Measuring the Effect of Vacant Lots and Green Infrastructure Improvements on Home Values in Allegheny County, 2012-2014

Tri-COG Collaborative





Acknowledgements

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Executive Summary

For decades regions of Allegheny County served as economic engines that drove the national economy. In the early 1900's the region was responsible for half of the nation's steel production and was a leader in coal production. In the latter half of the twentieth century, many different communities throughout Allegheny County began to lose their industrial base with the closure of steel plants and coal product facilities. Beginning in the 1960's the population of Allegheny County sharply declined. Many communities lost over 50% of their population since the peak with some having lost as much as 70%. The exodus of industry and people led to a decline in municipal tax revenue. After decades of disinvestment, the spread of blight created strain on municipal services to address decaying infrastructure.

The Tri-COG Collaborative (TCC) is a group comprised of the 40 municipality members of the Steel Rivers Council of Governments (formerly Steel Valley and Twin Rivers COGs) and Turtle Creek Valley Council of Governments in Allegheny County. Due to the significant problems created by vacant, blighted and abandoned properties in the region, the first project of the TCC was to quantify the costs of blight in their communities. In 2013, the collaborative released an analysis titled, *The Financial Impacts of Blight,* which determined that the effect vacant and blighted residential structures have on communities is staggering. In 2012, the direct costs to municipal services, which include police, fire, public works, and code enforcement, was approximately $10.7 million per year and the revenue lost due to tax delinquency was approximately $8.6 million. Additional millions of dollars are lost each year due to property devaluation as a result of proximity to blighted properties. This loss in value was estimated to be $220 million in the TCC region in 2012. Demolition has become a primary strategy to deal with residential blight brought on by decades of disinvestment. While demolition may have removed the decaying property, new health and safety issues as a result of unmaintained land, such as rodents and invasive weeds, need to be addressed by communities.

The *Financial Impacts of Blight* revealed the negative effects blighted properties have on residential property values; however the quantifiable effect of blighted residential lots has not yet been analyzed in Allegheny County. This study seeks to determine the effects of stable vacant lots, blighted vacant lots, and green infrastructure improvements on residential property values in Allegheny County. Vacant lots were identified using Allegheny County parcel data and filtered to ensure the lots studied were residential. Tax delinquency through Allegheny County's Treasures' data was used as a proxy for the blighted vacant lot study variables. Lastly, a number of community groups were surveyed to gather data related to green infrastructure improvement locations throughout the county.

A hedonic regression analysis was employed, using regional sales data, to determine the three study variables effects on residential sales prices. The results indicate that these three study variables affect residential property values differently in different submarkets. The analysis looks at five submarkets, High, Moderately High, Average, Moderately Low and Low. In every model, except the High submarket which had too few sites to adequately measure an effect, stable vacant lots are estimated to **increase** surrounding home values between 1.1% in Low submarkets and as high as 2.8% in Moderately Low submarkets. **On average across Allegheny County, stable vacant lots are estimated to increase surrounding home values by 1.6%** which suggests that maintaining properties has a positive effect on communities.

Stable Vacant Lots

Submarket	Effect on Home Values
High Submarket	Not statistically significant
Moderately High Submarket	+ 1.5%
Average Submarket	+ 2.2%
Moderately Low Submarket	+ 2.8%
Low Submarket	+ 1.1%
Pooled	+ 1.6%

In every model, blighted vacant lots are estimated to **decrease** surrounding home values between 3.8% in Low submarkets and as high as 11.5% in Average submarkets. **On average across Allegheny County, blighted vacant lots are estimated to decrease surrounding home values by 6.0%.** Therefore, efforts to eliminate blight will financially benefit communities.

Blighted Vacant Lots

Submarket	Effects of Home Values
High Submarket	- 7.6%
Moderately High Submarket	- 5.3%
Average Submarket	- 11.5%
Moderately Low Submarket	- 10.6%
Low Submarket	- 3.8%
Pooled	- 6.0%

Unfortunately there was a lack of a conclusive trend on property values for green infrastructure improvements within individual submarkets. This lack of observed trend might stem from the limited number of sites included in the models, because there is limited data available. However, a statistical test was completed which concludes across Allegheny County green infrastructure improvements have a more positive effect than blighted vacant lots in terms of housing values, meaning that **installing green infrastructure on a blighted vacant lot will increase nearby property values.**

These results were then expanded to determine the compounding effects of the study variables throughout Allegheny County. The expanded studies indicate that across Allegheny County stable and maintained residential vacant lots add an estimated $234,394,760 in property values to surrounding homes, while blighted and unmaintained lots decrease values by an estimated $424,162,631. At the end of 2014, there were 5,466 blighted residential vacant lots affecting 88,952 or 22.9% of households throughout Allegheny County. These affected homes are assessed at $6,021,317,048 and are currently undervalued due to the surrounding blighted lots. **Across Allegheny County, on average, efforts to simply stabilize these blighted lots would increase home values by 7.6%. Differently stated, if these blighted lots were turned into stable residential lots there would be an estimated increase of $457,620,095 in property value created which translates to roughly $5,145 per affected house.**

This analysis has demonstrated that positive increases in neighboring residential property values occur when vacant lots are simply maintained. The study also revealed that blighted vacant lots have negative effects on residential property values. Therefore, green improvements to a blighted vacant lot will have a positive effect. Furthermore, investment in green infrastructure on blighted lots in low, moderately low, and average submarkets has the highest financial benefit to communities.

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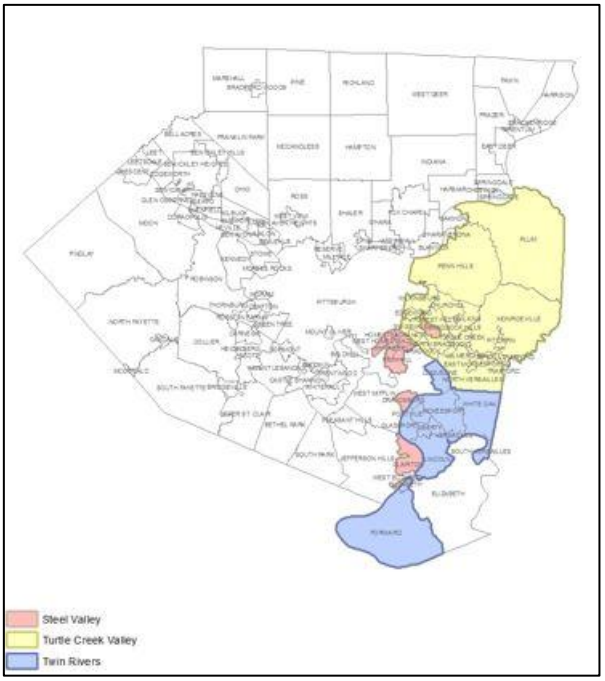
I. Introduction

The Tri-COG Collaborative

In 2011, the Executive Directors of the Steel Rivers Council of Governments (formerly Steel Valley and Twin Rivers COGs) and Turtle Creek Valley Council of Governments came together to understand the quantitative effects of blight. Now known as the Tri-COG Collaborative (TCC), the group encompasses 40 municipalities in the Mon Valley and eastern suburban communities of Allegheny County. A Council of Government, also known as a COG, is a multi-municipal organization that works to effectively and efficiently implement programs through cooperation on behalf of its member municipalities.

Figure 1.1 Tri-COG Communities



Blight, serving as the catalyst that first sparked the Tri-COG Collaborative, is exemplified in the large amounts of vacant land, blighted and abandoned properties in the Mon Valley and proximate Eastern suburbs. The TCC has been working tirelessly since 2011 in order to fully understand the problem of blight and develop potential solutions. The TCC has established a blight committee of key stakeholders such as code enforcement personnel, solicitors, community representatives, and local experts to develop methods to address blight from a multi-municipal viewpoint. They host monthly meetings, called Blight Busters, whose purpose is to disseminate information, bring in expert speakers and create a forum where municipal staff, elected officials, community-based organizations, citizens and other key stakeholders can share strategies to address and prevent blight.

The impacts of blight, while seen throughout Allegheny County, are pervasive and concentrated in the Tri-COG's footprint. Of all the communities in Allegheny County, excluding the City of Pittsburgh, sixty percent of the blight exists in the Mon Valley and eastern suburbs[1]. In 2013, the collaboration released a study titled the *Financial Impacts of Blight* which quantified the effect vacant residential structures had on communities. The direct costs to municipal services, which include police, fire, public works, and code enforcement, was approximately $10.7 million per year and the revenue lost due to tax delinquency was approximately $8.6 million in 2012.[2] Additional millions of dollars are lost each year due to property devaluation as a result of proximity to blighted properties. This loss in value was estimated to be $220 million in the TCC region in 2012. For these reasons, the TCC has committed time and resources to understand the costs of blight, develop

[1] Tri-COG Collaborative, (2013), Financial Impact of Blight
[2] ibid

effective solutions for preventing the damaging spread of blight, as well as assisting communities effectuate their revitalization.

