# Geocoding for Better SES Indication
# Or
# GeoInformatics in Education Research

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By Trevor Mahlum
Assessment Data Coordinator
Natrona County School District #1

**Abstract**

Socio Economic Status (SES) is an indicator of Title I (federal education funds targeting students in poverty) status for schools. SES is typically taken from self-referred Free and Reduced Price lunch (F/R) applications made directly to schools or districts. Federal laws protecting the privacy of student records make use of this identifier troublesome. In addition, fears of stigmatization associated with applying for F/R lunch make this indicator suspicious of under reporting true SES of a school's student population.

This paper will demonstrate how GIS may provide another approach for collecting the requisite SES information with a higher level of reliability and anonymity. Using GIS to associate the home address of students with US Census bureau block group data can create an SES value for students based on public information. Schools could document the percentage of students whose blockgroup indicators fell below the poverty level to determine Title I funding.

**Introduction**

Public schools in a democratic society are intended to be an equitable commodity. The practical realties of life have prevented this from becoming fact in America. Too often students with economically underprivileged backgrounds attend schools in which funding and resources are inferior to schools in neighboring communities. In the latter half of the 20th century, policymakers decided to dedicate more resources to schools where an identifiable quantity of students could be acknowledged to be *disadvantaged*. This term as been interpreted to describe economic status near or below the poverty line.

While the *Elementary and Secondary Education Act of 1965*[*] outlined the intent of the federal government to distribute resources based on need, details of *how* to do this were left largely to states and districts to work out. Current practice in most state and local education agencies has been a rough estimate at best. Often the proxies used as an indicator of being disadvantaged, are not completely reliable.

The purpose of the study reported here is to answer one basic question about current practice in identifying need and allocating federal resources.

Are current practices of identification accurately reflecting the true economic need of schools? Subordinate but related to the first question is: Does identification become less reliable as grade level increases?

**Background**

ESEA/NCLB is organized into several sections detailing what resources are to go to which groups and the type of accountability associated with each. The section detailing the resources focused on improving schooling for disadvantaged students is commonly referred to as Title 1. Title 1 has become, in educational conversations, a ubiquitous label for all federal resources connected with students of poverty.

While Title 1 describes the programmatic trappings of getting money to help educate the poor, the label most commonly used to indicate whether or not a student qualifies for assistance is Socio Economic Status (SES). In most state and local education agencies SES is typically associated with self-referred Free and Reduced Price meal (F/R) applications made directly to schools or districts. The application for F/R involves families demonstrating financial need by

[*] *ESEA until 2002 when it was re-authorized as the No Child Left Behind Act*

***Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us***
***970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar***

indicating a low annual household income at or near the national poverty level. This system has been criticized for creating a socially stigmatizing barrier to accessing needed support. Too often due to fears of social stigmatization associated with applying for F/R meals this indicator under reports true SES of a school's student population.

Federal Title 1 law is a bit vague on what other indicators may be used to determine eligibility. In some cases school attendance areas and census data on economic status have been associated to approximate a school's level of Title 1 need. However, too few of the geographic census areas and school attendance zones are not well matched. Often a school zone is comprised of parts of several census blockgroups, making clear identification difficult. Census response information about basic demographic identities AND some economic factors are made available for groups above an identifiably small size (census blockgroups). Census information is attached to an area rather than a school or individual student. It is then, a question of how to attach the available SES indicators to students and schools that, if answered positively could have a great impact on how funding is distributed and used.

It must be noted U.S. census data often suffers from a lag of several years between the data collection and time of use. The data used in this study was collected in 1999 dollars and used the 1999 benchmark for poverty level. The census bureau is in the initial stages of establishing a five year rolling cohort of *sampled* census estimates to update their data collection between decennial censuses. This data will not be useable for political re-districting, but could valuable to educational research. However, this data is not yet available from the U.S. Census Bureau.

The question posed in this study is really only answerable with the use of Geographic Information Systems (GIS). GIS tools, though developed for commercial and civic needs, have a great potential in the area of education research and policy planning. The GIS process of Geocoding to match students to census data to clarify a schools SES is at the heart of the research outlined here.

**Review**

GIS as a research tool, concerns over Title 1 identification accuracy and practical use of census data are all issues research has focused on for at least two decades. As a research method, GIS tools have not been at the forefront of educational research until recently. Early work linking the geospatial identity of an individual with specific membership in a group for

identification purposes began primarily in the Health field. Epidemiologists have been using GIS to associate individuals with group characteristics for several years with great success (Krieger, et al, 2002 and Miner et al, 2005). Public health analysts have been able to use Geocoding to make generic associations about the residential patterns of patients experiencing specific medical conditions. While it is not accurate to state an individual will exhibit a specific condition solely because he or she lives in a specific local, it is accurate to associate the shared health patterns of a larger group sharing geography with the individual.

Indeed some health research has crossed over into education research with studies of school location and health issues. A research team examining the proximity of fast food restaurants to schools in Chicago was searching for causes of childhood and adolescent obesity, used GIS to document their findings (Austin et al, 2005). Additionally in California health, researchers used GIS to establish an unhealthy pattern of heavy traffic roadways growing very near low-income schools and the prevalence of associated childhood and adolescent asthma (Krieger et al, 2001). Based on the successes of public health research use of GIS, it is likely that a growth in the use of GIS for educational policy development and planning could also be successful.

