

**ArcGIS MAPPING OF  
RADON TEST RESULTS  
FOR 23 WYOMING COUNTIES**

**ENVIRONMENTAL PUBLIC HEALTH TRACKING  
ASTHO FELLOWSHIP REPORT**

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## **II. Introduction**

The Centers for Disease Control and Prevention (CDC) launched a National Environmental Public Health Tracking Network in order to enhance the capacity of state and territorial health agencies to conduct tracking related activities. Currently there are 23 cities, counties and states that are participating in the fellowship program. The Wyoming Department of Health, Environmental and Occupational Health Program joined this year, 2013 with a project to Geomap all 23 Wyoming counties using ArcGIS 10.1, with the radon test results from the Wyoming Radon Program over the last 23 years, 1990 to 2013.

### **Background**

The Wyoming Radon Program (WRP) began in 1990 and has contracted with Air Chek Laboratories in Mills River, North Carolina for the majority of the subsequent 23 years. Other radon laboratories also supplied limited radon test kits to the Wyoming public, such as Alpha Energy in Carrollton, Texas. The majority of radon test kits, however, were supplied by Air Chek Laboratories. All test kit results were kept in an Excel spreadsheet with the following information:

Kit number  
Radon level in pCi/L  
Test start date  
Test stop date  
Home owners' name  
Test address  
Test City  
Test County  
Test zip code  
Test state (Wyoming)

Additional information was supplied on the hard copy report sent via postal mail to the home owner and the WRP.

Air Chek Laboratories supplied short-term, long-term and water test kits for use by the public to test their homes for radon. Approximately 1,000 short-term radon test kits on average, per year, were analyzed by Air Chek Laboratories from home owners in Wyoming. These reports were postal-mailed to the home owners and emailed to the Wyoming Radon Program. The radon

reports from Air Chek supplied the home owners, and the WRP, with the details and the levels of radon that were in each home, respectively, informing the home owners if they had elevated radon levels and were in need of either further testing, mitigation, or that their radon level was low enough that further action was not warranted.

The U.S. Environmental Protection Agency (EPA) recommends that each home be tested once every two years. Some home owners did conduct follow-up tests in subsequent years and these test results were added to the WRP database.

### **Statement of Relevance**

Radon is a radioactive gas that naturally occurs and is chemically and biologically inert. Radon's half-life is 3.8 days. It is present in air, water and soil. As radon progeny undergo radioactive decay, radiation is released in forms that include high-energy alpha particles, beta particles, and gamma radiation. Radon progeny are a significant source of human exposure to alpha radiation.

Radon exposure is the second-leading environmental cause of lung cancer death, after tobacco smoke (ACS 2006; Copes 2007; EPA 2009a), and the leading cause of lung cancer death for nonsmokers (EPA 2009b). Radon exposure is responsible for approximately 21,000 lung cancer deaths per year in the United States (NCI 2004; EPA 2007; EPA 2009b). Some estimates suggest that approximately 14% of the 300,000 annual lung cancer cases in the United States are attributable to radon (EPA 2009b). The World Health Organization (WHO) estimates that radon causes between 6% and 15% of lung cancers worldwide (WHO 2005). In addition, everyone is exposed to environmental radon and all homes have some level of radon.

Wyoming radon data has never been geo-mapped and the current EPA Zone Map for the country is too broad-brushed to give specific location data regarding areas of radon levels on a more specific range. Geo-mapping the state with the 19,334+ test results will create a more accurate radon map of Wyoming.

### **III. Tracking Activities**

#### **Tracking-related National Conference**

Wyoming did not attend the National Conference as it had not occurred in 2013 prior to either of the two site visits or this report.