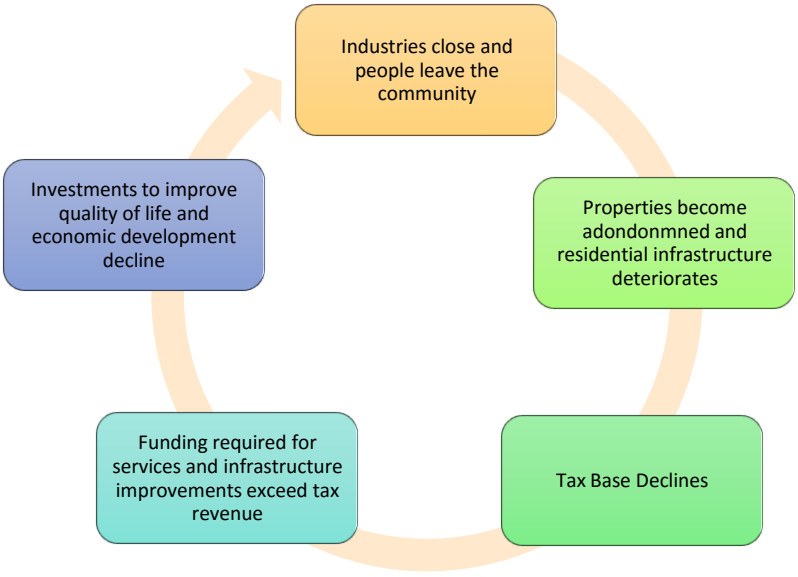
Background:

For decades, regions of Allegheny County served as economic engines that drove the national economy. In the early 1900's, the region was responsible for half of the nation's steel production and was a leader in coal production. The three rivers allowed for transportation of goods, positioning the region as an economic powerhouse for the rest of the nation. While Allegheny County continued to grow throughout the 1960s and 1970s, the collapse of the steel industry caused signification economic challenges for the region.

In the latter half of the twentieth century, many different communities throughout Allegheny County began to lose their industrial base. In the late 1970s and early 1980s, the US rust belt pattern of deindustrialization took over.[3] Following the recession of the early 1980's, the region's mills laid off 153,000 workers.[4] The steel mills, one after one, closed. The mill closures and massive unemployment caused a ripple effect. Other industrial and manufacturing businesses either reduced their workforce or closed. The traditional main street small businesses, like local restaurants and hardware stores also began to fail. Many people fled to the suburbs or to other regions.[5]

Since its peak in the 1960s, the population of the county experienced a steady decline. While recent population estimates suggest Allegheny County overall may be growing slightly, all but one of our forty (40) river towns and eastern suburban municipalities continue to experience a declining population. Many communities have lost over 50% of their population since the peak with some having lost as much as 70%. The magnitude of this exodus is still felt sharply throughout the region. According to the 1960 and 2010 Census, there were 24.9% fewer people living in the county in 2010 than there were in 1960. The region's infrastructure, including the roads, electrical grids, sewer lines and buildings that once supported a much larger population are now deteriorating. This poses a huge financial challenge in an era of

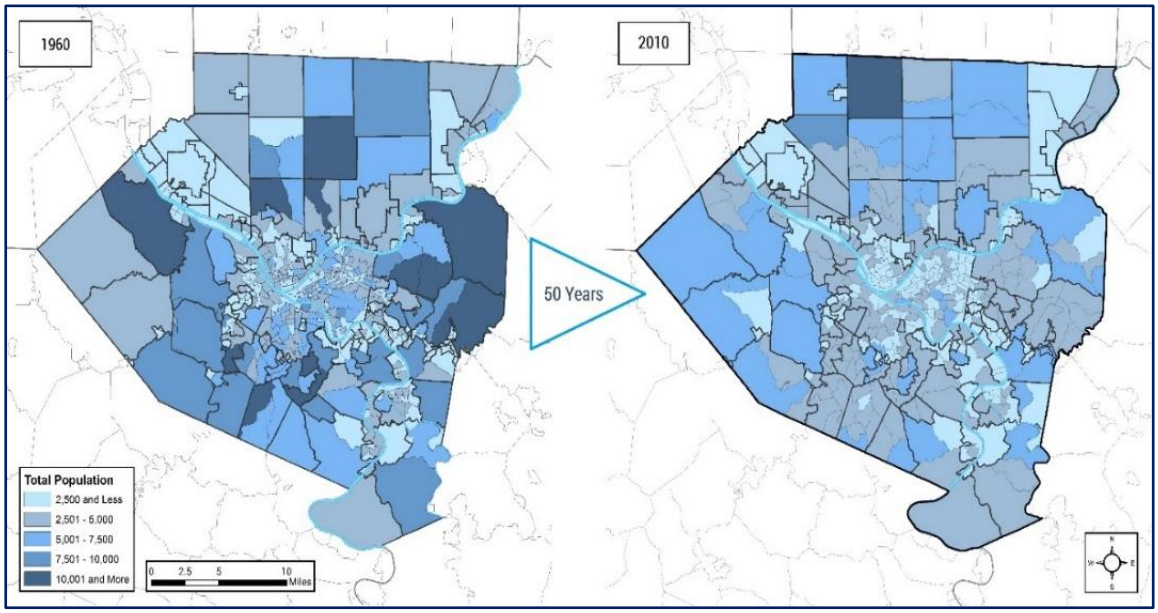
Figure 1.2 Cycle of Blight

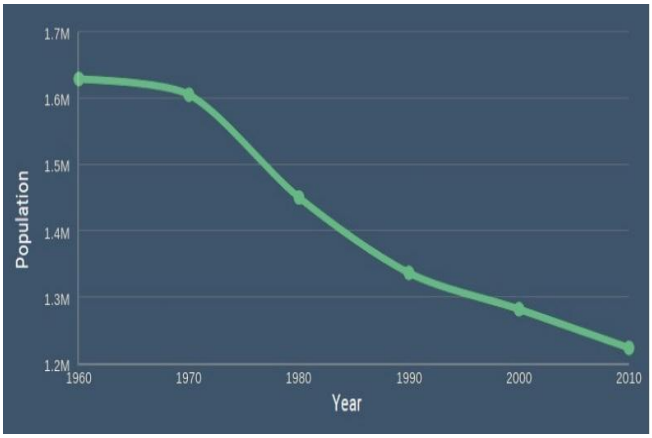


[3] Toland, Bill (December 23, 2012). "In desperate 1983, there was nowhere for Pittsburgh's economy to go but up". Pittsburgh Post-Gazette. Retrieved February 10, 2014.
[4] Hoerr, John P. (1988). And the Wolf Finally Came: The Decline of the American Steel Industry. University of Pittsburgh Press. ISBN 0-8229-5398-6.
[5] Western PA History: Renaissance City: Corporate Center 1945–present". WQED's Pittsburgh History Teacher's Guide series. Archived from the original on March 17, 2008. Retrieved April 14, 2007.

declining tax revenue as a result of the smaller tax base. The demand for housing also declined as a result of the population exodus. The housing stock that remains supported a much larger population, creating an inevitable pattern of property abandonment and blight.

Figure 1.3 Population Change in Allegheny County





The negative impacts felt by property abandonment and deterioration have forced municipalities to react. Due to the extreme deterioration existing in many communities, demolition has become the primary form of intervention. The strong reliance on demolitions as a solution for abandoned and blighted properties has created an excess of vacant lots in already struggling communities. While the reduction of available housing inherently is not bad for communities where housing demand has significantly decreased, abandoned land presents new challenges, and if unmaintained, can become a different kind of public nuisance. This abandoned land also puts an additional economic burden on the municipalities who eventually must take responsibility for the public health, safety and nuisance issues. This is particularly burdensome since in most cases the land is still titled to private owners.

Primary Focus of Analysis:

Focus 1: Effects of Vacant Land on Home Values

Demolition as a strategy for dealing with the derelict and nuisance properties comes at a high cost. In 2012, the Tri-COG communities spent $618,936 in grant funds from the Community Development Block Grant program on demolition. This figure does not include demolitions that were financed through municipalities' general fund. In addition to taking on the cost to demolish privately owned properties, communities in the Tri-COG area also took on the responsibility of lot maintenance. Around 70% of communities have municipal employees provide lawn and weed service to maintain overgrown properties. The decision to provide these services is in part due to the reality that vacant overgrown land is unsightly, but also because it becomes a breeding ground for rodents, dumping, and potential criminal activities. In 2012, the estimated cost incurred by municipalities to maintain overgrown lots was $727,195. There are over 20,000 vacant lots across the Tri-COG area.

While demolition and lot maintenance are two direct costs to municipal services, the communities bear the indirect cost of abandoned privately owned land. The legal process in Allegheny County does not transfer ownership of the land to the governments. Furthermore, municipalities are not suited to be land owners. Therefore, these vacant lots continue to be privately held, tax delinquent properties, accumulating debt in the form of tax and municipal liens. This debt is frequently higher than the value of the land. Therefore over time, it too becomes another barrier to new ownership.