Title 1 identification concerns have been a part of education research for almost as long as Title 1 funding has been available. Some researchers have pointed to the practice requiring application based on documented poverty as a barrier to complete and equitable distribution of Title 1 resources(Hulsey, Gleason and Ohls, 2004 ). Still others indicate a marked drop in the number of applications for free and reduced price lunch service in middle and high school. This assertion, is problematic, however, in that family economic status may improve in the time from elementary to secondary enrollment. No current research adequately addresses this issue. Additional concerns arise over the degree to which the current system is reportable publicly. The Family Educational Rights and Privacy Act of 1974 (FERPA) makes it clear that F/R meal applications are a protected private records that may not be publicized in an individualized way. This has raised concerns about the use of F/R counts to qualify sites for funding. However, as extensive as the Title discussions have been, they pale in comparison to the degree of information about who lives where collect by the Federal government.

By far the greatest amount of data available is from the U.S. Census bureau. However, this data has some short-comings of its own. While the census data is exhaustive, extremely detailed it is publicly available only to a point and is collected only decennially (Peters and

MacDonald, 2004). However, much census data is available at the census blockgroup level. While less specific than blocks, or individual response, the census blockgroup is accurate enough to make general assumptions without publicizing individually identifying information. The US census bureau is also expanding the frequency and depth of intermediate surveys to update basic data sets on a more timely basis using sampling. While these intermediate data sets can not be legally used for congressional districting, they are becoming a great source of information useful in education research regarding resource distribution and planning.

**Method**

This study took place in a mixed economy medium-to-small K-12 district of approximately 11,400 students in central Wyoming. This district is unique in that it is a completely open enrollment district. No barriers to school selection exist save physical classroom capacity. The district provides transportation to any district school upon request. This is significant in that the distribution of student residence is potentially much greater than in a traditional attendance zone school district.

Student demographic information including mailing and home address collections were collected from the district Student Information System (SIS) for the target students. To be as accurate as possible existing designation of F/R status was also collected from the SIS and linked to the student data set. Demographics also included grade level and current school of enrollment.

Environmental Science Research Institute (ESRI) GIS software ArcINFO 9.2 was used to manage spatial mapping of the targeted community. A base map to be used in a GIS must have some referential feature minimums. For this study files depicting the centerline of all residential, county and state roadways was obtained from the GIS office of the local city government. For many areas of the U.S. similar line files are available from commercial sources. U.S. Census blockgroup shapes were taken from StreetMapUSA a GIS mapping and addressing resource packaged with ArcINFO. Additional blockgroup data files were taken from the U.S. Census bureau website download center (http://factfinder.census.gov/servlet/DownloadDatasetServlet?_lang=en).

To make the basic map of the community useful for purposes of analyzing SES three features had to be associated accurately with the map.

- First, the location of student residential addresses had to be associated with map locations. This was accomplished by a process known as *geocoding* in the GIS industry. Geocoding is the process of establishing a point in space for a given address. In the study, the student address file was *geocoded* to place a point on the map for each student in the dataset. This was accomplished with 99% matched placement (a few student records could not be mapped due to unmapped new construction, un-indexed rural county addresses and simple unrecoverable address errors).
- The second necessary feature to be associated with the map was the U.S. Census blockgroups. The U.S. Census conducts a federally mandated census every ten years to collect demographic data, primarily to support fairness in federal congressional district apportionment. A by-product of the process is a wealth of data about U.S. residents available at limited local levels. The Census data is collected and reported in a descending order from states, counties or large urban centers, tracts, blockgroups and blocks. In order to protect the privacy of respondents data is only aggregated and reported from the blockgroup (approximately 800 households) and larger. However, for any household falling within the boundaries of a particular blockgroup, many economic factors can be associated. While it would never be accurate to state a student whose home address places them in census blockgroup *x* has a specific economic status, it would be logical to assume, however, that the same student has the *potential to reflect* the economic status of blockgroup *x*. When taken as populations (school group or grade level for example) the collective SES data aggregated from the various census blockgroups could be a strong indicator of a school's expected SES.
- The third necessary feature required to describe SES with GIS is the physical location of the schools in the study community. This was accomplished again with Geocoding. All thirty five K-12 school sites were placed on the map using ArcINFO 9.2. A few steps using the geocoded data were needed to create a dataset with usable census blockgroup values. While the GIS map contained the students and schools as points and the census blockgroups as polygons (areas) in space, there was as of yet no connection between any of the three. Using ArcINFO, the census blockgroups as polygons were queried for any points contained within. The resulting selected student dataset was joined to the blockgruop table resulting in a data collection containing all student data AND the data from the associated census blockgroup. This process was repeated for schools to

associate schools with census blockgroup data. This visual representation of the students, schools with the overlay of areas of census blockgroups made it possible to edit the dataset for unusable records. A small number of mapped student addresses fell in neighboring communities outside the study area and were removed from the dataset. In addition the ArcINFO tool allowed a clear visualization of where students reside in relation to their chosen school site.

