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State of Residential Water Service Lines in Rock Island, IL: Statistical & Economic Findings and Recommendations

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Lead Service Line Replacement Project

Authors Note:

The authors and contributors of this report recognize the ever-changing nature of a project of this size and goal. The data in this report has been collected over the past 6-12 months and is subject to change. This report is meant for internal use only.

Background Information

City of Rock Island: Water Service Line Statistics:

Our analysis was conducted with a list of **12,625 residential homes** in Rock Island. Through multiple methodologies (e.g. primary verification, survey verification, contractor maintenance, historical records) we were able to achieve **verification for 3,114 (24.66%) homes** for the status of water service lines throughout Rock Island. Leaving 9,511 (75.33%) homes left unknown for prediction. **Of the 3,114 known parcels, 2,279 (73.19%) were Non-Lead (Copper, Cast Iron, PVC, etc.), 647 (20.77%) were Galvanized, and 188 (6.04%) were Lead,** ***AS OF 9/15/23.***

Through several prediction methods (Random Forest based Regression, Empirical Bayesian Kriging Regression, Optimized Hot-Spot Analysis) we've been able to interpret the 9,511 unknown parcels with our known data set. Our work has yielded two results, a Low-End and a High-End prediction.

The **Low-End prediction** estimates around 3.2% to be Lead, 41.4% to be Galvanized, and 55.4% to be Non-Lead across all 12,625 parcels. Note, compared to our current known statistics this model seems to give what may be a *slight underprediction* of Lead, an *overprediction* of Galvanized, and an *underprediction* of Non-Lead. We would expect this prediction to be similar to the current known statistics. That does not mean our predictions are wrong, it could mean that our sample was unrepresentative (we utilized stratified random sampling to the best of our ability when selecting which homes to sample so I find this to be unlikely) or it could mean that there a variable that we are not accounting for in our model (we are currently developing models that will account for these perceived variables, our hypothesis is that our new mathematical models will reduce the overall replacement numbers)

The **High-End prediction** estimates around 12.2% to be Lead, 41.4% to be Galvanized, and 46.4% to be Non-Lead across all 12,625 parcels. Note, compared to our current known statistics this model seems to give what may be a *slight overprediction* of Lead, an *overprediction* of Galvanized, and a *significant underprediction* of Non-Lead. The same explanations apply from above.

We also conducted an **Optimized Hot-Spot Analysis** and found that 7.08% of homes are in what could be considered a hot-spot of Lead, 9.54% of homes are in what could be considered a hot-spot of Galvanized, and 13.55% of homes are in what could be considered a hot-spot of Non-Lead. These findings replicated other statistical tests that tell us the material makeup of water service lines is spatially clustered across Rock Island.

Cost Estimation:

Predicting the cost of a water service line replacement is incredibly difficult to do. Considering the volatile nature of construction services, price fluctuations across time are **unpredictable**. Considering the nature of a water service line replacement the price fluctuations will vary not just across time but also location. The price of one home's replacement does not guarantee the price of another's. That being said, we can provide predictions to be used across a wide range of data. Given the nature of both financial and infrastructure projects, predicting costs more than 5 years into the future can sometimes be futile and even dangerous. It is **heavily** recommended that the replacement of water service lines be segmented into 3-5 year "phases" where costs are predicted in a short-term model. This will ensure a greater accuracy in financial modeling.

To accurately estimate the cost of a LSLR or GRR in Rock Island, data analysis was done on a wide spread of service line replacements done by a specific contractor–provided by Rock Island Public Works. This resulted in a sample size of 28 full replacements spanning from December 2020 to July 2023. The median price across all replacements was $10,723.15. When adjusted for inflation, the median price increases to **$10,781.34** for a single replacement in Rock Island–this figure will be expanded in the following paragraphs.

The cost estimation for a service line replacement took part in two stages. In the first stage, the itemized bills for all replacements are brought to 2023 dollars. Then, in the second stage, the replacement costs are forecasted by the annualized average inflation rate to predict future costs. To increase the accuracy of our estimation, we broke down the contract price into three components: labor, material copper, and miscellaneous costs. We found that–on average–44% of costs are incurred from labor costs, 2.6% from material copper, and 53% from other miscellaneous costs (concrete, machinery, road closures, landscaping, building permits, etc.).

In the first stage of the estimation, we used the following data to adjust the prices of each component of the contract price to October 2023 dollars. All indices are pulled from Federal Reserve Economic Data (FRED), fred.stlouisfed.org.

Components	Data Source	Data frequency
Labor	*ILWCON_NBD20230401 Construction Wages and Salaries in Illinois, Index Q2 2023=100, Quarterly, Seasonally Adjusted Annual Rate*	Quarterly

Copper	*WPU10250239_NBD20230901 Producer Price Index by Commodity: Metals and Metal Products: Copper and Copper Alloy Pipe and Tube, Index Sep 2023=100, Monthly, Not*	Monthly
Miscellaneous	*EXPINF1YR Expected Inflation*;	Monthly

Adjusting for inflation, the median cost of a water service line replacement with wages, material copper, and miscellaneous costs, over the past four years through the specified contractor and Rock Island Public Works was **$10,781.34**. Our calculations are based on the *median* cost for replacement, recognizing that, on average, 50% of replacements will cost less than $10,781.34, and 50% will cost more than $10,781.34. The interquartile range (25%→75%) for all provided service replacements from McClintock since 2020 is $6,325.75 → $14,896.51. This is the statistical range for Rock Island specifically; on average, we expect 50% of homes will fall within this range.

In the second stage of the cost estimation, we decided to use a uniform rate of increase to project the labor and copper prices, whereas we decided to use Octobers 2023's CPI forecast to project the miscellaneous costs. For the rates for labor and copper, we found the periodic rate of change for each of the indices for the past 10 years–the Illinois wages are reported quarterly, and the copper prices are reported monthly–then, annualized each rate to find the average over the 10-year period. We found an expected annual inflation cost for wages to be 5.37% annually, material copper to be 5.88% annually, and miscellaneous costs to be 2.3% annually. Once we obtained the forecasted rate of change for all three components, we weighted the rates based on the percentage of the components we calculated (Labor:44%, Copper:2.6%, Miscellaneous:53%) to reach the annual projected change in price for the time span of the project. We then compounded the rate so that it could be used to calculate the projected price for each individual year by applying the rate to the current price.

Overall, the average–expected–cost for a service line replacement **in Rock Island in 2023** is $10,781.34. Five years from now, in 2028, it is projected to cost $12,981.11. Ten years from now, in 2033, it is projected to cost $15,531.71. Fifteen years from now, in 2038, it is projected to cost $18,585.83. Twenty years from now, in 2044, it is projected to cost $23,083.18. **All in October 2023 dollars**

This greatly emphasizes the need to start replacement sooner, rather than later. It is heavily recommended that replacement for the first 7 years (until 2030) be prioritized for frontloading, as after 2030 the cost per replacement begins to outpace normal inflation expectations exponentially (The cost of a replacement is projected to outpace inflation expectations by 41% by 2030 and 209% by 2040. Whereas from 2023 to 2030 it is only projected to outpace expected inflation by only 30%).

<u>Current</u> Cost Estimation:

Using our known parcel data, 188 Lead homes and 647 Galvanized homes, there is a current need for **835 replacements**. At an estimated rate of **7% per year, 59 homes per year**, the total cost adjusting for compounding inflation will be **$11,937,317.23** over **15 years**.