Allegheny County parcel records indicate over 61,000 vacant lots are present in the county, 90% of which are privately owned. Almost a third of all the vacant lots are over three years tax delinquent, and are likely abandoned. The *Financial Impacts of Blight* revealed the negative effects blighted properties have on residential property values; however the quantifiable effect of blighted residential lots has not yet been analyzed in Allegheny County. One primary goal of this analysis is to understand exactly how these abandoned vacant lots, as well as maintained lots, affect the property values in residential real estate markets.

Figure 1.4 Vacant Land in Allegheny County

Allegheny County (2013)[1]

- 61,451 Vacant Lots in Allegheny County
- 90.1% of vacant land is privately owned
- 32% of vacant lots are chronically tax delinquent and likely abandoned
- 70% of Tri-COG Municipalities maintain abandoned vacant land at a cost of $70/lot with an average of 5 visits per year

Focus 2: Effects of Green Infrastructure Improvements on Home Values

Realizing the effects of vacant and unmaintained lots on residential property values is the first step in moving towards finding a solution for productive reuse. The second goal of this study is to determine what effect, if any, green infrastructure improvements have on residential property values. Many governments and nonprofits in Allegheny County have recognized the benefit of providing solutions for vacant lots, and have worked to turn nuisance properties into opportunities. Community groups and municipalities have begun reimagining how these sites can be reused and repurposed for the benefit of the community. Some organizations have leveraged resources and made the investment to improve vacant lots. Conversations across the region boast positive results to neighborhoods with rain gardens, community farms, community gardens and meeting places, and green infrastructure installations.

The Western Pennsylvania Conservancy[6] has been a leading protector of natural resources and green spaces in Allegheny County for over eighty years. The group has planted more than 130 gardens in over 20 counties throughout the state. They are a partner in treeVitalize, an initiative to plant trees throughout the city. More recently the organization has been working with municipal governments to think through green infrastructure improvements that can take place of vacant land within the communities. These infrastructure improvements can come in the form of trees, engineered storm water tree pits, rain gardens and bioswales, permeable paving, retention ponds, riparian buffers. The organization is helping municipalities develop greening action plans to strategize productive reuse of vacant lots in their communities.

[6] http://waterlandlife.org/

GTECH Strategies[7], Growth Through Energy and Community Health, focuses their efforts on finding sustainable solutions for vacant land that can bring about ownership and positive change in communities. Through their ReClaim Ambassador program funded by the Benedum Foundation, GTECH has provided micro-grants to residents to reclaim the vacant land and transform previously abandoned lots into community assets. The group also supports Lots to Love[8], an online resource guide which provides information on current green infrastructure projects and allows residents to post ideas for projects they have in their own communities. The website also provides comprehensive resources and information regarding average costs for projects and identifies organizations to contact for assistance.

Allegheny Grows[9], a program of Allegheny County Economic Development and administered through Grow Pittsburgh, encourages community and workforce development through urban farming and gardening. The program has made significant green infrastructure improvements through gardens in our communities. The program fosters community driven gardens and provides resources and capacity that are not typically available in resource scare communities.

ALCOSAN, Allegheny County Sanitation Authority, has invested in green stormwater and source control projects for decades. Since the mid-1990s, ALCOSAN has been investing in green stormwater infrastructure in its member municipalities and on its own property. ALCOSAN has provided direct financing and secured specific federal and state funding to help local communities and groups install cost-effective green stormwater infrastructure. Working from data developed by Three Rivers Wet Weather and as part of its Source Control Study, ALCOSAN, in partnership with municipalities, has identified over 200 projects that could be implemented in the near term. ALCOSAN is preparing to provide design services and $85 million in investments to local municipalities and organizations. The projects will require local funding matches, as well as contractual agreements by the property owners to maintain the infrastructure for at least 20 years.

The region greatly benefits from the work of these organizations and the countless others who have taken on the charge of implementing green infrastructure improvements on vacant lots. The second primary goal of this study is to capture and quantify the regional effect of these efforts on residential property values.

[7] https://gtechstrategies.org/
[8] http://www.lotstolove.org/
[9] http://www.growpittsburgh.org/

II. Relevant Studies

Effects of Vacant Lots on Residential Property Values, examples of Philadelphia and Cleveland

Efforts to quantify the effects of vacant lots on surrounding properties values have taken place in other Rust-Belt cities throughout the country. While their geographies and political realities may differ, key patterns emerge from these studies, which are that vacant, unmaintained lots in residential neighborhoods have detrimental effects on surrounding home values.

Case Study: Philadelphia

In 2010, the Redevelopment Authority of the City of Philadelphia and the Philadelphia Association of Community Development Corporations set out to quantify the financial effects of vacant lots in the city of Philadelphia in a report entitled "Vacant Land Management in Philadelphia: The Costs of the Current System and the Benefits of Reform."[10] The study found 40,000 vacant lots throughout the city, 75% of which were privately owned. Through the use of a hedonic regression, the research team, comprised of Econsult Corporation, the Penn Institute for Urban Research, and May 8 Consulting determined that vacant lots in proximity to residential properties decrease property values by an average of 6.5%. Some areas experienced as high as a 20% decrease in property value. For the average household, this property value loss equated to around $8,000.00. The study also determined that vacant lots were costing the city around $20 million in maintenance each year. The researchers concluded that: "A strategic and coordinated response by the City could substantially reduce the negative effect of vacant parcels, and transform them from liabilities to assets through redevelopment, with significant gains in neighborhood stability, job creation, and tax revenue generation."[11]

Case Study: Cleveland

A similar report in Cleveland titled, "Estimating the Effect of Demolishing Distressed Structures in Cleveland, OH, 2009-2013: Impacts on Real Estate Equity and Mortgage-Foreclosure" by the Thriving Communities Institute, found similar results. The analysis focused on lots that were made vacant in residential neighborhoods due to demolition activity. The purpose of the study was to determine the financial impacts of demolitions on real estate values in the four submarkets that were identified. The study concluded that vacant lots reduced property values of homes within 500 feet by 1-1.2%. Additionally, vacant lots, which were also tax delinquent, reduced property values of homes within 500 feet by 2.8-8.6%, depending on the submarkets.

[10] Econsult Corporation, Penn Institute for Urban Research, May 8 Consulting (November, 2010); *Vacant Land Management in Philadelphia: The Costs of the Current System and Benefits of Reform*

[11] Ibid *Page ii*

Figure 2.1 Case Studies

Philadelphia (2010) [12]	Cleveland (2014) [13]
▪ Identified 40,000 Vacant Lots throughout the city. Over ¾ were privately owned. ▪ Deceased home values city-wide on average by 6.5%; up to 20% in some neighborhoods. ▪ Total of **$3.6 billion** loss in property value loss.	▪ Vacant lots reduced property values between 1.0% and 1.2%. ▪ Lots which were also tax delinquent reduced property values between 2.8%- 8.6% depending on the submarket. ▪ In moderately and high functioning submarkets, the benefits of demolition outweighed its costs.

Effects of Green Infrastructure Improvements on Residential Property Values, examples of Philadelphia and Allegheny County

While uncovering the negative effects of unmaintained vacant lots is important, a second primary objective of this analysis is to determine the economic benefits to property values when green infrastructure improvements are implemented. Often times green improvements like bioswales, rain gardens and green roofs are installed to improve water quality, reduce energy consumption, and cut down on air pollution among other positive environmental effects. However, there are a growing number of studies which show that there is an added economic benefit to property values when green infrastructure improvements are implemented.

Case Study: Philadelphia

In 2007, three researchers in the Philadelphia region published a study titled, "Green Investment Strategies: How They Matter for Urban Neighborhoods."[14] With the hypothesis that transforming vacant lots by use of greening techniques could reverse neighborhood decline, they analyzed "place-based investments" in green improvement projects in the City of Philadelphia. The analysis concluded that properties adjacent to vacant lots can experience property value decline by up to 20%. Furthermore, once the vacant lot is "cleaned and greened" which can include action as simple as removing trash, planting grass, trees, or flowers, or include adding benches, sidewalks, and fences, the adjacent property value can increase up to 17%. Simply planting a new tree in a public space can increase property values by 9%, and planting green streetscapes can increase property values by 28%. The researchers conclude that place-based and green infrastructure investments increase the property value of nearby homes as well as increase the overall neighborhood desirability.

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[12] Econsult Corporation, Penn Institute for Urban Research, May 8 Consulting (November, 2010); *Vacant Land Management in Philadelphia: The Costs of the Current System and Benefits of Reform*

[13] Griswold Consulting Group, Nigel G. Griswold, Benjamin Calnin, Michael Schramm, Luc Anselin and Paul Boehnlein (February, 2014); *Estimating the Effects of Demolishing Distressed Structures in Cleveland, OH, 2009-2013*

[14] Susan M. Wachter, Kevin Gillen, Carolyn R.Brown; The Wharton School of Business, University of Pennsylvania (2007); *Green Investment Strategies: How They Matter for Urban Neighborhoods.*

Case Study: Allegheny County

In 2012, Allegheny County Department of Economic Development engaged a team of graduate students at the Carnegie Mellon's Heinz College to quantify the economic and social impact of community gardening, through the Allegheny Grows program. The analysis, titled "Assessing the Economic and Social Impact of Community Gardening in Allegheny County" found that community gardens can have positive financial impacts on single unit households in Allegheny County. The researchers found that property values increase by 6% within the first year of a community garden being established.