#### **SME Site Visit and ESRI / ArcGIS Training**

Wyoming participated in two site visits. The first site visit was an ArcGIS Subject Matter Expert (SME) who traveled from Gillette, WY to Cheyenne, WY to instruct the Radon Program Manager in ArcGIS 10.1 prior to the site visit to the Colorado Department of Public Health and Environment. The SME site visit consisted of two half-days of introductory tutoring in the Esri ArcGIS 10.1 software. The two sessions were held on Sunday, April 28, 2013 from 1pm to 5pm and Monday, April 29, 2013 from 8am to 12 noon. The two sessions consisted of:

##### **Session 1:**

1pm – 2pm:	Navigating the ArcGIS Desktop Platform
2pm – 3pm:	Navigating ArcGIS Desktop Tools
3pm – 4pm:	Using ArcGIS Desktop Tools Introduction
4pm – 5pm:	Navigating and using ArcCatalog Basics

##### **Session 2:**

8am – 9am:	Excel and ArcGIS Basics
9am – 10am:	Geo-database Management Basics
10am – 11am:	Cartography Basics
11am – 12am:	Q&A Time

The instruction was helpful for a basic introduction of ArcGIS and the SME encouraged further study and a formal course if possible. The data, shape files and maps were downloaded to a jump drive for the site visit to Colorado.

## **Colorado Host-State Site Visit, Learning Experience and Application of Lessons Learned.**

The Colorado Department of Public Health and Environment (CDPHE) was the host site for the Wyoming site visit, which occurred on May 6 and May 7, 2013. Part of the ArcGIS information created on the SME site visit was emailed to Eric Brown of CDPHE who worked with the data to initiate a map for the site visit.

The CDPHE site visit started at 8:30 am with an overview of the Wyoming radon project of mapping the radon points for all 23 Wyoming counties. The CDPHE staff then presented an overview of the Colorado Environmental Public Health Tracking (EPHT) network organization, web portal demonstration, indicators, content, metadata, messaging, risk communication, key features, enhancements, program outreach and education strategies.

Nine CDPHE staff members participated in the various presentations, each giving their role in the EPHT project. Topics covered were identifying key players, contracting and negotiating with data custodians, Colorado Data (environmental and health), challenges/solutions – lessons learned, data release and confidentiality, GIS mapping applications, EPHT technology, developing radon data on the Colorado portal. These presentations took most of the first day. The late afternoon was used to start geocoding and mapping the Wyoming radon data.

Day two of the site visit was spent primarily on working with ArcGIS and the Wyoming radon data to produce two maps illustrating the mean radon level for each Wyoming County and the mean radon level for each Wyoming zip code. Several large areas of Wyoming were not covered due to the sparse population and many areas of Wyoming having no population, but being Federal and State land where no cities or town exist.

Discussion regarding census track mapping of radon test results was an item of interest and a possible future ArcGIS mapping project. Eric Brown and Stephanie Kuhn offered their assistance in this area, as well as general assistance with Wyoming and the EPHT program.

## **Accomplishments**

During the two day site visit, the Colorado CDPHE team educated the Wyoming ASTHO representative on the variety of topics listed above. The main item of discussion was the ArcGIS 10.1 software and the Wyoming Radon data which was the information to be mapped.

Mapping the data to three areas was the focus of the ArcGIS sessions. The three areas are county mean radon levels, zip code mean radon levels and census track mean radon levels. Both county and zip code mean radon levels were mapped with two large-scale maps being printed for display at the Wyoming Department of Health. Census track level mapping is a project that will be worked on at a later time.

The goal of the Wyoming ASTHO fellowship was to produce a more accurate radon zone map to update the EPA Zone Map that is currently being used nationwide. It is one of the EPA's goals that each state produces a more accurate map representing the radon actualities illustrating the radon potential within the boundaries of the respective state. This was completed during the site visit. However, county mean radon levels are still too broad-based. Zip code and census track mean levels are considered to be more representative and accurate for use within professional circles and for use by the public.

Fine tuning of all of these maps will be a project of the Wyoming Radon Program so that enhancements will be more useful and accurately represent the radon levels throughout Wyoming. When completed, or at the earliest opportunity, all Wyoming radon maps will be shared with ASTHO for the benefit of fellow ASTHO members.

## **Wyoming Radon Mapping Project Summary**

The specific aim of the Wyoming Radon GIS mapping project was intended to provide radon data in a GIS map format for the benefit of radon professionals, real estate agents, contractors, building code officials, physicians, general public, and Region 8 US EPA in Denver, CO. With the assistance of ASTHO, ESRI and CDPHE, two maps have been produced; one showing the average radon level by county and the second showing the average radon level by zip code.