The cost breakdown for each Ward looks like the following:

- Ward 1
  - Current need for **76** replacements with **30 Lead** and **46 Galvanized**, at an estimated rate of 6% per year, 6 homes per year, the total cost adjusting for compounding inflation will be **$1,086,510.31** over **15 years.**
- Ward 2
  - Current need for **44** replacements with **8 Lead** and **36 Galvanized**, at an estimated rate of 6% per year, 3 homes per year, the total cost adjusting for compounding inflation will be **$929,032.29** over **15 years.**
- Ward 3
  - Current need for **158** replacements with **33 Lead** and **125 Galvanized**, at an estimated rate of 6% per year, 11 homes per year, the total cost adjusting for compounding inflation will be **$2,258,797.75** over **15 years.**
- Ward 4
  - Current need for **159** replacements with **32 Lead** and **127 Galvanized**, at an estimated rate of 6% per year, 11 homes per year, the total cost adjusting for compounding inflation will be **$2,273,093.94** over **15 years.**
- Ward 5
  - Current need for **125** replacements with **28 Lead** and **97 Galvanized**, at an estimated rate of 6% per year, 9 homes per year, the total cost adjusting for compounding inflation will be **$1,787,023.54** over **15 years.**
- Ward 6
  - Current need for **129** replacements with **21 Lead** and **108 Galvanized**, at an estimated rate of 6% per year, 9 homes per year, the total cost adjusting for compounding inflation will be **$1,844,208.29** over **15 years.**
- Ward 7
  - Current need for **144** replacements with **36 Lead** and **108 Galvanized**, at an estimated rate of 6% per year, 9 homes per year, the total cost adjusting for compounding inflation will be **$2,058,651.12** over **15 years.**

	# of Lead homes	# of Galv homes	Total Replacement #	Total # of homes	% of homes to be replaced	Total cost per ward	Total cost per ward
Ward 1	30	46	76	1528	4.97%	$1,086,510.31	$51,738.59
Ward 2	8	36	44	1565	2.81%	$629,032.29	$29,953.92

Ward 3	33	125	158	1887	8.37%	$2,258,797.75	$107,561.80
Ward 4	32	127	159	2255	7.05%	$2,273,093.94	$108,242.57
Ward 5	28	97	125	1477	8.46%	$1,787,023.54	$85,096.36
Ward 6	21	108	129	1467	8.79%	$1,844,208.29	$87,819.44
Ward 7	36	108	144	2446	5.89%	$2,058,651.12	$98,031.01
All Wards	**188**	**647**	**835**	**12625**	**6.61%**	**$11,937,317.23**	**$568,443.68**

<u>Predictive</u> Cost Estimation:

Using our **two** predictive models we can provide a Low-End and a High-End total cost estimate for the two models. **NOTE, these cost estimations are only if the two predictive models are to be true.**

For the **Low-End** model, predicted 3.2% Lead and 41.4% Galvanized. This sums to **approximately ~5,600 homes for replacement** at an estimated rate of **5% per year**, 338 homes per year, the total cost adjusting for compounding inflation will be **$82,595,304.23** over **20 years.**

The cost breakdown for the **Low-End** model of each Ward looks like the following:

- Ward 1
  - Predicted need for **692** replacements with **41 Lead** and **651 Galvanized**, at an estimated rate of 7% per year, 42 homes per year, the total cost adjusting for compounding inflation will be **$10,162,864.60** over **20 years.**
- Ward 2
  - Predicted need for **608** replacements with **15 Lead** and **593 Galvanized**, at an estimated rate of 7% per year, 37 homes per year, the total cost adjusting for compounding inflation will be **$8,929,222.60** over **20 years.**
- Ward 3
  - Predicted need for **926** replacements with **80 Lead** and **846 Galvanized**, at an estimated rate of 7% per year, 56 homes per year, the total cost adjusting for compounding inflation will be **$13,599,440.21** over **20 years.**
- Ward 4
  - Predicted need for **739** replacements with **84 Lead** and **655 Galvanized**, at an estimated rate of 7% per year, 45 homes per year, the total cost adjusting for compounding inflation will be **$10,853,116.97** over **20 years.**

- Ward 5
    - Predicted need for **843** replacements with **69 Lead** and **774 Galvanized**, at an estimated rate of 7% per year, 51 homes per year, the total cost adjusting for compounding inflation will be **$12,380,483.90** over **20 years.**
- Ward 6
    - Predicted need for **942** replacements with **25 Lead** and **917 Galvanized**, at an estimated rate of 7% per year, 57 homes per year, the total cost adjusting for compounding inflation will be **$13,834,419.73** over **20 years.**
- Ward 7
    - Predicted need for **971** replacements with **85 Lead** and **789 Galvanized**, at an estimated rate of 7% per year, 53 homes per year, the total cost adjusting for compounding inflation will be **$12,835,756.74** over **20 years.**

	Low-End Lead #	Low-End Galv #	Low-End Replacement #	Low-End Replacement Rate	Total # of homes	Low-End Replacement %	Low-End Cost per Ward	Low-End Cost per Year
Ward 1	41	651	692	42	1528	45.29%	$10,162,864.60	$483,945.93
Ward 2	15	593	608	37	1565	38.85%	$8,929,222.08	$425,201.05
Ward 3	80	846	926	56	1887	49.07%	$13,599,440.21	$647,592.39
Ward 4	84	655	739	45	2255	32.77%	$10,853,116.97	$516,815.09
Ward 5	69	774	843	51	1477	57.08%	$12,380,483.90	$589,546.85
Ward 6	25	917	942	57	1467	64.21%	$13,834,419.73	$658,781.89
Ward 7	85	789	874	53	2446	35.73%	$12,835,756.74	$611,226.51
All Wards	**399**	**5225**	**5624**	**49**	**12625**	**44.55%**	**$82,595,304.23**	**$3,933,109.73**

For the **High-End** model, 12.2% Lead and 41.4% Galvanized. This sums to **approximately ~6,700 homes for replacement** at an estimated rate of **6% per year**, 406 homes per year, the total cost adjusting for compounding inflation will be **$99,322,909.41** over **20 years.**

The cost breakdown for the **High-End** model of each Ward looks like the following:

- Ward 1
    - Predicted need for **1054** replacements with **403 Lead** and **651 Galvanized**, at an estimated rate of 7% per year, 64 homes per year, the total cost adjusting for compounding inflation will be **$15,4791276.43** over **20 years.**

- Ward 2
    - Predicted need for **682** replacements with **89 Lead** and **593 Galvanized**, at an estimated rate of 7% per year, 41 homes per year, the total cost adjusting for compounding inflation will be **$10,016,002.40** over **20 years.**
- Ward 3
    - Predicted need for **1066** replacements with **220 Lead** and **846 Galvanized**, at an estimated rate of 7% per year, 64 homes per year, the total cost adjusting for compounding inflation will be **$15,655,511.08** over **20 years.**
- Ward 4
    - Predicted need for **865** replacements with **210 Lead** and **655 Galvanized**, at an estimated rate of 7% per year, 52 homes per year, the total cost adjusting for compounding inflation will be **$12,703,580.75** over **20 years.**
- Ward 5
    - Predicted need for **1052** replacements with **278 Lead** and **774 Galvanized**, at an estimated rate of 7% per year, 64 homes per year, the total cost adjusting for compounding inflation will be **$15,449,903.99** over **20 years.**
- Ward 6
    - Predicted need for **1073** replacements with **156 Lead** and **917 Galvanized**, at an estimated rate of 7% per year, 65 homes per year, the total cost adjusting for compounding inflation will be **$15,758,314.62** over **20 years.**
- Ward 7
    - Predicted need for **971** replacements with **182 Lead** and **789 Galvanized**, at an estimated rate of 7% per year, 59 homes per year, the total cost adjusting for compounding inflation will be **$14,260,320.13** over **20 years.**

	High-End Lead #	High-End Galv #	High-End Replacement #	High-End Replacement Rate	Total # of homes	High-End Replacement %	High-End Cost per Ward	High-End Cost per Year
Ward 1	403	651	1054	64	1528	68.98%	$15,479,276.43	$737,108.40
Ward 2	89	593	682	41	1565	43.58%	$10,016,002.40	$476,952.50
Ward 3	220	846	1066	64	1887	56.49%	$15,655,511.08	$745,500.53
Ward 4	210	655	865	52	2255	38.36%	$12,703,580.75	$604,932.42
Ward 5	278	774	1052	64	1477	71.23%	$15,449,903.99	$735,709.71
Ward 6	156	917	1073	65	1467	73.14%	$15,758,314.62	$750,395.93
Ward 7	182	789	971	59	2446	39.70%	$14,260,320.13	$679,062.86
All Wards	**1538**	**5225**	**6763**	**59**	**12625**	**53.57%**	**$99,322,909.41**	**$4,729,662.35**

Recommendations:

1) As with any other infrastructure project, it is crucial to have multiple streams of revenue for each year, or phase, of the project.
2) Focus on reducing the "financial burden" of households falling below 150% of the Federal Poverty Level (FPL) as per recommendation from the Illinois Lead Service Line Replacement Advisory Board (LSLRAB).
3) Conduct an analysis of the financial ability to pay among all households connected to water service while focusing on protecting low-income households from sustained water rate increases.
    a) The Illinois LSLRAB advised a progressive charge on water rates to protect lower-income households.
4) To complete the replacements of Lead Service Lines (LSLs) and Galvanized Service Lines (GSLs) in the most efficient manner it is heavily recommended that replacement be done at the city block level rather than a piecemeal replacement (done randomly jumping house to house). This ensures the most efficient implementation of: transportation of equipment, road closures, homeowner consent, etc.
    a) "It is generally far cheaper and faster to replace the entire service line for every house along a street or in a neighborhood at once, rather than to do the replacements piecemeal based on individual customers' willingness to pay."[1]
    b) The Illinois LSLRAB recommends block-level replacement also for operational efficiencies.[1]

[1] http://clinics.law.harvard.edu/environment/files/2019/04/Rates-Fund-LSL-Replacement-States_Harvard_EDF_2019.pdf

5) Expect future price increases of completing an LSL replacement.
    a) It's not uncommon to see a 20%-100% increase per year.[2]
        i) The city of Springfield Illinois saw a 68% increase in cost from phases 1-2 (2021-2023) of their project.[3]
6) Prioritize certain vulnerable individuals for Lead Service Line Replacement (LSLR) first.
    a) Lead is a neurotoxin that disproportionately affects children under 5 years of age in terms of brain mass development.
    b) Prioritization of socially and economically disadvantaged households will provide future sustained community development.
7) The most successful LSLR projects have split up replacement goals into "phases".
    a) Creating 3-5-year phases allows for not only better economic projections but it can create achievable goals.
    b) Continuous upkeep and implementation of new methodologies are advised.