Figure 2.2 Green Infrastructure Case Studies

Philadelphia (2007) [15]	Allegheny County (2012) [16]
▪ Found that properties adjacent to a blighted vacant lot deceases value by 20% ▪ Activities like trash removal, proper grading and landscaping almost entirely remove the negative impact. ▪ Concentrated tree plantings on vacant lots increased property values by 9%	▪ Analyzed the effect of community gardens on property prices. ▪ 49 sites were assessed throughout Allegheny County. ▪ Found that urban gardens increase property values by 6% in the first year.

The data in all the studies present a similar story: vacant lots can have detrimental effects on neighboring property values, whereas maintenance of vacant lots can have positive effects on property values. We expect to find similar results in Allegheny County. Furthermore, the Cleveland study brought to light the importance of categorizing real estate markets when measuring effect. Therefore, we have made submarkets a fundamental component of this analysis.

[15] Susan M. Wachter, Kevin Gillen, Carolyn R.Brown; The Wharton School of Business, University of Pennsylvania (2007); *Green Investment Strategies: How They Matter for Urban Neighborhoods.*

[16] Farahman, Jean-Louis, Meloche, Rede, Shi, Siu, Tan, Fu. (2012). *Assessing the economic and social impact of community gardening in Allegheny County.* Heinz College, Carnegie Mellon University. Pittsburgh, Pa.

III. Methodology

Hedonic Regression Model

The statistical method used in this study to measure the effect of vacant lots and green infrastructure is called Hedonic Regression. This is a traditional method used in the field of real estate to study the effects that amenities and nuisances have on surrounding property values. It measures the extent to which each amenity and/or nuisance, the *dependent variables*, influence on the property values, the *independent variable*.

In order to determine the effect of vacant lots and green infrastructure improvements on property values, we will use residential home sales as the independent variable. There are a number of characteristics of a home that affect its value. These characteristics represent the dependent variables in the analysis and include the physical characteristics of the home itself, like the number of bathrooms, fireplaces, bedrooms and yard space and also other neighborhood factors like proximity to work, parks and schools.

Figure 3.1 Regression Basics

Home sales
(Dependent Variable)

Desirable Housing Characteristics
(Independent Variables)

Housing characteristics effect on sales price
(Observation)

The regression uses a point in time analysis for the study period (2012-2014).

Residential Property Sales

The sales data used in this study was obtained from RealSTATs[17], a local firm which specializes in producing electronic real estate sales data in Allegheny County. The dataset for the study was limited to residential sales of single and two family households. Condos, apartments and other multi-family

[17] The RealStats product is a sales based database comprised of sales and real-estate transactions. Multi-parcel sales were removed and the remaining sales were joined to the county's assessment file. The joining process between Realstats and ArcGIS also resulted in a number of sales being dropped due to minor recording errors found in the data. Lastly, any remaining sale missing building characteristics were left out of the study. Even with these minor setbacks, there remains a sizable sample of sales to conduct the study (2012: 13,377. 2013: 14,627. 2014: 14,357)

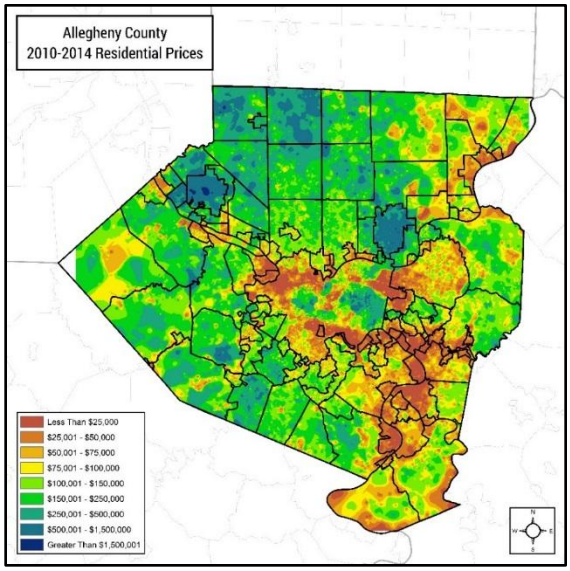
structures were not included in this study because of limited building characteristic information and different market characteristics. Tax and mortgage foreclosures taken through the sheriff sale proceedings were also eliminated from the study because the true market value of the property is not reflected in the property transfer transaction price.

From 2012 – 2014 there has been a slight increase in the number of sales that took place in Allegheny County as well was the mean sale price and mean sale price per square foot.

Figure 3.2 Residential Property Sales in Study

Year	Number of Sales	Mean Sale Price ($)	Mean Sale Price / Sq. Ft. ($)
2012	13,377	144,028	79.07
2013	14,627	149,720	82.38
2014	14,357	154,883	86.25

Figure 3.3 Allegheny County Residential Sales price 2012-2014



Factors Influencing Sales Prices

There are many factors which can influence the final sale price of a residential property. These independent variables allow us to measure the effect an unmaintained lot or an infrastructure improvement project has on the sale price of a nearby property.

All the independent variables that were used in this analysis are listed in the chart below. The variables highlighted in blue, vacant lot, vacant lot tax delinquencies and green infrastructure are the study variables.

Chart 3.4 Independent Variables

Variable	Type	Description	Source
Structural	Quantitative	Describes the characteristics of the structure. Includes: Age, Condition, Grade, # Bathrooms, Bedrooms, Fireplaces, Garage, Lot Size (Sq. Ft.), Finished Living Area (Sq. Ft.)	Allegheny County Parcel Dataset
Vacant Lot	Quantitative	Indicates how many vacant lots which are current on their taxes are within 500 feet of a sale.	Allegheny County Parcel Dataset PASDA[18]
Delinquent Vacant Lot	Quantitative	Indicates how many vacant lots which are chronically tax delinquent are within 500 feet of a sale.	Allegheny County Treasurer
Green Infrastructure	Quantitative	Indicates the number of residential green infrastructure improvements are within 500 feet of a sale.	Three Rivers Wet Weather, Grow Pittsburgh, gTech's Lots to Love
Year	Categorical or "Dummy"	Identifies the quarter in which a sale occurred between 2012-2014	RealStats
Submarket	Categorical or "Dummy"	Identifies if a sale occurred within a Weak, Moderately-Weak, Moderately-Strong or Strong Housing Submarket. Submarkets were created at the census tract level utilizing an index score made up of vacancy rate, poverty level, gross rents, and income level.	American Community Survey 5 Year (2009-2013)
(Sub_Market)*(Year)	Categorical or "Dummy"	Identifies the quarter and submarket of each sale. Included to control for quarterly trends which may occur within each submarket Used only in Pooled model.	Created for study

[18] Pennsylvania Spatial Data Access – The state's clearing house for geospatial data. More information can be found at http://www.pasda.psu.edu/

Determining the final Data Sets

Independent Variables

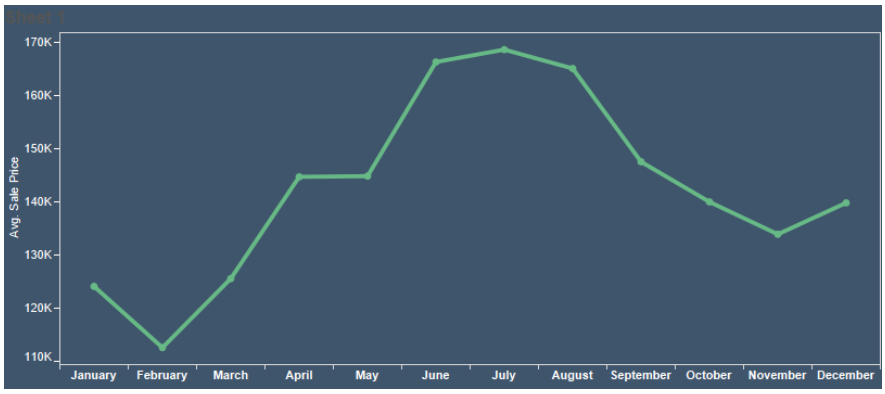
Property Characteristics

Some of the most important elements that contribute to a home's value are the basic characteristics and quality of the structure itself. In order to control for these variables, a complete list of these characteristics was obtained from the Allegheny County property database. This dataset contains over 500,000 records and various levels of information on every property throughout the county. The variables specifically used from the dataset include: age of the structure, number of bathrooms, bedrooms, fireplaces, garage, total size of the house and lot in square feet. The condition and grade of the structure, which are categories that define the physical condition and the architectural complexity of the property, were also included.

Year

The time of year a sales transaction takes place can also have an effect on the sales price. There is a clear trend, demonstrated in Figure 3.5, in which sales prices are often higher in the summer months. To control for the trend, twelve time periods were established that correspond to the four quarters of the year.