The Wyoming Radon Program began in 1990 and has distributed over 1,000 radon test kits per year and approximately 1,000 test kits have been analyzed each year by Air Chek laboratory in North Carolina. Alpha Energy laboratory in Carrollton, TX has also analyzed several hundred radon test kits from Wyoming. These two labs have been the primary suppliers of short-term radon test kits for the residents of Wyoming. Various other labs have also supplied a limited number of test kits throughout Wyoming. Having contacted these radon testing labs, the Wyoming Radon Program has been able to obtain some of those test results from those miscellaneous labs.

With the assistance of ASTHO, ESRI and the CDPHE, the Wyoming Radon Program proposed to use ArcGIS 10.1 to GIS map the 23 years of radon test data from home owners test kit results as supplied by Air Chek laboratories. Training on ArcGIS was to occur via the Laramie County Community College. However, the ArcGIS class was cancelled due to the Radon Program Manager being the sole participant to sign up for the class.

It was then that a Subject Matter Expert, Jason Boucher of BKS Environmental Associates, Inc. was contacted to supply 8 hours of GIS tutoring. This helped to familiarize the Radon Program Manager with ArcGIS prior to the CDPHE site visit in Colorado on May 6, and 7, 2013.

The CDPHE site visit produced the two maps and laid the foundation for future maps which are to include more test data from miscellaneous radon labs and to display them via census tracks and an updated zip code map.

### **Research Design**

The WRP began with approximately 25,000 test kit results from Air Chek laboratory. These 25,000 test kits needed to be purged of duplicate tests, Post Office Box addresses, test kit results from other states, test kits with ERROR messages and other abnormalities that negated the use of certain test kits in the database.

After purging the database, the data was arranged by county and zip code according to the level of radon in those areas. The data consisted of the test kit address, city, county, zip code

and level of radon. These were divided into groups by county, with a maximum of 1,000 lines of code per group.

The GPS Visualizer (<http://www.gpsvisualizer.com/geocoder/>) was used to acquire the latitude and longitude of each address. When completed, the coordinates, by county, were placed onto the ArcGIS map in three groups with an assigned color: 0.0 pCi/L to 1.9 pCi/L (Green), 2.0 to 3.9 (Yellow) and 4.0 pCi/L and above (Red). This completed the first map of setting the radon level points. The second task was accomplished at CDPHE with the county map and the zip code map.

### **Benefits to Wyoming**

These maps are designed to benefit the Wyoming populace, both public and professional, to identify potential pockets of elevated radon and to assist in constructing homes with radon mitigation systems installed during the construction phase.

### **Key Personnel**

Key personnel in this project were the author, Ify Mordi of ASTHO, Jason Boucher of BKS Environmental, and the following personnel from CDPHE: Jane Mitchell, Eric Brown, Stephanie Kuhn, Andy Putnam, Randi Rycroft, Jeff Scott, Paul Turtle, Devon Williford, and Chrys Kelley.

### **Results**

The main result is the informal partnership between the Wyoming Department of Health, the CDPHE and ASTHO. This informal partnership will assist Wyoming in the availability of resources for ArcGIS assistance. The second result is the maps produced in cooperation with CDPHE and future maps and possibly a Wyoming EPHT portal.

### **Discussion and Planned Activity**

The Wyoming use of ArcGIS mapping is in its infancy as ArcGIS 10.1 is not an easy program to learn, although it has a lot to offer. There is still a lot of learning, application and maps to be created in the area of radon.



As stated earlier, a map employing the U.S. Census Tracts is proposed so that a larger coverage area will be possible, more so than zip codes.

#### **IV. Planned Activities**

The action plan for future tracking activities will revolve around upgrading the zip code map and producing a Census Tract map of radon results.

#### **Conclusion**

The Wyoming ArcGIS Radon mapping project is off to a good start, but it needs to develop more in the way of training for the personnel involved, more data input and more data analysis. The Wyoming EPHT still has a ways to go before it is ready to be placed on the web.