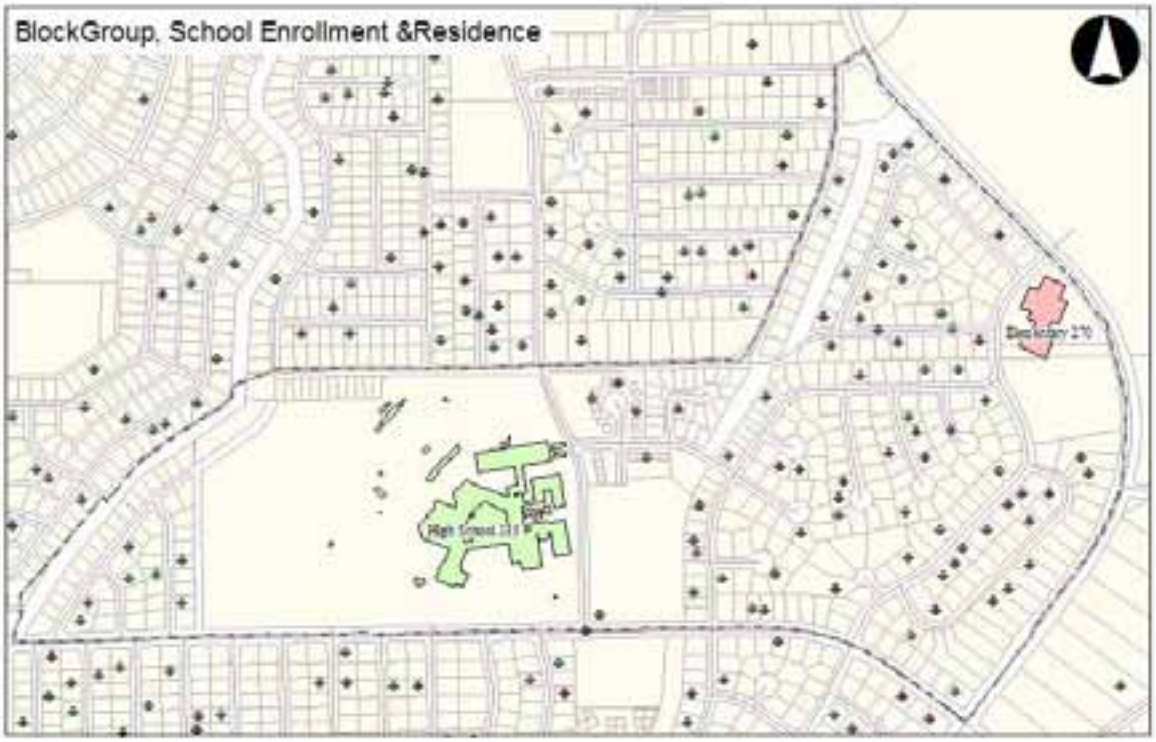
The GIS elements of the research were at this stage largely complete. The data now consisted of a table containing student demographics and census blockgroup SES data. This was re-sorted using a basic database system to build crosstabs displaying census blockgroups and schools with the interactive data being a count of student IDs in membership with both tabs. Census data specifically highlighting median family income, percent below the poverty line and level of educational attainment were attached to the student data in this study. For purposes of this report detailed analysis of the median household income only was examined. Further research is planned on the other Census data potential indicators.

More importantly this data was available to process with more sophisticated analytical tools to determine whether or not geocoded census blockgroup SES data was as good as or better indicator of SES need than existing F/R lunch indictors at schools.

***Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us***
***970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar***

**Findings**

Figure 1




Typical of most of the study district is the wide distribution of student residence. These patterns of home address do not match any set of blockgroup identity similarities or earlier school zone boundaries. The community has largely adopted an open enrollment pattern of school selection and residential placement.

In figure 1, a large high school and a large elementary school are displayed along with the U.S. census blockgroup they share. High School 135 is a 9-12 grade secondary school with approximately 1200 students. The reported F/R rate – as an indicator of low SES—is 19% of the total school enrollment (see figure 2). Likewise, elementary school--270—has a 19% Low SES representation of a school of approximately 400. Both schools fall within the U.S. Census blockgroup 5602500005022. This particular blockgroup had a median household income of $53,295 in 2000.

*Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us*
*970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar*

Figure 2

| School Number | Free or Reduced Lunch | Not F/R | Total | % Low SES |
|---|---|---|---|---|
| 130 | 212 | 1051 | 1263 | 17% |
| 135 | 247 | 1085 | 1247 | 19% |
| 138 | 63 | 68 | 131 | 48% |
| 140 | 57 | 83 | 140 | 41% |
| 145 | 32 | 66 | 98 | 33% |
| 148 | 5 | 13 | 18 | 28% |
| 149 | 41 | 38 | 79 | 52% |
| 151 | 257 | 231 | 488 | 53% |
| 155 | 280 | 615 | 895 | 31% |
| 160 | 174 | 408 | 582 | 30% |
| 162 | 174 | 459 | 633 | 27% |
| 166 | 35 | 86 | 121 | 29% |
| 170 | 135 | 105 | 240 | 56% |
| 175 | 39 | 301 | 340 | 11% |
| 180 | 139 | 118 | 257 | 54% |
| 190 | 64 | 322 | 386 | 17% |
| 200 | 143 | 97 | 240 | 60% |
| 210 | 75 | 245 | 320 | 23% |
| 220 | 52 | 39 | 91 | 57% |
| 225 | 141 | 56 | 197 | 72% |
| 230 | 124 | 104 | 228 | 54% |
| 235 | 160 | 65 | 225 | 71% |
| 237 | 95 | 217 | 312 | 30% |
| 240 | 196 | 263 | 459 | 43% |
| 245 | 53 | 250 | 303 | 17% |
| 250 | 93 | 103 | 196 | 47% |
| 257 | 120 | 218 | 338 | 36% |
| 260 | 51 | 236 | 287 | 18% |
| 265 | 135 | 100 | 235 | 57% |
| 270 | 84 | 365 | 445 | 19% |
| 275 | 215 | 118 | 333 | 65% |
| 280 | 208 | 74 | 282 | 74% |
| 285 | 16 | 135 | 151 | 11% |
| 295 | 2 | 6 | 8 | 25% |
| 315 | 50 | 134 | 184 | 27% |
| 320 | | 4 | 4 | 0% |
| 325 | | 6 | 6 | 0% |
| 335 | | 3 | 3 | 0% |
| Grand Total | 3967 | 7887 | 11854 | 33% |