Figure 3.5 Sales Price by Month



Submarkets

There have been varying degrees of decline and growth throughout Allegheny County which has created different real estate submarkets throughout the county (See Figure 3.6). Previous studies have shown that the impacts of blight and distress vary across real estate submarkets[19]. Therefore, blight affects

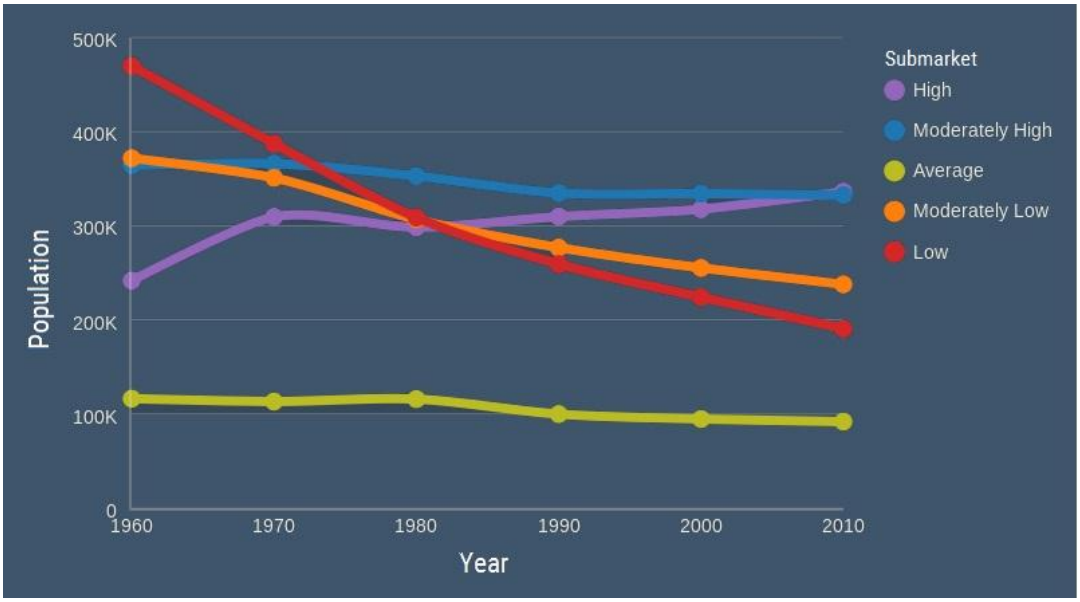
[19] Whitaker, S., and T.J. Fitzpatrick. 2013. Deconstructing distressed-property spillovers: The effect of vacant, tax-delinquent, and foreclosed properties in housing submarkets. Journal of Housing Economics. Vol. 22, pp. 79-91.

Griswold, N., Calnin, B., Schramm, M., Anselin, L., Boehnlein, P. 2014. Estimating the Effect of Demolishing Distressed Structures in

different places differently. A vacant lot, abandoned home or mortgage foreclosure will affect home prices differently depending on the housing market. Identifying these residential submarkets allows for the control of trends unique to each submarket. It also allows us to measure the degree to which blight or infrastructure improvements affect home values within each submarket.

For the purposes of this analysis, residential submarkets were created at the census tract level by identifying vacancy rate, poverty level, gross rent, and median family income. These four factors have been used for this purpose in similar studies, including those previously mentioned. The factors were summarized into an index and five unique submarkets were defined based on their total score: High, Moderately High, Average, Moderately Low and Low.[20]

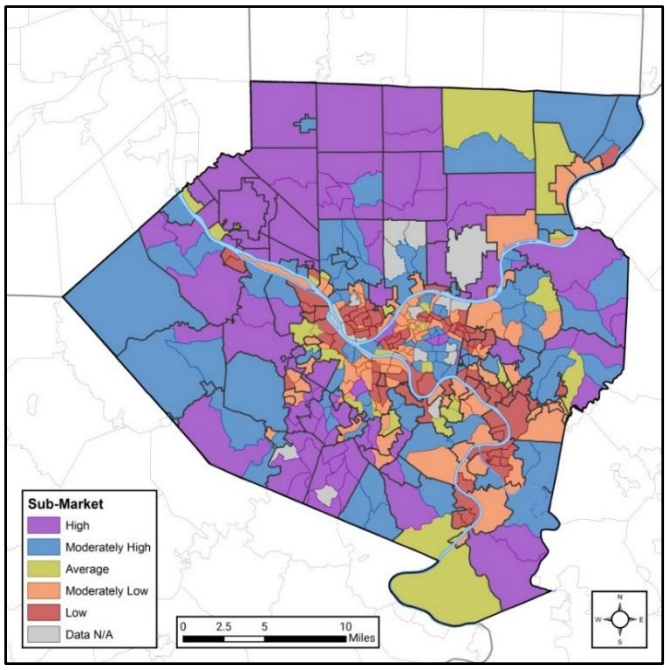
Figure 3.6 Allegheny County Population Decline by Submarket



Cleveland, OH, 2009-2013: Impacts on Real Estate Equity and Mortgage-Foreclosure. http://www.wrlandconservancy.org/pdf/FinalReportwithExecSummary.pdf

[20] Several census tracts were missing several data and had to be removed from the analysis. Final set of sales used in study: **2012**: 12,990**; 2013**:14,196; **2014**:13,949

Figure 3.7 Housing Submarkets by Census Tract

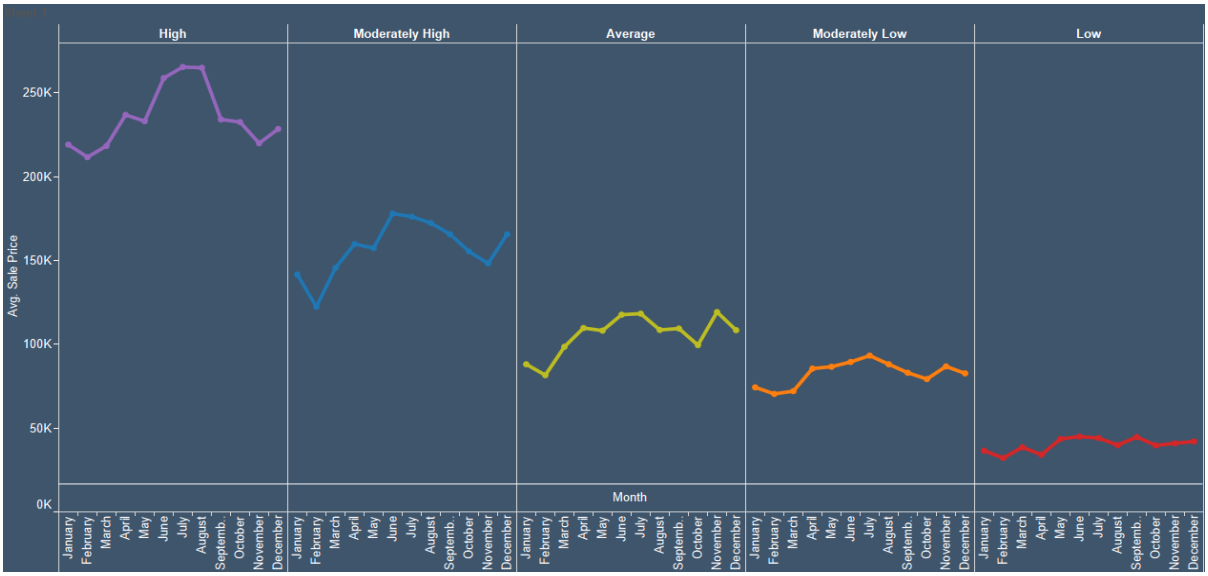


Price Trend Differences across Submarkets

The analysis demonstrated that there are differing seasonal price trends within each submarket. Figure 3.8 below reveals how different times of the year affect sale prices within each individual submarket. For example, there is a high variability in price in the summer in a high submarket and virtually no variability in a low submarket. These differing trends are controlled for with the addition of an interaction term.