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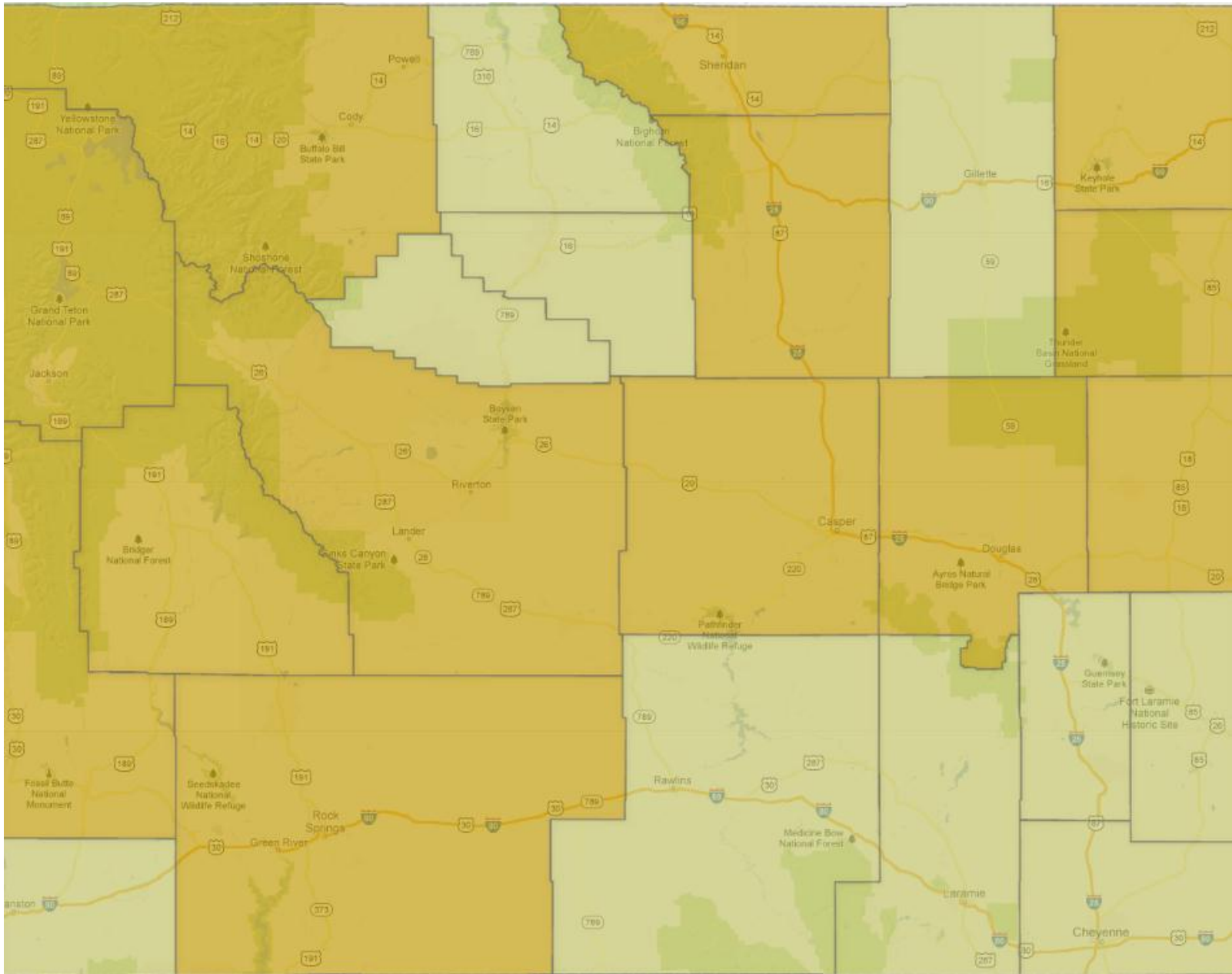
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**Mean Radon Levels by County:**

