willing to participate
  - Determine industries that fall under municipal permit and which do not and why
- Analyze yearly water-use permit data from the NDSWC from 2000-2017 for both municipal and industrial permits
- Explore rural water systems in North Dakota that provide water to rural water users as well as municipalities and industry.

## • Expected Results

- Understand what constitutes an industrial permit vs. a municipal permit and what are the similarities and differences in categories
- Understand the amount and types of water-use in industrial and municipal categories and how they are changing between 2000-2017
- Determine potential thresholds of industrial water-use vs. what is normal commerce across the state
- Assess water-use from rural water district and NDSWC from 2000-2017 to determine pre-oil boom, boom, post-boom trends



QUESTIONS?