Figure 3.8 Submarket Price Trends

Study Variable: Vacant Lots



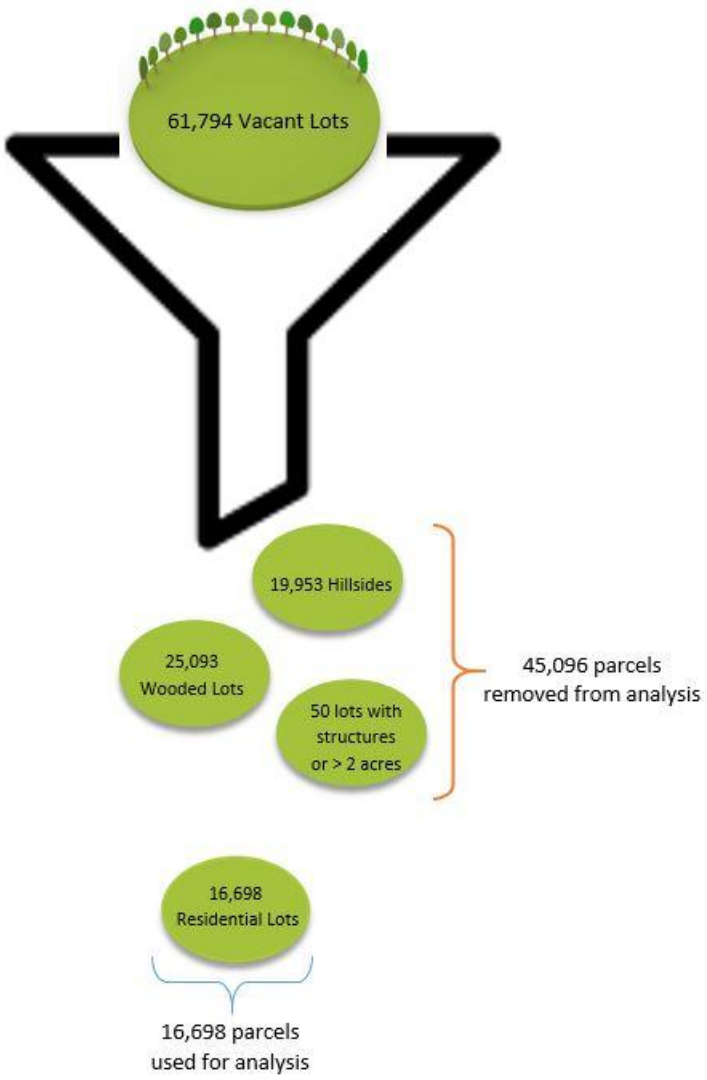
In 2014, there were 61,794 vacant lots recorded in the Allegheny County Parcel Dataset. Many of these parcels are hillsides, large expanses of woods and even median strips. In an attempt to reach a true set of residential "vacant lots," the following process was employed to eliminate erroneous data:

The first filter applied effectively removed lots which were large and densely populated with trees. To do this the 2011 wooded area file[21] was used to capture canopies of at least one acre in size or of major significance. 25,093 parcels were identified as wooded lots and removed from the analysis.

The next filter aimed to remove hillsides from the dataset. The 2010 county slope file[22] was used to identify vacant lots with slope grades between 15% and 100%. 19,953 were identified as hillsides and removed from the analysis.

The final two filters identified lots with any buildings and other abnormalities. Lots with auxiliary buildings were found by identifying parcels with a value greater than $0 in the building assessment field. 33 parcels were identified and removed. Additionally, any lot larger than 2 acres was identified. 17 parcels were eliminated for this reason.

The final dataset contained 16,698 vacant residential lots for the study year of 2014.



This methodology was employed to determine the number of vacant lots for the study in years 2012 and 2013.[23]

Study Variable: Unmaintained Vacant Lots

In order to determine what observable effect vacant lots and blighted lots have on home values, chronically delinquent vacant lots were identified. A county wide dataset that reveals the conditions of

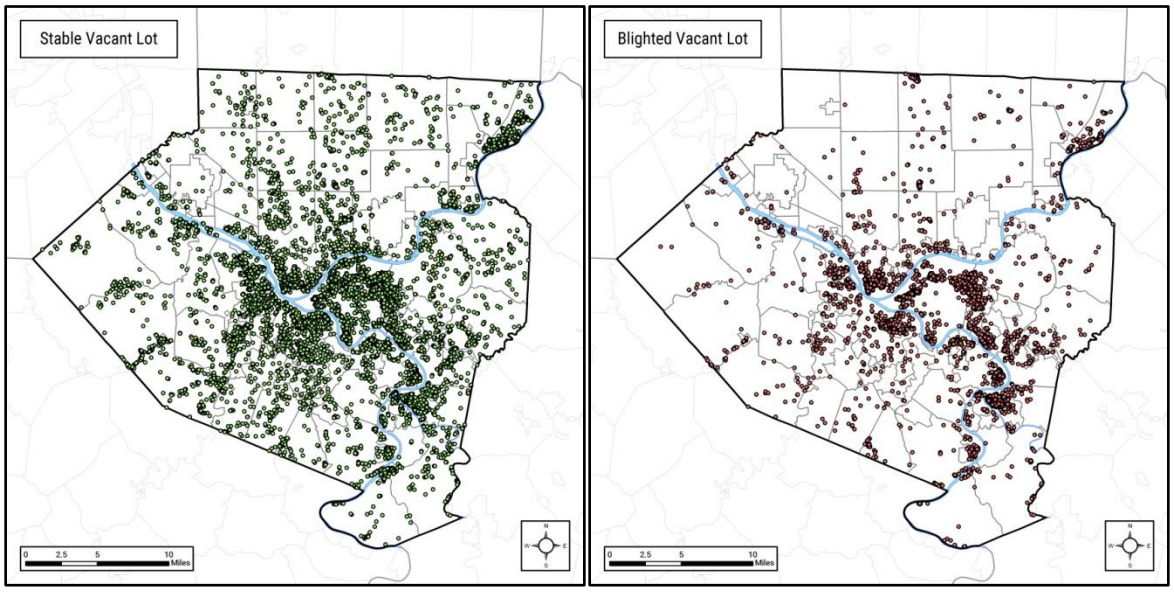
[21] Allegheny County Division of Computer Services Geographic Information Systems Group
[22] Allegheny Places Design Team
[23] 2012 - Vacant Lots: 60,151 - 25,152 wooded Lots - 19,090 steep lots - 0 with building value - 24 larger than two acres = 15,885 residential lots.
2013 - Vacant Lots: 61,085 - 25,032 wooded Lots - 19,619 steep lots - 36 with building value - 16 larger than two acres = 16,382 residential lots.

vacant lots does not exist. Instead, chronic tax delinquency was used to estimate the condition of vacant lots. The dataset specifically identified vacant lots that had three consecutive years of delinquent county taxes. For example, the study identified vacant lots as chronically delinquent in 2014 if they were delinquent in 2012, 2013 and 2014. Three consecutive years of delinquency was used to identify those lots which were presumed truly abandoned and neglected, but to eliminate lots whose owners might be experiencing temporary financial hardship and not paying their taxes but who would continue to maintain their property.

In 2014, of the 16,698 residential vacant lots, 5,466, or 32.73%, were chronically delinquent.

Using the same methods, chronically delinquent vacant lots were identified for 2012 and 2013.[24]

Figure 3.9 Stable and Blighted Vacant Lots (2014)



Study Variable: Green Infrastructure Improvements

Unfortunately a centralized dataset which identifies green infrastructure improvements in Allegheny County does not exist; therefore additional data collection was required. Several sources of sites with green infrastructure improvements throughout Allegheny County were identified and surveyed in order to gather this data. They are described below:

- Grow Pittsburgh, a nonprofit organization whose mission is to "teach people how to grow food and promote the benefits gardens" provided data related to garden projects they have helped to implement and maintain.

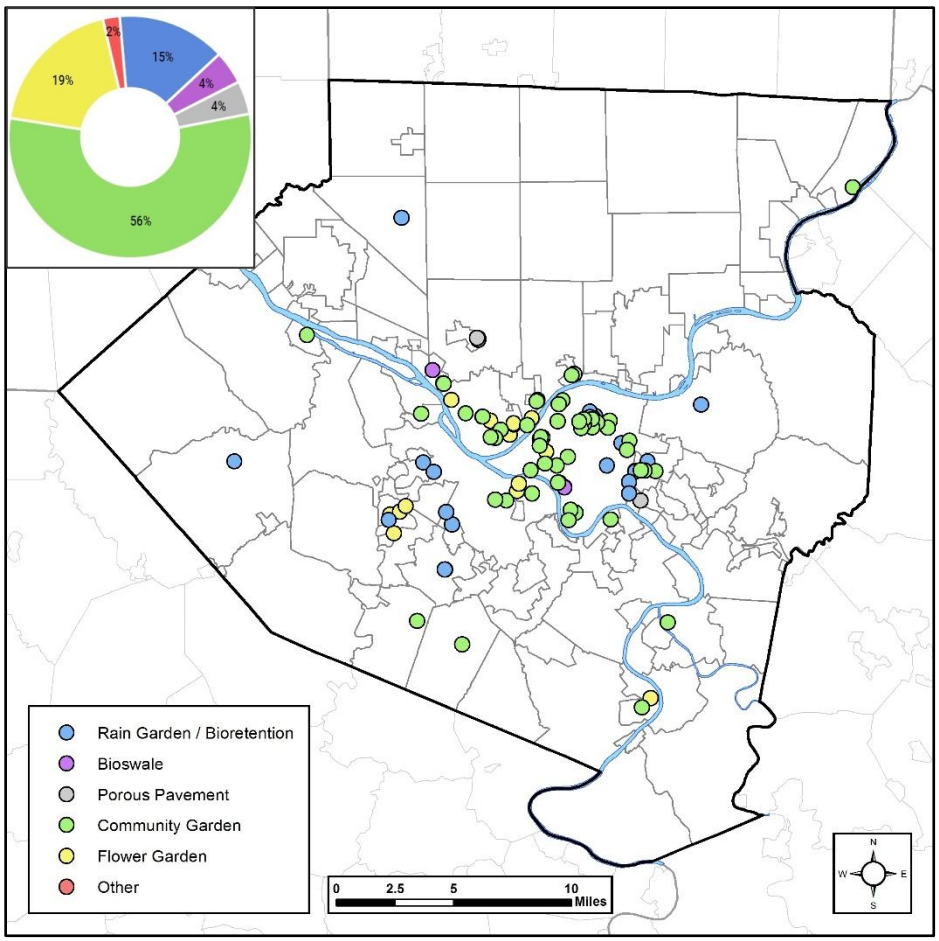
[24] 2012- Of the 15,885 identified residential lots, 5291 or 33.31%.were found to be chronically delinquent.
2013- Of the 16,382 identified residential lots, 5229 or 31.92%.were found to be chronically delinquent.