While the high school home attendance zone under traditional school attendance area systems would not be so small as one blockgroup, the elementary would likely have an attendance area not much larger;—an area likely to have very similar demographics. This would indicate that attendance areas might not be the best proxies for SES indicators. Likewise, current

SES indicators of F/R lunch applications seem out of line with the Census reported median household income for the neighborhood.

Reversing the model and looking at all students that attend a given school, creating a prototypical SES profile by collapsing the median household income of all blockgroups in which students reside could offer a better picture of SES at the school level. In the case of elementary 270, this brings to bear every census blockgroup in the county (all 47) to varying degrees. It would not be accurate to draw evenly upon the median household income of each blockgroup equally. Instead, each of the 445 students enrolled at elementary 270 – through the geocoded, census blockgroup association described in the methods section—has a unique blockgroup identifier attached. Using this identifier to list an associated median income to each student, adding these values together and dividing them by enrollment generates a median income approximation for the whole enrollment group (see figure 3).

***Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us***
***970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar***

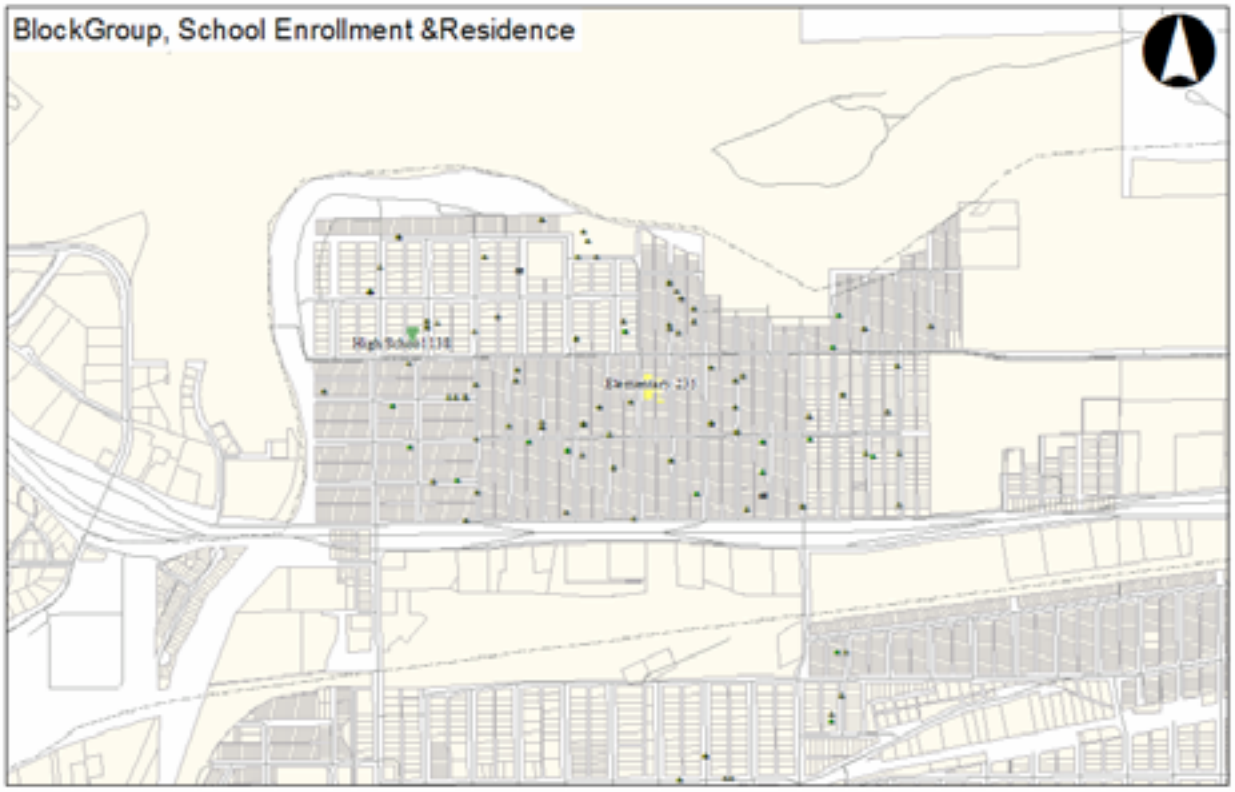
Figure 3

| FIPS | Median Household Income | Elementary 270 | | High School 135 | |
|---|---|---|---|---|---|
| 560250002003 | $13,955 | 1 | $13,955 | 14 | $195,370 |
| 560250002001 | $17,697 | 3 | $53,091 | 8 | $141,576 |
| 560250007001 | $19,219 | 0 | $0 | 3 | $57,657 |
| 560250003003 | $19,954 | 2 | $39,908 | 12 | $239,448 |
| 560250002002 | $22,419 | 6 | $134,514 | 19 | $425,961 |
| 560250003001 | $24,269 | 2 | $48,538 | 18 | $436,842 |
| 560250016011 | $25,333 | 26 | $658,658 | 48 | $1,215,984 |
| 560250008001 | $26,214 | 0 | $0 | 4 | $104,856 |
| 560250011001 | $27,156 | 2 | $54,312 | 7 | $190,092 |
| 560250007002 | $27,378 | 3 | $82,134 | 6 | $164,268 |
| 560250012002 | $27,569 | 1 | $27,569 | 8 | $220,552 |
| 560250012001 | $28,029 | 3 | $84,087 | 7 | $196,203 |
| 560250003002 | $28,478 | 10 | $284,780 | 24 | $683,472 |
| 560250008003 | $30,542 | 1 | $30,542 | 8 | $244,336 |
| 560250006001 | $31,328 | 6 | $187,968 | 20 | $626,560 |
| 560250011002 | $31,534 | 0 | $0 | 5 | $157,670 |
| 560250009011 | $32,900 | 1 | $32,900 | 15 | $493,500 |
| 560250005012 | $33,704 | 14 | $471,856 | 50 | $1,685,200 |
| 560250004003 | $35,652 | 13 | $463,476 | 39 | $1,390,428 |
| 560250006004 | $35,660 | 12 | $427,920 | 74 | $2,638,840 |
| 560250004002 | $35,771 | 6 | $214,626 | 18 | $643,878 |