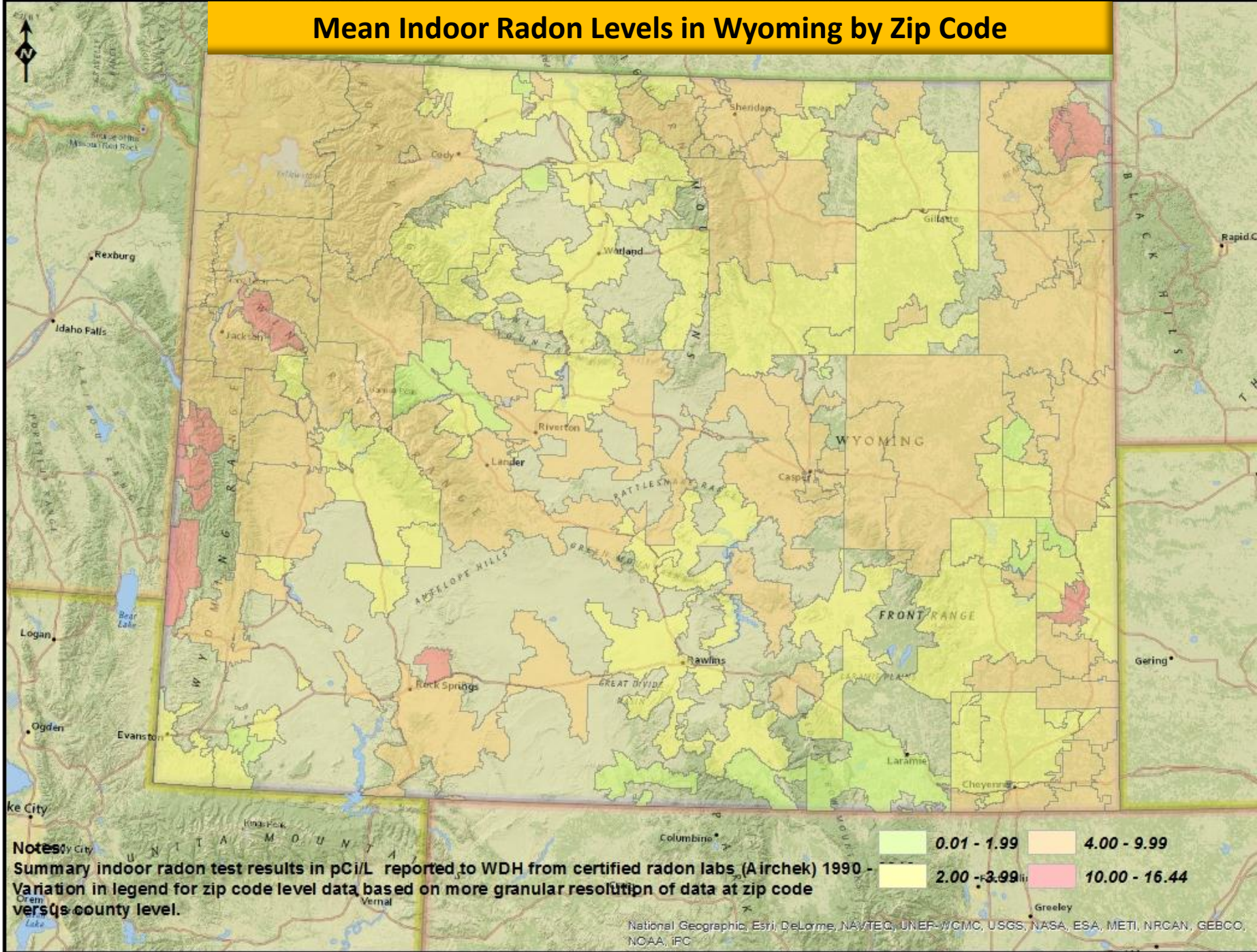


**0.1 pCi/L to 3.9 pCi/L Mean Level**



**4.0 pCi/L and Above Mean Level**

# Mean Indoor Radon Levels in Wyoming by Zip Code



**Notes:** Summary indoor radon test results in pCi/L reported to WDH from certified radon labs (Airchek) 1990 - 2000. Variation in legend for zip code level data based on more granular resolution of data at zip code versus county level.

- 0.01 - 1.99
- 2.00 - 3.99
- 4.00 - 9.99
- 10.00 - 16.44