- Three Rivers Wet Weather, a nonprofit environmental organization who has taken a leadership role in implementing green infrastructure as a solution to current environmental conditions, provided data related to storm water management and water retention projects.
- RAND, a nonprofit research corporation dedicated to informed policies and decisions, provided a dataset of gray and green infrastructure which is being used in their research to test the county's resilience to potential climate change.
- GTECH Strategies, a non-profit organization whose focus on reclaiming vacant land through sustainable practices and community ownership, provided data gathered through their Lots to Love Program, which is "an online resource guide for those who have an interest in transforming vacant lots in their neighborhoods into community green spaces". A number of flower gardens were implemented by the Western Pennsylvania Conservancy was obtained through this data source.

The information was evaluated for errors and translated into GIS data points. Any improvement located within or directly next to another amenity which could influence property value was removed to ensure the effects observed were due to green infrastructure improvements and not the amenity, examples included, libraries, universities, downtown center, and churches. Since a focus of this study is to measure the effect of green infrastructure, grey infrastructure improvements were removed from the analysis. Some green infrastructure improvements were also removed from the analysis because they are not normally visible on the street level and may not effect nearby sales prices, such as green roofs. Lastly, any improvement planned for the future or located outside of Allegheny County was removed. A map of the final dataset can be seen below.

Figure 3.10 Green Infrastructure Improvements in Allegheny County

Type	Count
Community Garden	50
Flower Garden	17
Rain Garden / Bioretention	13
Bioswale	4
Porous Pavements / Green Streetscape improvements	4
Other	2



Empirical Models and Hypothesis

Models

The final dataset of arms-length sales for the study was used to develop a hedonic price function where the price of a home sale is assumed to be a function of a bundle of attributes that characterize a home. The hedonic price function for this study is:

$$LN(Sale\_Price) = \beta_0 + \beta_1(Vacant\_Lot) + \beta_2(Vacant\_Lot\_Del) + \beta_3(Green\_Infrastructure) + \beta_i(Structure) + \beta_i(Submarket) + \beta_i(Year) + \beta_i[(Sub\_Market)*(Year)] + u_i$$

The function assumes a log-linear relationship where the natural log of the dependent variable, *Sale_Price,* is determined by a series of independent variables (for descriptions of the independent variables please see Table 3.4). This semi-log form transforms the model and allows for all coefficients to be viewed as percentage change in home price as opposed to simply nominal change in terms of dollars.

A total of six models were run for this study. The first model is pooled and combines all sales across all submarkets in Allegheny County. In addition, this model included all of the independent variables seen in the above equation. This Pooled model provides information about how the independent variables function as a whole throughout Allegheny County regardless of the time period or submarket. The remaining five models are separate based on submarket and include only those sales which occur within that respective submarket. These models were included in order to observe how the independent variables affect home values differently within each individual submarket. Since the remaining models are based on submarkets, both the Submarket variable and interaction term are withheld.

The time frame for this study begins in the first quarter of 2012 and ends with fourth quarter of 2014. The omitted time period for all models is the first quarter of 2012, meaning all coefficients will represent the level of difference between that time period and the omitted time dummy. Additionally, for the Pooled model, the "low" submarket was withheld, meaning that coefficients represent the percent value difference between their respective submarket and the low submarket.

Hypothesis

The focus of this study is to determine the effect that stable lots, blighted vacant lots, and green infrastructure improvements have on surrounding residential property values. The study expects to see an increase in property values as the number of green infrastructure installations and other improvements increase. The opposite is expected for blighted vacant lots, where an increase in blighted lots in proximity to a home sale is hypothesized to be associated with lower property values. Stable vacant lots are expected to have little to no effect on property values.

IV. Results

Summary of Results

The results indicate an increase in home value in all submarkets as attributes like the number of bathrooms, garages and fireplaces increase. However the strength of the results decreases as the market strength of the submarket decreases. This trend has been seen in similar studies[25] and is observed because modeling techniques, like the hedonic price function, fundamentally perform better when markets are healthier. In other words, selling points like the number of bedrooms and the size of the yard play a much larger role in explaining a home's final sale price in stronger rather than weaker functioning markets.

The three study variables were observed in each of the five submarkets, with trends apparent in stable and blighted lots, but not in green infrastructure improvements. Additionally, a pooled category was created to provide information about how the independent variables function as a whole throughout Allegheny County regardless of the time period or submarket. The summary of the results are discussed below. An additional explanation on the regression analysis and significance measures is located in the Appendix.

Stable Vacant Lots

The first major trend demonstrates the positive effect stable vacant lots have on home values. In every model except the High submarket, where the variable was not statistically significant, **stable vacant lots are estimated to increase surrounding home values between 1.1% in Low submarkets and as high as 2.8% in Moderately Low submarkets. On average across Allegheny County, the Pooled model estimates the positive effect to be 1.6%.** All but the High submarket model were highly statistically significant.

Stable Vacant Lots

Submarket	Effect on Home Values
High Submarket	Not statistically significant
Moderately High Submarket	+ 1.5%
Average Submarket	+ 2.2%
Moderately Low Submarket	+ 2.8%
Low Submarket	+ 1.1%
Pooled	+ 1.6%

[25] Griswold Consulting Group, Nigel G. Griswold, Benjamin Calnin, Michael Schramm, Luc Anselin and Paul Boehnlein (February, 2014); *Estimating the Effects of Demolishing Distressed Structures in Cleveland, OH, 2009-2013*

Blighted Vacant Lots

The next major trend shows the negative effect blighted vacant lots have on home values. In every model, **blighted vacant lots decrease surrounding home values. The decrease is between 3.8% in Low submarkets and as high as 11.5% in Average submarkets. On average across Allegheny County, blighted vacant lots decrease property values by 6.0%.** All models were statistically significant.

Blighted Vacant Lots

Submarket	Effects of Home Values
High Submarket	- 7.6%
Moderately High Submarket	- 5.3%
Average Submarket	- 11.5%
Moderately Low Submarket	- 10.6%
Low Submarket	- 3.8%
Pooled	- 6.0%

Green Infrastructure

Unfortunately, a consistent trend on property values for green infrastructure improvements within individual submarkets was not established. Two of the six models were found to hold no statistical significance. The remaining models are in varying states of statistical significance when testing standards are relaxed or greatly relaxed. This lack of observed trend might stem from the limited number of sites included in the models. Additional data is required in order to more thoroughly reveal how green infrastructure improvements affect home values in the various submarkets.

As a result of this finding, another test was conducted to identify with a degree of statistical confidence that there is a positive effect garnered from the introduction of green infrastructure when compared to that of a blighted vacant lot. This statistical test was completed for the Pooled model and concludes, that statistically, green infrastructure improvements across Allegheny County, when all else is equal, have a positive effect on housing values when compared to a blighted vacant lot, meaning that **installing green infrastructure on a blighted vacant lot will increase nearby property values.**

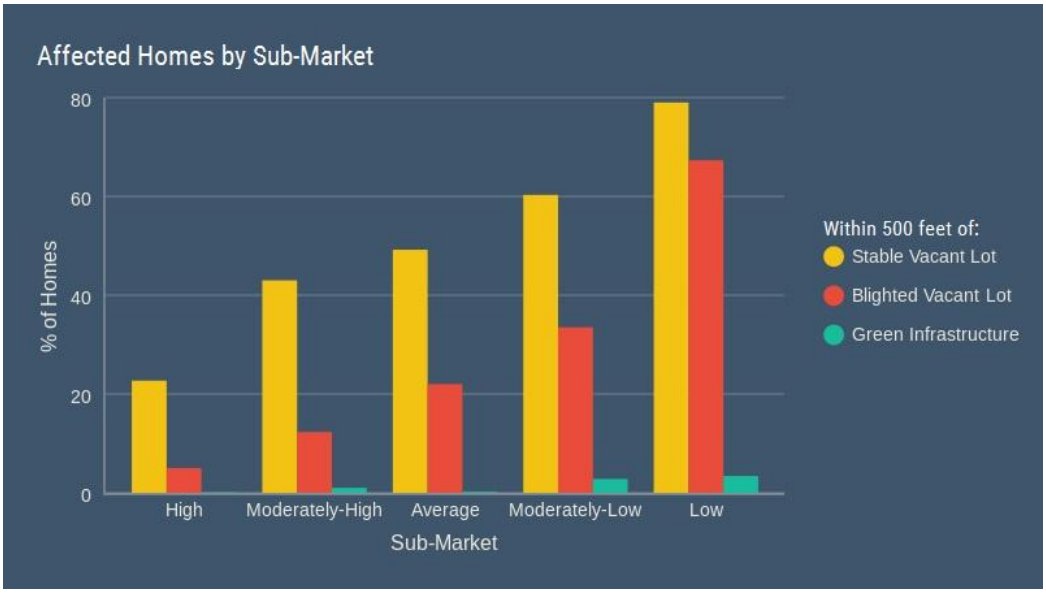
Economic Effect of Stable Lots, Blighted Lots and Green Infrastructure

Using the results from the models, an analysis of the economic effect these variables have on residential property values across Allegheny County was conducted. There are two interrelated parts to this analysis. The first attempts to reveal the current economic effect experienced throughout the county due to the existence of the three study variables. The second step of the analysis examines the potential net benefit earned by stabilizing blighted vacant lots.