| 560250014011 | $36,216 | 7 | $253,512 | 40 | $1,448,640 |
| 560250004004 | $36,250 | 2 | $72,500 | 48 | $1,740,000 |
| 560250005013 | $36,823 | 9 | $331,407 | 32 | $1,178,336 |
| 560250008002 | $37,174 | 0 | $0 | 6 | $223,044 |
| 560250010001 | $37,261 | 2 | $74,522 | 21 | $782,481 |
| 560250006002 | $37,941 | 9 | $341,469 | 62 | $2,352,342 |
| 560250004001 | $38,490 | 7 | $269,430 | 26 | $1,000,740 |
| 560250006003 | $38,576 | 8 | $308,608 | 21 | $810,096 |
| 560250005021 | $40,045 | 47 | $1,882,115 | 61 | $2,442,745 |
| 560250014012 | $40,455 | 10 | $404,550 | 27 | $1,092,285 |
| 560250018001 | $41,286 | 1 | $41,286 | 10 | $412,860 |
| 560250007003 | $45,078 | 1 | $45,078 | 14 | $631,092 |
| 560250017001 | $45,865 | 4 | $183,460 | 11 | $504,515 |
| 560250010002 | $47,462 | 5 | $237,310 | 34 | $1,613,708 |
| 560250017002 | $47,606 | 5 | $238,030 | 26 | $1,237,756 |
| 560250009012 | $49,256 | 4 | $197,024 | 23 | $1,132,888 |
| 560250005011 | $51,250 | 31 | $1,588,750 | 74 | $3,792,500 |
| 560250018002 | $51,776 | 9 | $465,984 | 30 | $1,553,280 |
| 560250005022 | $53,295 | 54 | $2,877,930 | 53 | $2,824,635 |
| 560250009023 | $54,085 | 0 | $0 | 11 | $594,935 |
| 560250009021 | $54,375 | 1 | $54,375 | 12 | $652,500 |
| 560250009022 | $54,777 | 0 | $0 | 15 | $821,655 |
| 560250009013 | $55,000 | 2 | $110,000 | 15 | $825,000 |
| 560250016014 | $62,308 | 2 | $124,616 | 15 | $934,620 |
| 560250016013 | $64,453 | 12 | $773,436 | 29 | $1,869,137 |
| 560250016012 | $72,232 | 101 | $7,295,432 | 124 | $8,956,768 |
| **Mean** | **$38,385** | **445** | **$48,273** | **1247** | **$42,968** |

***Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us***
***970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar***

While the official poverty line in 1999 was $ 16,895, only one blockgroup median household income in the study community fell below that line. However, for the F/R lunch income eligibility guideline for Reduced price meals for a household of four $37,000 annual income was the threshold in 2006($35,798 in 2005 and $34,873 in 2004). Extrapolating backwards approximately $1,000 a year establishes $30,000 as the minimum income level of F/R meal aid as a threshold in 2000. Using this figure as an indicator 186 (or 15% of) students at High School 135 and 60 (or 13%) at Elementary 270 could be considered to be economically disadvantaged or Low SES. Applying the district Low SES percentage of 33% to these sites yields a median income of $35,000 and $38,000 for the lowest third of income levels. This is also significant in light of the mean of all income levels of all enrolled students. At Elementary 270, this figure was $48, 273 while High School 135 was at $42,968. For these two sites, the Geocoded SES indicator predicted slightly lower levels of need than the self-reported F/R application collection currently in place.