Potential Funding Options:

Federal:

1. **Drinking Water State Revolving Fund (DWSRF)**
    a. The DWSRF is, to date, the largest single source of monies solely dedicated to LSLR.
    b. $11.7 billion administered over 5 years through the Bipartisan Infrastructure Law.
    c. 49% of the loans have to be administered as
        - grants, forgivable loans, zero interest, or negative interest loans on the basis of a state's *"disadvantaged community"* definition consistent with the Safe Drinking Water Act.
        i. The average loan length is 30 years.
            1. Disadvantage communities would qualify for an extended loan period of 40 years.[4,5]
        ii. The DWSRF rate is 1.24% through June 2023[6] well below the market average.

[2] https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/drinking-water/public-water-users/documents/lead-service-line-replacement-advisory-board/city-of-springfield-lead-service-line-replacement-program-rev-5.pdf
[3] https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/drinking-water/public-water-users/documents/lead-service-line-replacement-advisory-board/city-of-springfield-lead-service-line-replacement-program-rev-5.pdf
[4] https://www.epa.gov/system/files/documents/2022-12/DWSRF%20DAC%20Definitions%20Webinar%20-%20November%202022_508ed.pdf
[5] https://www.epa.gov/system/files/documents/2023-06/DWSRF%20infographic-May%202023-508%20%281%29.pdf
[6] https://epa.illinois.gov/topics/grants-loans/state-revolving-fund.html

iii. The Illinois DWSRF base interest rate from July 1, 2023, through June 30, 2024, is 1.81%.[7]
    1. It is heavily recommended that the implementation of a project start sooner rather than later as the cost of borrowing can increase with time and the competitiveness of the funds starting after 2027.
iv. Repayment of the loan can start up to 18 months after the project completion.[8]

d. The IEPA is expected to receive $230.2 million in the 2023 FY.[9]
    i. Estimated $1.03 billion over 5 years in Illinois.
e. Every July 1st, the annual rates are set. The applications for the upcoming FY are due March 31st.

2. Community Development Block Grants (CDBG)

a. Administered through the U.S. Department of Housing and Urban Development (HUD)
b. Recipients usually have much more flexible discretion of the funds, however, they must demonstrate a benefit for low- or middle-income households.
    i. No less than 70% of the funds must be used to benefit low- or middle-income households.[10] *[See Figure 1]*

c. Healthy Homes Production Grant Program

d. Lead Hazard Reduction Healthy Homes Supplements

i. Focusing on Low-income households with children.[11] *[See Figures 1-4]*
ii. Can be used for LSLR following the Healthy Homes rating system.[12]

e. Public Housing Fund

i. Healthy Homes Set-Aside

1. Lead pipe replacement would fall under the "other housing hazards" category.

ii. Capital Fund Formula Grants

f. Housing Trust Fund

[7] https://epa.illinois.gov/topics/grants-loans/state-revolving-fund.html
[8] https://www.epa.gov/system/files/documents/2023-06/DWSRF%20infographic-May%202023-508%20%281%29.pdf
[9] https://www.epa.gov/system/files/documents/2023-04/Final_FY23%20DWSRF%20Allotment%20Memo%20and%20Attachments_April%202023.pdf
[10] https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/drinking-water/public-water-users/documents/lead-service-line-replacement-advisory-board/2023_LeadServiceLineReplacement_FINAL_6-29-23.pdf
[11] https://www.hud.gov/program_offices/healthy_homes/hhi
[12] https://www.hud.gov/sites/documents/PGI-2016-02.PDF

i. Only for low-(below 50% AMI) and extremely low-(below 30% AMI) income households.[13] *[See figure 5]*

3. **Water Infrastructure Finance and Innovation Act (WIFIA)**
    a. Low/fixed long-term rates
        i. Similar to the U.S. Treasury maturity. [14]
        ii. Average rate 2.25% [10]
    b. Flexible loan repayment terms
        i. Rates are not determined by the borrower's credit rating.[9]
    c. Recently announced added $7.5 Billion dollars in new Federal Funding.
    d. $20 million minimum project size for large communities.[9]
    e. 35-year maturity date from the "substantial completion" date.[9]
    f. Deferred Payments up to 5 years after "substantial completion" date.[9]
    g. Loan amount can exceed $100 million.[15]
    h. Loan amount *cannot* exceed 49% of the project's total cost.[16]

4. **Water Infrastructure Improvements for the Nation Act (WIIN)**
    a. WIIN Grant: Reducing Lead in Drinking Water
        i. Funding is awarded on a "competitive basis" with priority given to disadvantaged communities with an action level exceeding the last 3 years in school, daycare, or other facility that primarily serves children.[17] *[See Figures 2-3]*

State:

1. **IEPA Public Water Supply Loan Program (PWSLP)**
    a. Low-interest and forgivable loans are provided through a capitalization grant from the federal government.
    b. $340 million in the 2023 FY in IL.[18]

2. **Coronavirus State and Local Fiscal Recovery Funds**
    a. Can use ARPA funds for LSLR[19]

[13] https://www.iira.org/rdrg/housing-trust-fund/
[14] https://www.epa.gov/sites/default/files/2021-03/documents/wifia_benefits_factsheet.pdf
[15] https://www.epa.gov/wifia/wifia-fund-facts-dashboard
[16] https://www.epa.gov/wifia/what-wifia
[17] https://www.epa.gov/dwcapacity/water-infrastructure-improvements-nation-act-wiin-act-grant-programs#reducing
[18] https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/drinking-water/public-water-users/documents/lead-service-line-replacement-advisory-board/2023_LeadServiceLineReplacement_FINAL_6-29-23.pdf
[19] https://www.govinfo.gov/content/pkg/FR-2022-01-27/pdf/2022-00292.pdf

3. **Rebuild IL Capital Program**
    a. Any unspent funds can be used for LSLR.[20]
4. **Lead Poisoning Screening, Prevention, and Abatement Fund**
    a. Can be used for lead reduction in childcare facilities. There is no language "enabling or prohibitory" for LSLR. The LSLRAB advised this fund can be used for LSLR.[17]
5. **General Revenue Funds**
    a. There is $200 million dedicated for LSLR per year in the General Revenue Fund
        i. $10 million "pay-as-you-go" capital grants.[21]

Local:

1. **Ratepayer Funds**
    a. Advised if a progressive payment plan is produced that reduces the financial burden on households below 150% of FPL and protects low-income households from rate increases. *[See Figure 6]*
    b. Legislation has proven it's ethical with a set of parameters (need to disclose how all the funds are being used, justification for price, deemed to benefit public health)
        i. Reducing early childhood lead exposure results in lower public medical expenses and educational expenses. See, e.g., John Paul Wright, et al., Association of Prenatal and Childhood Blood Lead Concentrations with Criminal Arrests in Early Adulthood, 5(5) PLOS Medicine e101 (2008); S.D. Lane, et al., Environmental Injustice: Childhood Lead Poisoning, Teen Pregnancy, and Tobacco, 42 J. Adolescent Health 43 (2008); R. Nevin, How Lead Exposure Relates to Temporal Changes in IQ, Violent Crime, and Unwed Pregnancy, 83 Envtl. Research 1 (2000).
    c. Best for communities with a small amount of lines to be replaced (lower than 15%)
    d. "It is reasonable and fair to residents for utilities to use ratepayer funds to replace LSLs on private property when the current homeowners generally played no role in the choice of installing an LSL"[22].
2. **On-Bill Financing**

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[20] https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/drinking-water/public-water-users/documents/lead-service-line-replacement-advisory-board/2023_LeadServiceLineReplacement_FINAL_6-29-23.pdf

[21] https://budget.illinois.gov/content/dam/soi/en/web/budget/documents/budget-book/fy2024-budget-book/Fiscal-Year-2024-Operating-Budget.pdf

[22] http://clinics.law.harvard.edu/environment/files/2019/04/Rates-Fund-LSL-Replacement-States_Harvard_EDF_2019.pdf

a. LSLRAB recommends that on-bill financing could come with either, or, or both water/sewer bills, recommending a progressive fee structure be put in place. *[See "Progressive Payment Structures" Section]*
b. The surcharge would stay with the water meter so an ownership change wouldn't matter.