However, the two schools displayed above are not currently schools receiving funding. Sample schools receiving Title 1 funds look very different when the geocoded census blockgroup process is applied (see figure 4). Figure 4

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The official 1999 poverty line of $ 16,895 flagged only one blockgroup median household income in the second study community. However, the F/R meal income eligibility reduced price meal guideline estimate, of $30,000 annual income for a family of four paints a significantly different picture with current sites (figure 5).

In figure 4, a small high school and a small elementary school are displayed along with adjacent U.S. census blockgroups in which they fall. High School 138 is a 9-12 grade secondary school with approximately 130 students. The reported F/R rate – as an indicator of low SES—is 48% of the total school enrollment (see figure 2). Likewise, elementary school--235—has a 71% Low SES representation of a school of approximately 200. These two schools fall within neighboring U.S. Census blockgroups 560250002001 and 560250002002. The first blockgroup—001-- had a median household income of $17,697, while blockgroup two—002—had a median household income of $22,419 in 2000 (figure 5).

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***970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar***

Figure 5

| FIPS | Median Household Income | High School 138 | | Elementary 235 | |
|---|---|---|---|---|---|
| 560250002003 | $13,955 | 8 | $111,640 | 10 | $139,550 |
| 560250002001 | $17,697 | 7 | $123,879 | 46 | $814,062 |
| 560250007001 | $19,219 | 3 | $57,657 | 7 | $134,533 |
| 560250003003 | $19,954 | 1 | $19,954 | 5 | $99,770 |
| 560250002002 | $22,419 | 10 | $224,190 | 53 | $1,188,207 |
| 560250003001 | $24,269 | 1 | $24,269 | 5 | $121,345 |
| 560250016011 | $25,333 | 6 | $151,998 | 21 | $531,993 |
| 560250008001 | $26,214 | 2 | $52,428 | 1 | $26,214 |
| 560250011001 | $27,156 | 3 | $81,468 | 1 | $27,156 |
| 560250007002 | $27,378 | 1 | $27,378 | 1 | $27,378 |
| 560250012002 | $27,569 | 5 | $137,845 | 0 | $0 |
| 560250012001 | $28,029 | 6 | $168,174 | 0 | $0 |
| 560250003002 | $28,478 | 4 | $113,912 | 3 | $85,434 |
| 560250008003 | $30,542 | 6 | $183,252 | 2 | $61,084 |
| 560250006001 | $31,328 | 3 | $93,984 | 5 | $156,640 |
| 560250011002 | $31,534 | 3 | $94,602 | 1 | $31,534 |
| 560250009011 | $32,900 | 2 | $65,800 | 3 | $98,700 |
| 560250005012 | $33,704 | 1 | $33,704 | 0 | $0 |
| 560250004003 | $35,652 | 2 | $71,304 | 2 | $71,304 |
| 560250006004 | $35,660 | 6 | $213,960 | 3 | $106,980 |
| 560250004002 | $35,771 | 1 | $35,771 | 0 | $0 |
| 560250014011 | $36,216 | 6 | $217,296 | 3 | $108,648 |
| 560250004004 | $36,250 | 1 | $36,250 | 0 | $0 |
| 560250005013 | $36,823 | 0 | $0 | 0 | $0 |
| 560250008002 | $37,174 | 1 | $37,174 | 0 | $0 |
| 560250010001 | $37,261 | 4 | $149,044 | 8 | $298,088 |
| 560250006002 | $37,941 | 3 | $113,823 | 3 | $113,823 |
| 560250004001 | $38,490 | 2 | $76,980 | 1 | $38,490 |
| 560250006003 | $38,576 | 1 | $38,576 | 2 | $77,152 |
| 560250005021 | $40,045 | 1 | $40,045 | 5 | $200,225 |
| 560250014012 | $40,455 | 4 | $161,820 | 2 | $80,910 |
| 560250018001 | $41,286 | 5 | $206,430 | 2 | $82,572 |
| 560250007003 | $45,078 | 1 | $45,078 | 1 | $45,078 |
| 560250017001 | $45,865 | 0 | $0 | 1 | $45,865 |
| 560250010002 | $47,462 | 5 | $237,310 | 1 | $47,462 |
| 560250017002 | $47,606 | 2 | $95,212 | 1 | $47,606 |
| 560250009012 | $49,256 | 2 | $98,512 | 0 | $0 |
| 560250005011 | $51,250 | 1 | $51,250 | 1 | $51,250 |
| 560250018002 | $51,776 | 2 | $103,552 | 0 | $0 |
| 560250005022 | $53,295 | 0 | $0 | 0 | $0 |
| 560250009023 | $54,085 | 3 | $162,255 | 0 | $0 |
| 560250009021 | $54,375 | 0 | $0 | 1 | $54,375 |
| 560250009022 | $54,777 | 0 | $0 | 2 | $109,554 |
| 560250009013 | $55,000 | 4 | $220,000 | 0 | $0 |
| 560250016014 | $62,308 | 2 | $124,616 | 0 | $0 |
| 560250016013 | $64,453 | 3 | $193,359 | 0 | $0 |
| 560250016012 | $72,232 | 0 | $0 | 2 | $144,464 |
| **Mean** | **$38,385** | **134** | *$33,550* | **205** | *$25,695* |

***Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us***
***970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar***

Using this $30,000 income figure as an indicator, 155 (or 76% of) students at Elementary 235 and 63 (or 47%) at High School 138 fit the local definition of Low SES. In addition the table of student linked blockgroup median income values (figure 2) indicates the district Low SES percentage of 33% at these sites is a median income of $19,000 and $27,000 for the lowest third of income levels (see figure 5). This is also significant in light of the mean of all income levels of all enrolled students. At Elementary 235, this figure was $25, 695 while High School 135 was at $33,550. Therefore, for sites the Geocoded SES indicator matches or exceeds the F/R application count of students eligible for federal assistance.

Extending the process to all sites listed with a percentage of students geocoded into Blockgroups with a median income of $30,000 or less generated mixed results (figure 6).

***Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us***
***970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar***

Figure 6

| School Number | Free or Reduced Lunch | Not F/R | Total | % Low SES | Geocoded % below $30K | Change |
|---|---|---|---|---|---|---|
| 280 | 208 | 74 | 282 | 74% | 45.26% | -28.50% |
| 225 | 141 | 56 | 197 | 72% | 59.57% | -12.00% |
| 235 | 160 | 65 | 225 | 71% | 75.61% | 4.50% |
| 275 | 215 | 118 | 333 | 65% | 43.27% | -21.29% |
| 200 | 143 | 97 | 240 | 60% | 24.71% | -34.87% |
| 265 | 135 | 100 | 235 | 57% | 24.73% | -32.71% |
| 220 | 52 | 39 | 91 | 57% | 2.60% | -54.55% |
| 170 | 135 | 105 | 240 | 56% | 9.29% | -46.96% |
| 230 | 124 | 104 | 228 | 54% | 60.70% | 6.31% |
| 180 | 139 | 118 | 257 | 54% | 71.18% | 17.09% |
| 151 | 257 | 231 | 488 | 53% | 27.32% | -25.34% |
| 149 | 41 | 38 | 79 | 52% | 32.84% | -19.06% |
| 138 | 63 | 68 | 131 | 48% | 47.01% | -1.08% |
| 250 | 93 | 103 | 196 | 47% | 18.66% | -28.79% |
| 240 | 196 | 263 | 459 | 43% | 5.39% | -37.32% |
| 140 | 57 | 83 | 140 | 41% | 11.45% | -29.26% |
| 257 | 120 | 218 | 338 | 36% | 10.17% | -25.33% |
| 145 | 32 | 66 | 98 | 33% |  | -32.65% |
| 155 | 280 | 615 | 895 | 31% | 27.02% | -4.27% |
| 237 | 95 | 217 | 312 | 30% | 4.92% | -25.53% |
| 160 | 174 | 408 | 582 | 30% | 19.71% | -10.19% |
| 166 | 35 | 86 | 121 | 29% | 12.77% | -16.16% |
| 148 | 5 | 13 | 18 | 28% | 45.45% | 17.68% |
| 162 | 174 | 459 | 633 | 27% | 16.90% | -10.59% |
| 315 | 50 | 134 | 184 | 27% | 14.97% | -12.20% |
| 295 | 2 | 6 | 8 | 25% | 50.00% | 25.00% |
| 210 | 75 | 245 | 320 | 23% | 10.95% | -12.49% |
| 270 | 84 | 365 | 449 | 19% | 13.48% | -5.23% |
| 135 | 247 | 1085 | 1332 | 19% | 14.92% | -3.63% |
| 260 | 51 | 236 | 287 | 18% | 10.28% | -7.49% |
| 245 | 53 | 250 | 303 | 17% | 27.87% | 10.38% |
| 130 | 212 | 1051 | 1263 | 17% | 20.70% | 3.91% |
| 190 | 64 | 322 | 386 | 17% | 15.84% | -0.74% |
| 175 | 39 | 301 | 340 | 11% | 9.45% | -2.02% |
| 285 | 16 | 135 | 151 | 11% | 18.00% | 7.40% |
| 320 |  | 4 | 4 | 0% | 0.00% | 0.00% |
| 325 |  | 6 | 6 | 0% | 0.00% | 0.00% |
| 335 |  | 3 | 3 | 0% | 0.00% | 0.00% |
| Grand Total | 3967 | 7887 | 11854 | 33% |  |  |

Of the ten elementary sites and one middle school currently identified as schools, only three increased student percent Low SES under the Geocoding model. Seven elementary sites and the sole middle level school receiving funds were depicted with 12% to 55% *fewer* Low SES students under the Geocoding model.