3. **Municipal Bonds**
    a. Municipal bonds are a very attractive option for funding LSLR. A conference held by the Chicago Federal Reserve in accordance with several "municipal water system officials, philanthropists, and innovative leaders who work in public finance or with private capital markets".[23] A municipal bond market is an attractive option for two reasons; these types of bonds have low default rates and offer market value returns.
        i. If these two conditions are met then the private investment from municipal bonds would be an excellent source of funding.
    b. However, two main concerns for using a municipal bond issue for water system infrastructure improvements are,
        i. Water-System creditworthiness: These types of bonds require demonstrated high credit ratings from an accredited rating agency to attract sufficient private investment.
        ii. Size of the infrastructure project: A bond issue of this size, tens of millions of dollars, would require massive borrowing from financial institutions where recent interest rate increases and demonstrated monetary stringency by the Federal Open Market Committee (FOMC) would increase the cost of borrowing substantially.
    c. The City of Denver, Colorado, used a municipal bond issue to fund their replacements of LSL.
        i. https://www.denverwater.org/sites/default/files/official-statement-green-bonds.pdf
4. **Tax Revenue**
    a. Property Tax
        i. The revenue generated by this option is unknown to the authors at this time.
        ii. If property taxes are deemed a serious option for funding, a deep financial study is heavily advised to avoid any unnecessary pressures on the already stressed housing market in Rock Island.
    b. Sales Tax

5. **Capital Improvement Funds**

[23] https://www.chicagofed.org/research/lead/lead-service-line-replacement-funding-and-financing-strategies

a. The revenue generated by this option is unknown to the authors at this time.

6. **Creative Funding Options**
    a. Consider partnering with neighboring healthcare providers. There has been previous displayed interest by healthcare providers to help target other public health issues. One example would be healthcare providers paying to use holes/trenches in yards to plant trees to promote better air quality.
    b. Advertisement space (GIS website, water towers, partnership with John Deere?)
    c. Lambeau Field sales tax rebate was used to provide homeowner reimbursements in Wisconsin.
    d. Cincinnati created a "Thirsty Thursday" program where local breweries donate a portion of their proceeds to fund LSLR.[24]

Other Financial Considerations

- If creditworthiness cannot be met through local channels there is potential for credit/financial consideration through the Community Reinvestment Act (CRA). The CRA (1977) helps low- and moderate-income communities/neighborhoods access the needed credit and meet the needs of borrowing in private markets.
    - If the City of Rock Island does not meet credit market requirements for a substantial infrastructure project, one the size of the expected replacements required, the CRA would be an integral aspect for accessing private equity pertaining to LSLR
- A potential vehicle to access private equity would display environmental, social, and governance (ESG) impacts. Showing all of these aspects to potential investors would be a way to tell a story to investors that would drastically increase the potential of receiving private equity funding.
    - An example of ESG impacts are:
        - Environmental: Public Health hazard of lead.
        - Social: Children/Public Health hazard of lead, prioritization of low-income households.
        - Governance: Compliance with the Illinois Lead Service Line Replacement and Notification Act.[25]
- Another vehicle to access private equity is through outcomes-based financing and social-impact investing.

[24] https://www.metroplanning.org/news/10378/Funding-lead-service-line-replacement-programs
[25] https://ilga.gov/legislation/ilcs/documents/041500050K17.12.htm

Water Service Line Replacement Customer Repayment Plan

1) 24-month 0% interest account paid monthly with public works.
2) 5-year ~3.5% *(consistent with 5-year US Treasury)* interest lien paid quarterly either on the property or the water meter.
3) 10-year ~5% *(consistent with 10-year US Treasury)* interest lien paid quarterly either on the property or the water meter.

Progressive Payment Structures

As per the Illinois Lead Service Line Replacement Advisory Board, protecting individuals living below 150% of the FPL (45k) from financial burden and protecting low-income households from water rate increases is a priority when considering using rate-payer funds[26]. In that same report, the Illinois Lead Service Line Replacement Advisory Board cited a progressive rate structure program, where depending on what income class a household resides in there would be either an exemption, a negligible increase, or an increase of water rates across the whole system to benefit public good. In the same report, the Illinois Lead Service Line Replacement Advisory Board writes, "A flat rate increase could have a disproportionate impact on low-income residents who are already struggling to pay their water bills." This effect would be especially pronounced in Rock Island, IL, as 25% of households are classified as low-income (80% of Area Median Income (AMI)). Water payment assistance programs/progressive payment structures could be a way to offset this financial burden on low-income households. The Illinois Lead Service Line Replacement Advisory Board cites that cities not wanting to tie assistance to income can use other guidelines such as SNAP and Low Income Home Energy Assistance Program (LIHEAP) recipients.

With how high the predicted yearly cost is, between $4-$10 million per year, the ability of the City of Rock Island to pay for 100% of replacement costs might come as a burden to those aforementioned individuals if a significant portion of funding is coming from city monies. A way to alleviate this would be to have a progressive split payment model when paying for the cost of a replacement. In our predictive cost models, we've built in a function where a portion of the replacement cost for the homeowner would be shared with the city and the homeowner.

Many cities have used progressive split payment models when financing their infrastructure projects.

[26] https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/drinking-water/public-water-users/documents/lead-service-line-replacement-advisory-board/2023_LeadServiceLineReplacement_FINAL_6-29-23.pdf

- The District of Columbia is paying 100% replacement costs for certain individuals based on income.[27]
- The City of Chicago, Illinois, is paying 100% replacement costs for all low-income individuals (80% of Area Median Income).[28]
- The City of Elmhurst, Illinois is paying 50% of all replacement costs.[29]
- The City of Albany, New York, is paying up to $2,000 in replacement costs.[30]
- The City of Oconomowoc, Wisconsin, is paying up to $2,500 in replacement costs.[31]
- The City of Evanston, Illinois, is paying up to 50% of replacement costs.[32]
- The City of Naperville, Illinois, is paying up to $4,250 for a full replacement cost, and $2,550 for half replacement cost.[33]

Potential Employment Opportunities:

"There is potential for banks to receive consideration under the Community Reinvestment Act when they help finance LSL replacement in low- and moderate-income (LMI) communities.[34] The Community Reinvestment Act (CRA) of 1977 a seminal pieces of legislation to address systemic inequities in access to credit for LMI communities[35]. Under the CRA, banks may be evaluated for their community development activities, including lending, in the LMI communities they serve. In 2020, banks reported over $169 billion in community development lending[36]. Attendees at the event discussed the potential for bank lending to help pay for LSL replacement—including bank investments in municipal bonds, state revolving fund bonds, and even personal loans—to be treated as a community development activity. Attendees also discussed the potential for banks to receive CRA consideration for funding workforce training that supports LSL replacement. By offering residents in LMI communities a chance to learn the plumbing trade, this job training would allow a neighborhood to build up its vocational capacity while reducing its risk of lead exposure. Attendees agreed that Community Development Financial Institutions (CDFIs) have the potential to play an important intermediary role between banks and communities by identifying lending opportunities and delivering funding[37]. Proposed

[27] https://www.dcwater.com/replacelead
[28] https://www.leadsafechicago.org/equity-lead-service-line-replacement-program
[29] https://elmhurst.org/1849/Lead-Service-Line-Information
[30] https://www.albanyny.gov/1932/Lead-Service-Replacement-Program
[31] https://www.oconomowoc-wi.gov/DocumentCenter/View/7462/Lead-Service-Line-Replacement-Program
[32] https://www.cityofevanston.org/government/departments/public-works/public-outreach/evanston-water-sewer-service/lead-in-drinking-water
[33] https://www.naperville.il.us/services/water-utility/your-water-service/water-quality/
[34] https://www.minneapolisfed.org/article/2018/defining-low--and-moderate-income-and-assessment-areas
[35] https://www.federalreserve.gov/consumerscommunities/cra_about.htm
[36] https://www.ffiec.gov/hmcrpr/cra_fs21.htm
[37] https://www.cdfifund.gov/sites/cdfi/files/documents/cdfi_infographic_v08a.pdf

updates to the CRA regulations released in May 2022,[38] treat water infrastructure investments that meet certain criteria as a community development activity and, as such, eligible for CRA credit[39]. This means that banks, CDFIs, and communities may find it worthwhile to discuss the potential role of the CRA in helping fund LSL replacement and related workforce training in LMI communities" (Anderson, Hull, & Saxena, 2022)[40].

- During the bidding process, there would be an opportunity to stipulate that a certain proportion of the service line replacements be done with certain unemployed/underemployed/job-insecure residents of Rock Island. This would be done by block-by-block analysis of unemployment to decipher high-need areas. Then community outreach in the specified areas to provide equitable opportunity to underserved individuals. *[See Figure 7]*

Replacement and Distribution Recommendations:

When considering how to go about LSLR the notion of equity should be first on the mind. How can we best protect the socially and economically disadvantaged to make sure that their water service lines get replaced first; keeping in mind the competitiveness and limitations of federal funding knowing that we won't have enough "free" money to go around. The author of this report has developed a statistical aid to help when prioritizing the replacement of LSLs and GSLs. The "Social Disadvantagement Idex" or "SDI" is a statistical tool that provides guidance on where to look first. The Social Disadvantagement Index uses 5 census variables, 2023PopAge25HighSchoolNoDiploma *(normalized for population)*, 2022ChildPopulation *(normalized for population)*, 2022RenterOccupiedHUs *(normalized for population)*, 2021HHsIncBelowPovertyLevelACS5Yr *(normalized for population)*, and 2022 Per Capita Income: Index, in a linear regression model to quantify social and economic disadvantagement of a city block in Rock Island comparative to every other block in Rock Island. This tool can serve as an aid when determining which homes/city blocks receive prioritization for the replacement of LSLs and GSLs.

This tool can also be used in conjunction with census variables of children under 5, as they are the most vulnerable population for adverse health effects. A replacement schedule that combines these data sets could potentially look like this: *[See Figure 9]*

- Sort dataset *X* into "bins" (bottom 10%, then 11-20%, then 21-30%, etc.) Overlay dataset *X* with dataset *Y* and within the top 91-100% of dataset *X* pick the homes with the highest

[38] https://www.federalreserve.gov/consumerscommunities/community-reinvestment-act-proposed-rulemaking.htm

[39] https://www.chicagofed.org/publications/blogs/cdps/2022/cra-modernization-and-community-development

[40] https://www.chicagofed.org/research/lead/lead-service-line-replacement-funding-and-financing-strategies

numbers within dataset *Y*. Once all the homes in the top 91-100% of dataset *X* are depleted, move to the next 81-90% homes of dataset *X*. Note the interchangeability of the *X* and *Y* datasets. You could sort blocks by highest SDI ranking and choose within the highest 91-100% the block with the highest number of children under 5, or you could sort by children under 5 and choose within the highest 91-100% the highest SDI ranked homes.

As written before, when conducting replacements of LSLs and GSLs it is most efficient to conduct replacement on the block level rather than a piecemeal replacement (done randomly jumping from house to house). This ensures the most efficient implementation of transportation of equipment, road closures, homeowner consent, etc.
"It is generally far cheaper and faster to replace the entire service line for every house along a street or in a neighborhood at once, rather than to do the replacements piecemeal based on individual customers' willingness to pay".[41]

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[41] http://clinics.law.harvard.edu/environment/files/2019/04/Rates-Fund-LSL-Replacement-States_Harvard_EDF_2019.pdf