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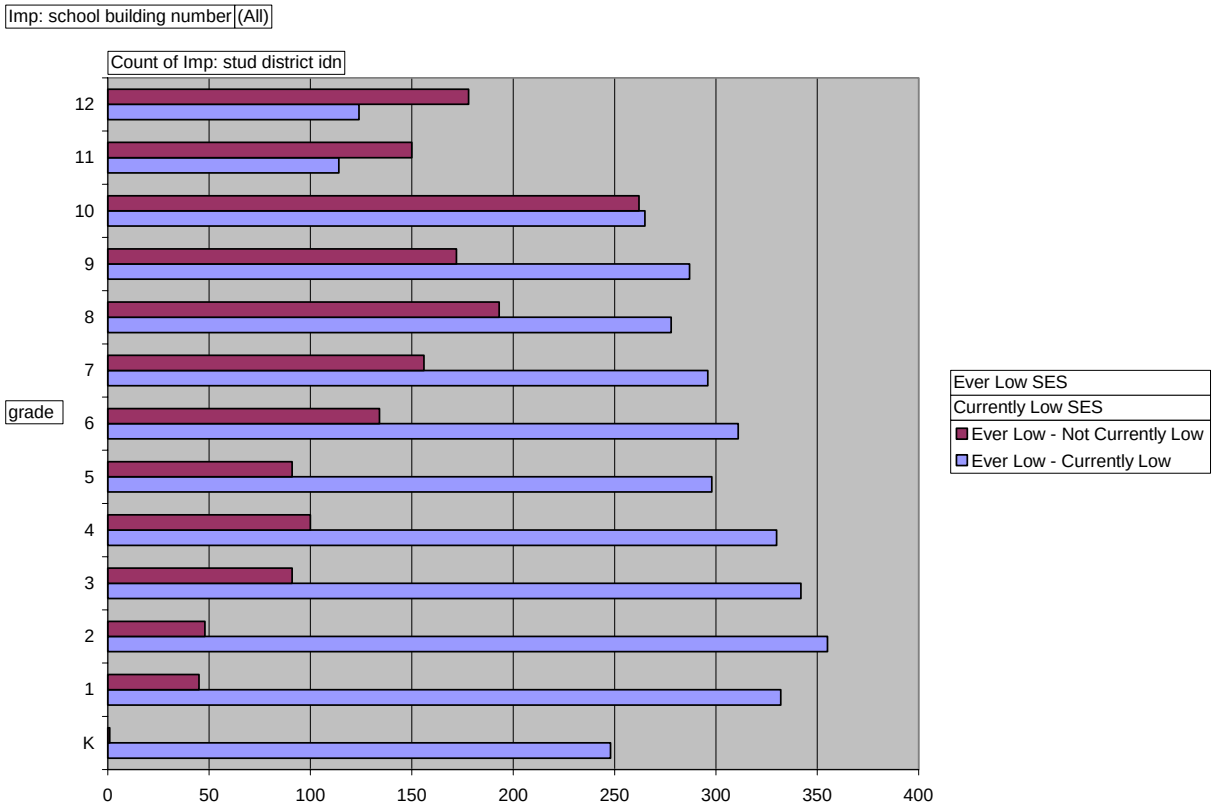
A final treatment of the two data sets finds a minimal correlation between the current F/R application designation of percent Low SES at a site and the Geocoding Blockgroup model. The correlation is 0.67, indicating a less than solid link between the two sets of data.

Before concluding the study, one other area of interest around F/R applications and Low SES identification was analyzed. Another area of potential under-reporting of Low SES status is at the secondary level. In the study district, the number of students that at one point applied for F/R lunch but then did not re-apply grows steadily as the grade level increases (figure 7). This drop in self-referral for F/R lunch is most pronounced in 9th grade; the threshold year for high school. In the Geocoded study group secondary schools overall suffered dramatic decreases in Low SES identification under the Geocode model (figure 6). Sites 130, 135, 138 and 140—all high schools—recorded only one increase in Low SES identification. All the other High Schools had slightly to significantly fewer Low SES enrollments identified under the Geocode model. However, there is a definite pattern of students once in need, no longer self-referring for F/R meal support at the secondary level (figure 7).

While further study of SES changes to typical district students as they age is in order, it appears that a substantial degree of under-reporting of Low SES may be occurring at the secondary level.

Figure 7




*Trevor Mahlum- Assessment Data Coordinator- trevor_mahlum@ncsd.k12.wy.us*
*970 N. Glenn Road- Casper, Wyoming 82609- (307) 261-6139- http://natronaschools.org/~ar*

**Conclusion**

A few issues become clear after analyzing the initial findings from this study. The initial question of the accuracy of current practices of identification in reflecting the true economic need of schools can only be partially answered. This study makes it appear evidence exists to support looking for other indicators to--at the very least--cross reference with the existing ones. While not definitive, the research indicates that significant differences exist between census data associated SES and that recorded by F/R applications at both ends of the economic spectrum.

What is clear is that currently in the study district more students self identify as Low SES with F/R meal applications than are identified through the Geocode model. One significant finding in the GIS data is the fact that the sites (elementary 235, 180 and 170 in figure 6) are very typical "neighborhood" schools. At these sites, unlike the rest of the study district, student enrollment comes largely from a near community. In another district, these schools would very easily fit into an "attendance zone" model. This relative concentration of student residence in one or a few near blockgroups could account for the more homogeneous nature of the SES description from the Geocode model.

In regard to the second question of the change in reliability of F/R as Low SES indicator as grade level increases: an intriguing suggestion of possible error based on the way Low SES is self reported is present in the evidence. The study findings are further muddied by differences in study residential patterns apparent within the study community despite a very liberal open enrollment policy. Further research is needed to eliminate the change in SES of typical district student families over the time students grow through various grades.

This study is not conclusive. There is no obvious decision indicated by the evidence produced. There are, however, enough interesting findings, to warrant further research and investigation. At the very least this study provides evidence of the value of the GIS tools to create a spatial analysis of this social problem. As educational policy makers struggle with making resource decisions where they will have the greatest impact, application of geoinformtic tools will be more and more essential.

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