Figure 1

Low- to Moderate-Income Households

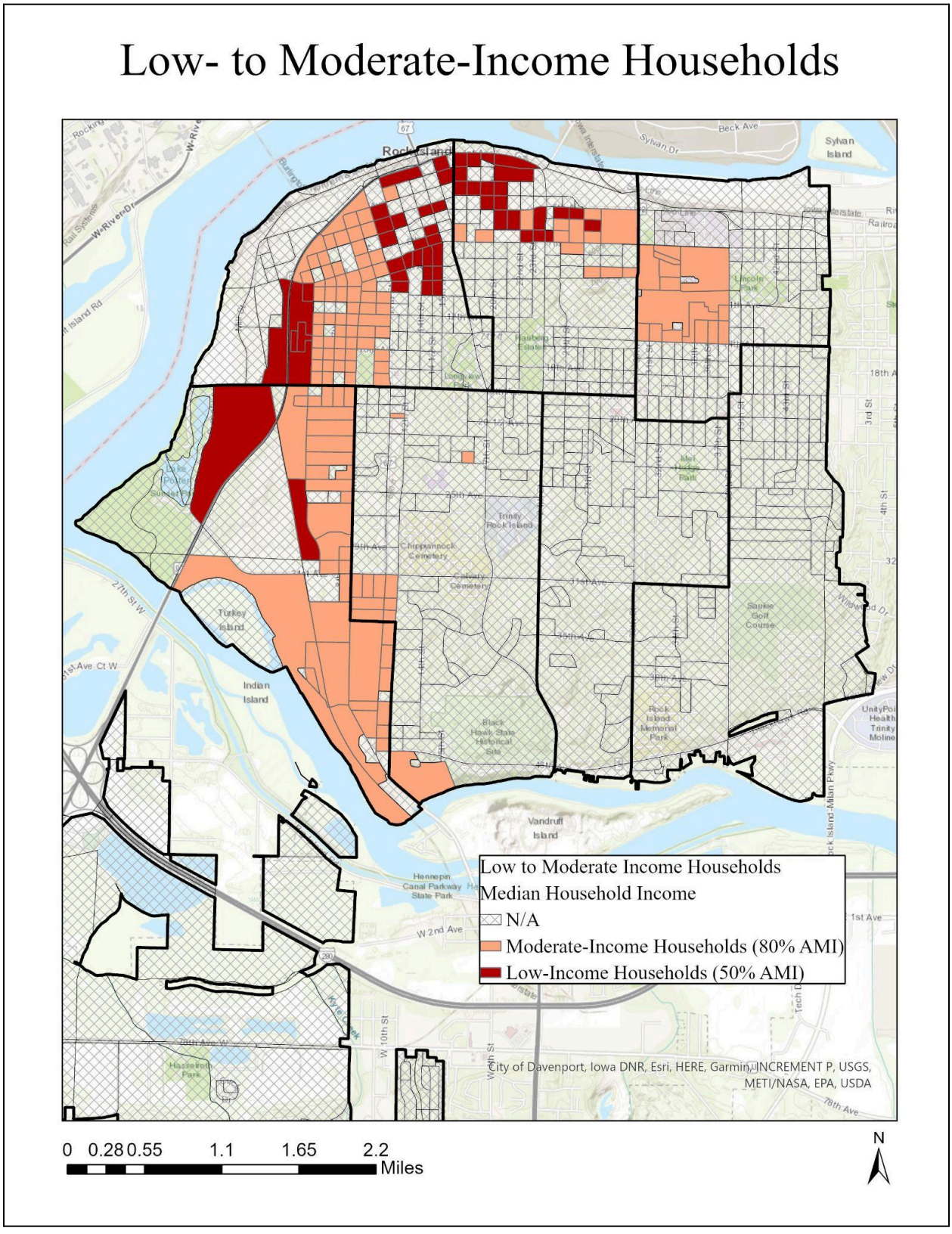

Figure 2

Children Population

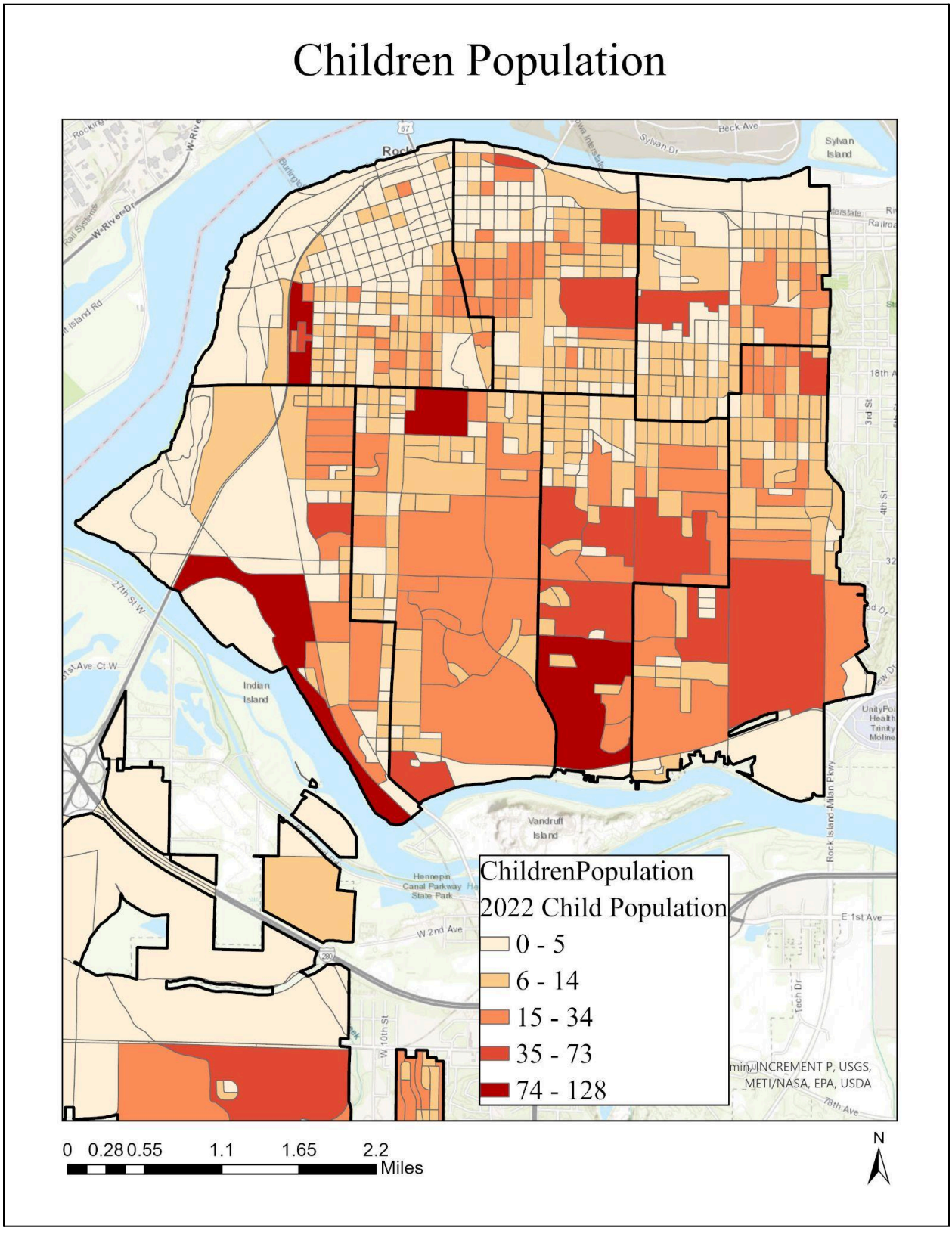

Figure 3

Children under 5

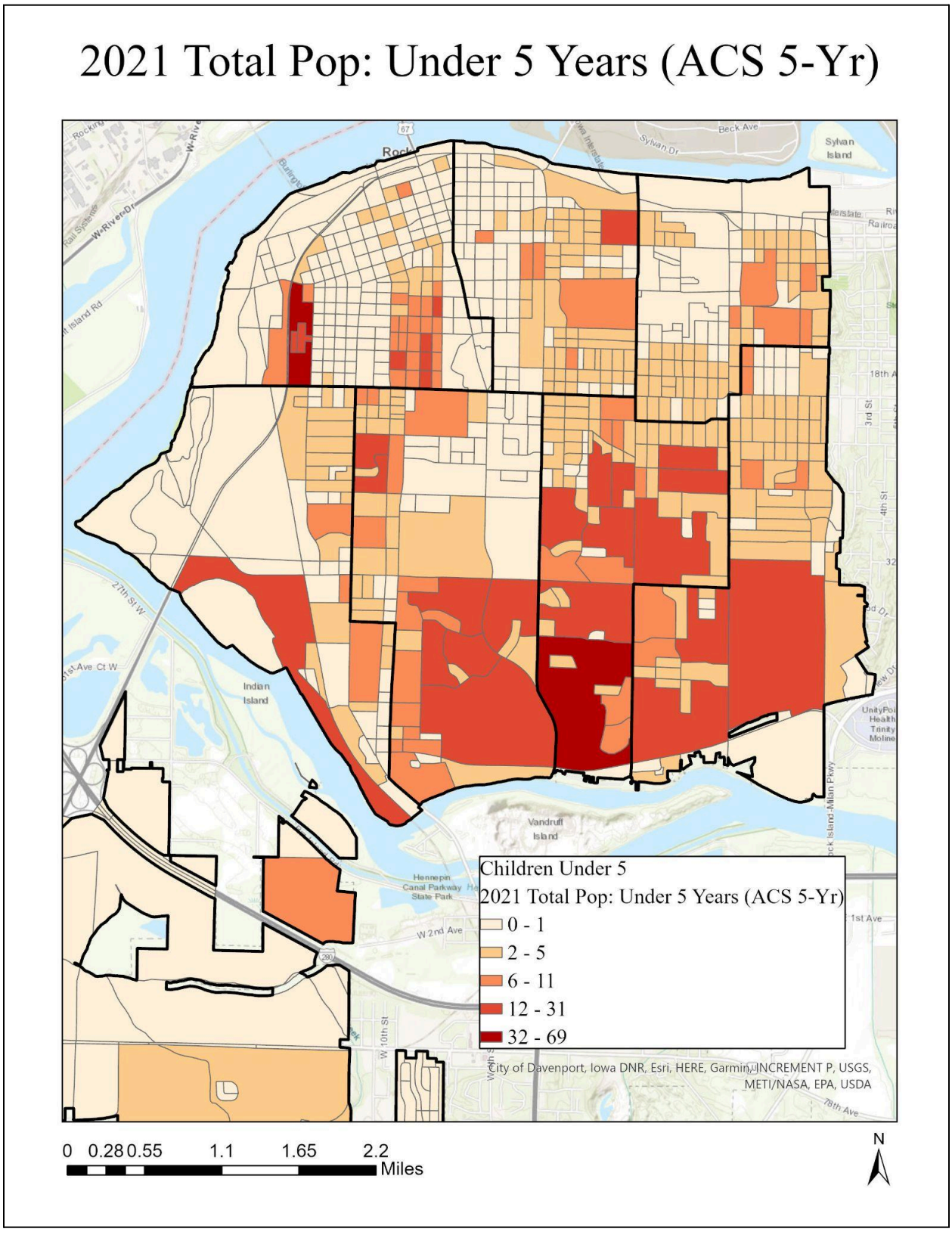

Figure 4

Bivariate map of Children Under and Median Household Income

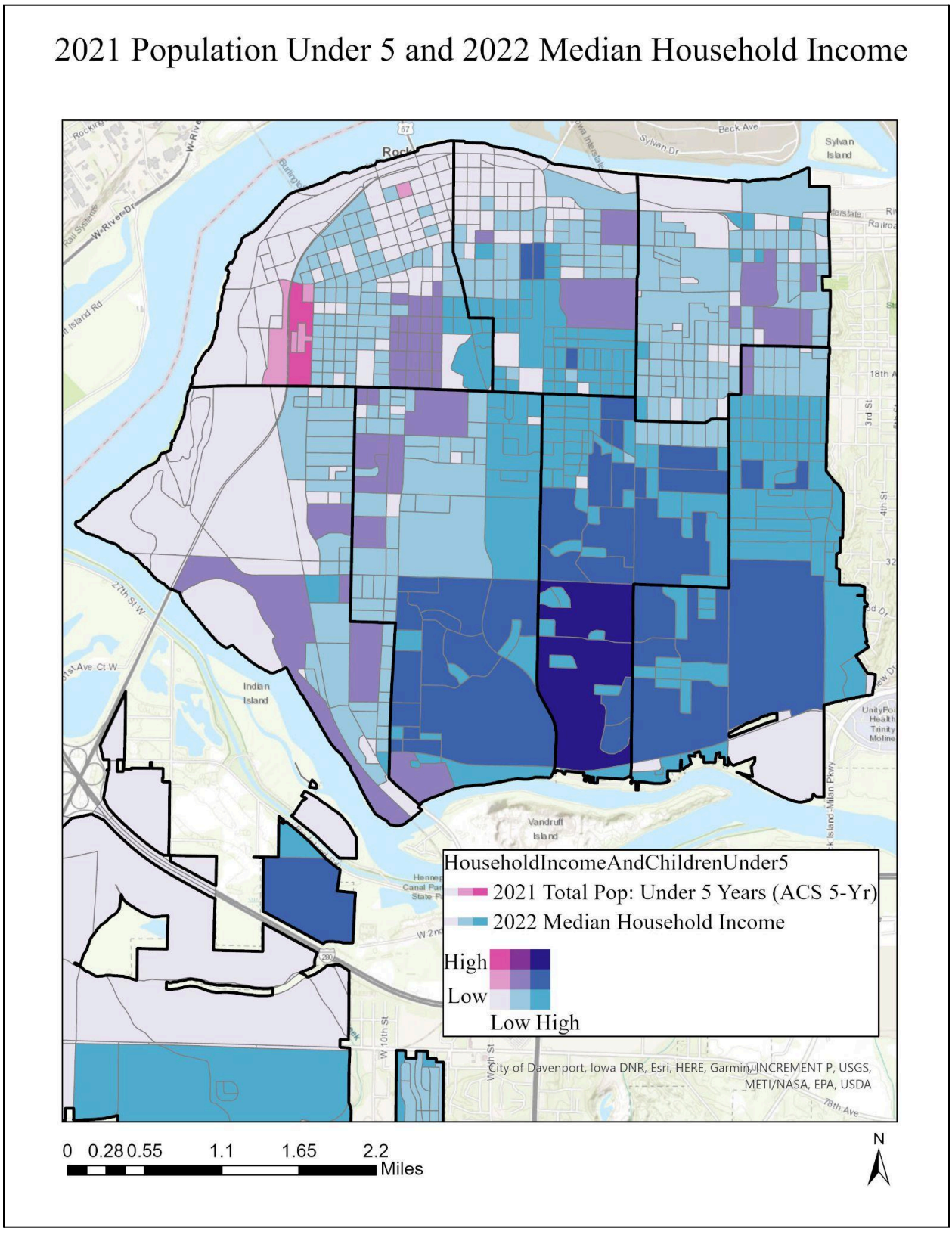

Figure 5

LIH and ExLow Income Households Hold off on this

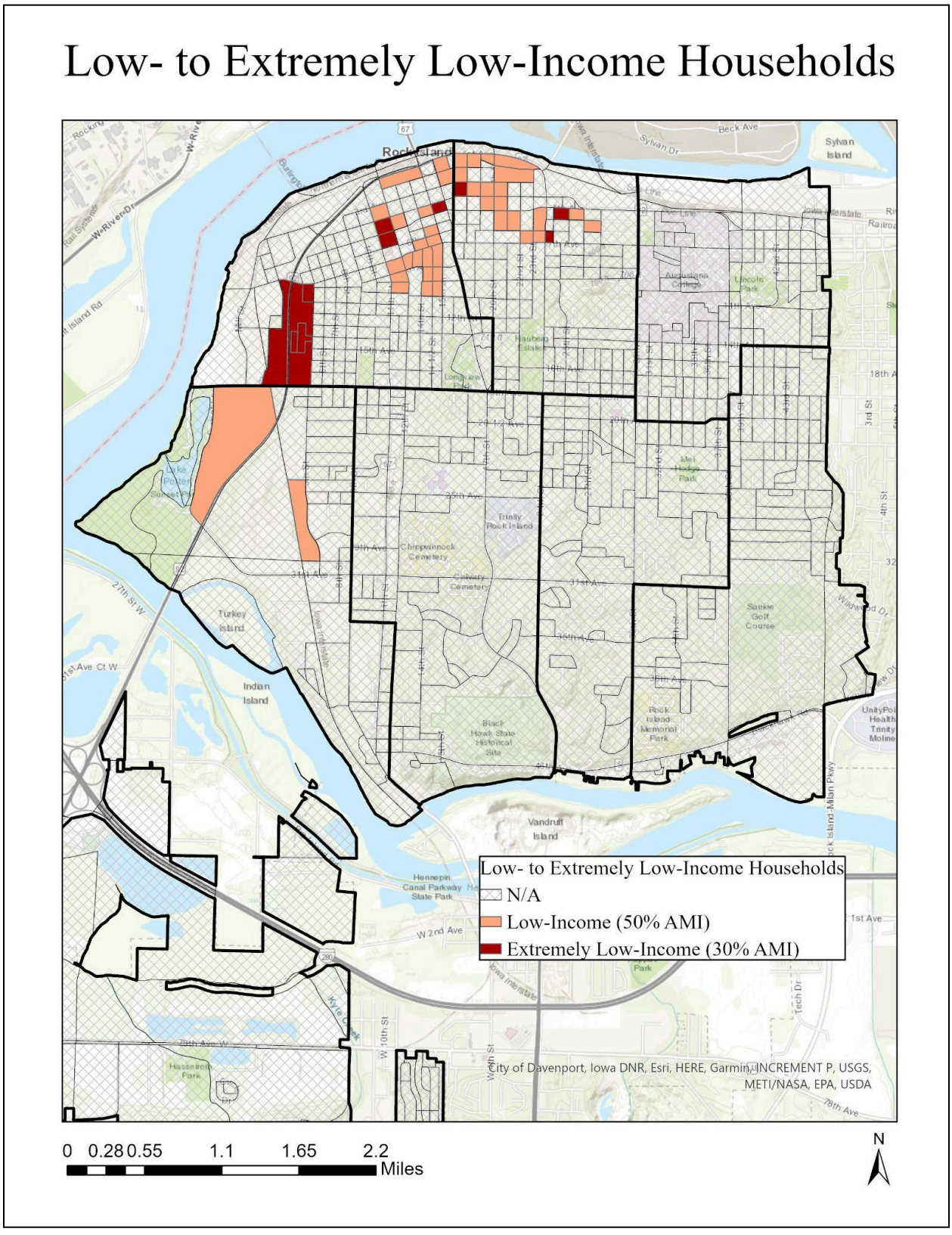

Figure 6

Households making less than 150% of the FPL (45k)

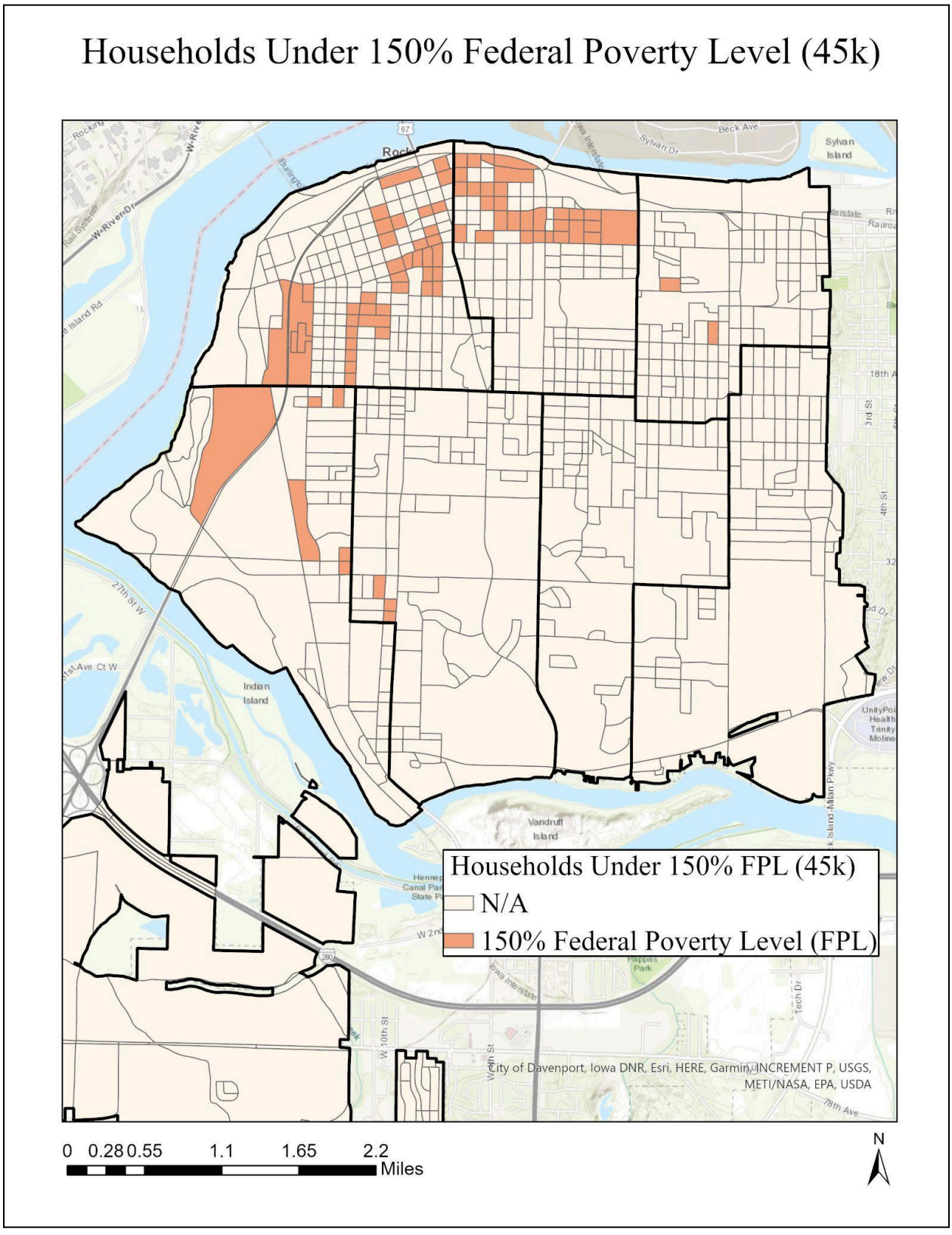

Figure 7

Map of unemployment %

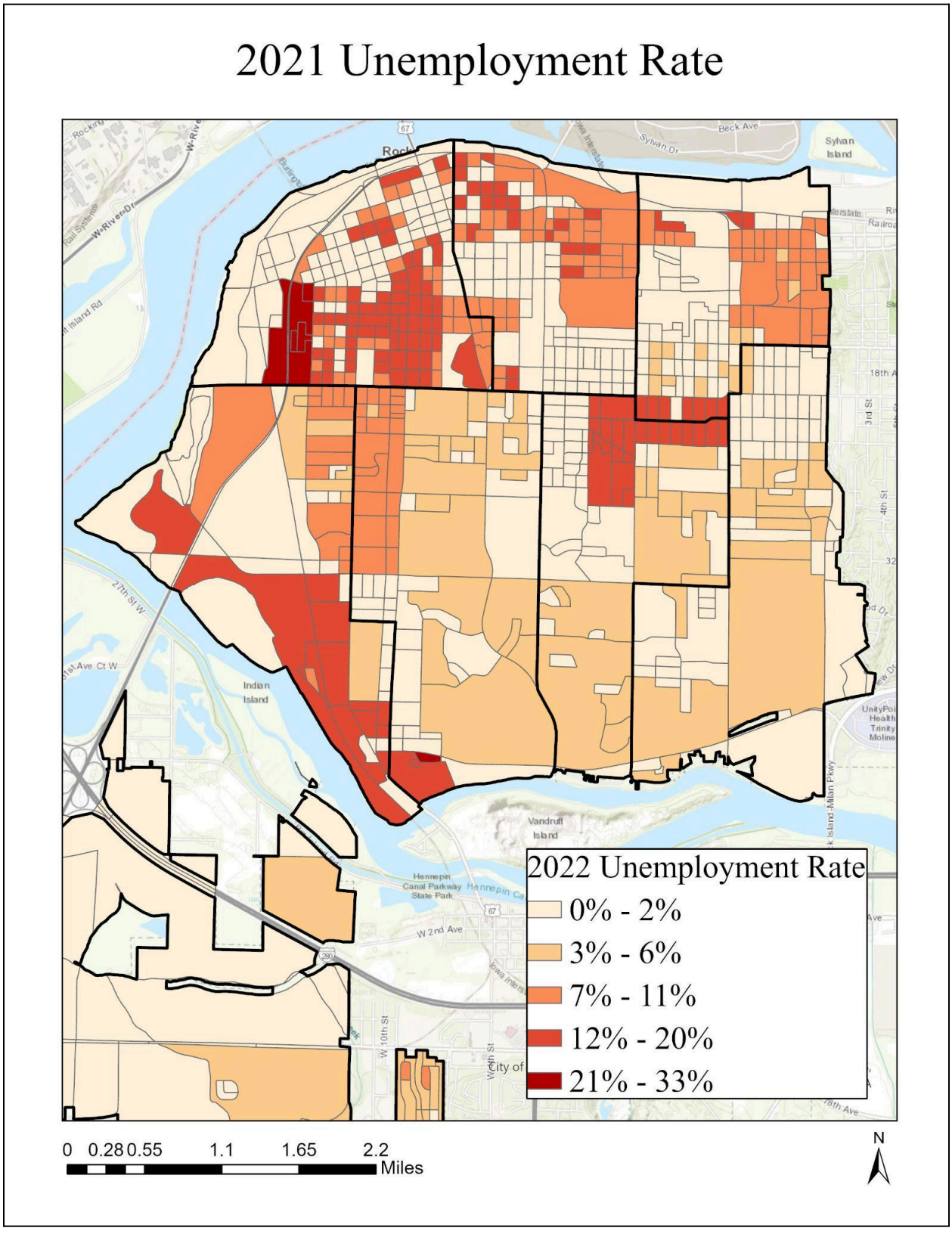

Figure 8

Social Disadvantagement Index (SDI)

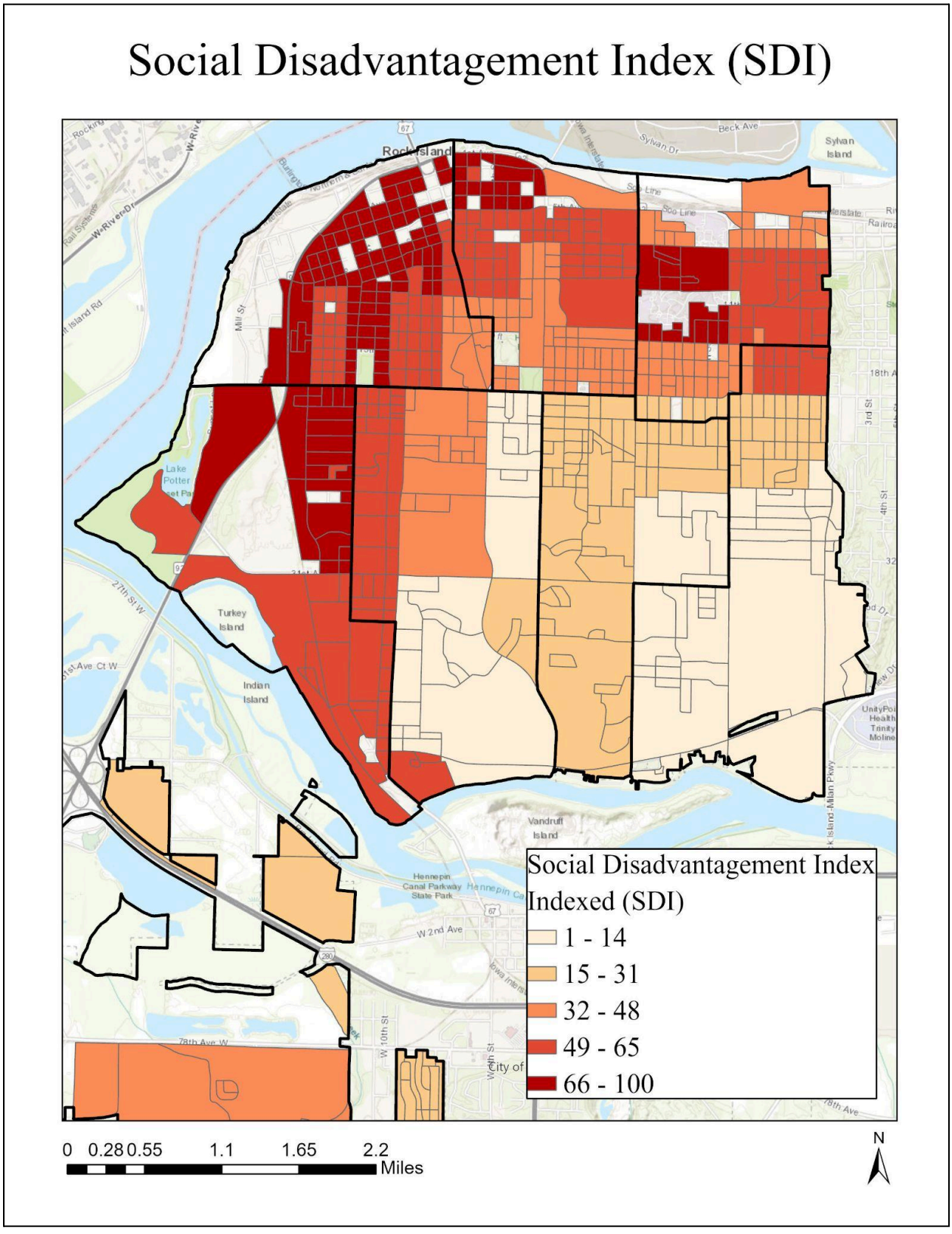

Figure 9

Bivariate Analysis of SDI and Children under 5