Identifying Affected Homes

In order to identify affected homes three lot buffers were defined to identify homes within 500 feet of each one of the study variables; stable vacant lots, blighted vacant lots and green infrastructure sites. Figure 4.1 below shows the percentage of homes in each submarket within each type of lot buffer:

Figure 4.1 Stable Lots, Blighted Lot and Green Infrastructure Buffers



If each submarket was affected uniformly, with roughly the same percentage of homes in proximity of each study variable, an analysis using the results from the Pooled model could be conducted. However, as the market weakens, a greater percentage of homes are within 500 feet of all three study variables. Therefore, this analysis takes into account the submarkets in order to gain a more accurate view of how stable and blighted vacant lots and green infrastructure affect home values.

Calculating the Current Economic Effect

With homes isolated within each submarket, the effects discovered from their corresponding models can be applied to see how home values are influenced by the study variables. The assessment values provided by Allegheny County's property dataset of the affected homes were then aggregated and the positive and negative effects were calculated. Figure 4.2 below is provided to show how each submarket is influenced by the existence of green infrastructure, blighted and stable lots. Chart 4.3 below summarizes the results of the statistical analysis. Only those variables found to be highly statistically significant or relevant were included.

Figure 4.2 Aggregate Economic Effect of Study Variables by Submarket

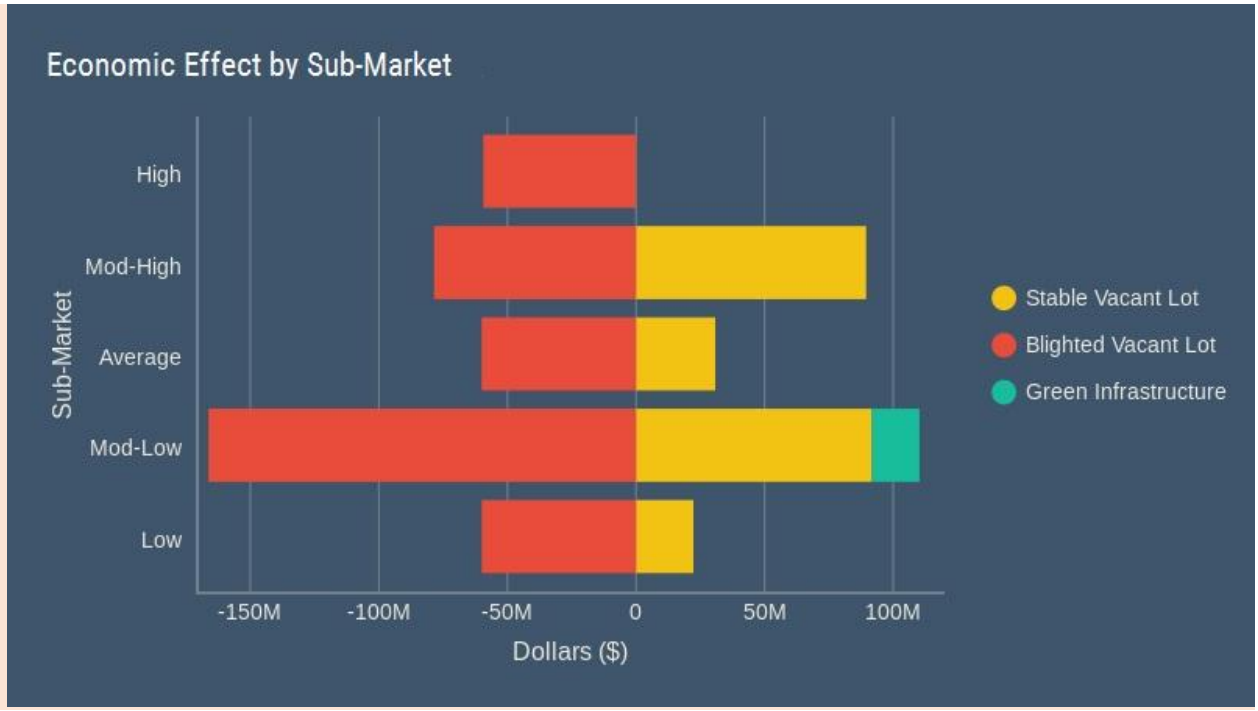


Chart 4.3 Summary of Affected Homes and Economic Effect of Study Variables

	% of Affected Homes			Economic Effect of Study Variables		
Submarket	Stable Vacant Lot	Blighted Vacant Lot	Green Infrastructure	Stable Vacant Lot	Blighted Vacant Lot	Green Infrastructure
High	22.7%	5.0%	0.1%	Not Statistically Significant	($59,395,291)	Not Statistically Relevant
Moderately High	43.0%	12.3%	1.0%	$89,483,289	($78,524,892)	Not Statistically Significant
Average	49.2%	22.0%	0.2%	$30,829,294	($60,016,166)	Not Statistically Significant
Moderately Low	60.3%	33.5%	2.8%	$91,759,696	($166,257,638)	$18,469,504
Low	79.0%	67.3%	3.4%	$22,322,481	($59,968,644)	Not Statistically Significant
				$234,394,760	**($424,162,631)**	**$18,469,504**

The totals observed in Chart 4.3 show that across Allegheny County, stable and maintained residential vacant lots add an estimated **$234,394,760** positive increase in value to surrounding homes, while blighted and unkempt lots decrease values by an estimated **$424,162,631**. Green Infrastructure was found to be statistically insignificant across most submarkets but was found to add a statistical increase in home values in Moderately Low submarkets by approximately **$18,469,504.**

Economic Effect of Mitigating Blighted Vacant Lots

All the models indicate that blighted vacant lots pose a negative impact to home values. If these lots were stabilized and even improved, the models suggest there would be a positive effect on nearby home values. Using the results found the Pooled model and utilizing a difference in difference approach where the absolute difference between two percentages is found, **simply stabilizing a blighted lot is estimated to increase home values by 7.6%.**

As of the end of 2014, there were 5,466 blighted residential vacant lots affecting 88,952 or 22.9% of households throughout Allegheny County. Using the average home value for Allegheny County, this cross section of affected homes would equal $6,021,317,048 in assessed value. They are currently undervalued due to the surrounding blighted lots. If these blighted lots were turned into stable residential lots, on average, there would be an **estimated increase of $457,620,095 or roughly $5,145 per affected house.**

Conclusion

This analysis has demonstrated that positive increases in neighboring residential property values occur when vacant lots are simply maintained. The study also revealed that blighted vacant lots have negative effects on residential property values. Therefore, green improvements to a blighted vacant lot will have a positive effect. Furthermore, investment in green infrastructure on blighted lots in low, moderately low, and average submarkets has the highest financial benefit to communities.

Appendix

Interpreting Regression Results

For interpretation purposes associated with reading the table found below, coefficients are read as percentage change in home price if a marginal unit of the variable were added. For example, a coefficient of -.010 for delinquent vacant lot would be interpreted as a 1.0% decrease on home value from an additional delinquent vacant lot within 500 feet of a home. In addition, asterisks correspond to tests of statistical significance for each variable. The more asterisks, the greater degree of confidence there is in that variable having an effect on home sales. The following Chart 5.1 shows the regression results for the three study variables from the six different models.

Chart 5.1 Summary of Regression Results for Study Variables

Model	R^2	Stable Vacant Lot	Blighted Lot	Green Infrastructure
Pooled n=41,124	64.08%	0.016***	-0.060***	0.007
High n=12,157	63.95%	-0.002	-0.076***	-0.698***
Moderately High n=11,157	49.23%	0.015***	-0.053***	-0.129*
Average n=3,155	43.85%	0.022***	-0.115***	-0.157*
Moderately Low n=8,414	32.77%	0.028***	-0.106***	0.127**
Low n=6,241	35.32%	0.011***	-0.038***	0.023

**Significant at the .15 percent alpha level*
*** Significant at the .05 percent alpha level*
**** Significant at the .01 percent alpha level*

Summary of Regression results

There are a few general trends observed across all models:

Stable Vacant Lots

The first major trend involves the positive effect stable vacant lots have on home values. In every model except the High submarket, **stable vacant lots are estimated to increase surrounding home values between 1.1% in Low submarkets and as high as 2.8% in Moderately Low submarkets. On average across Allegheny County, the Pooled model estimates the positive effect to be 1.6%.** All but the High submarket model were highly statistically significant.

Blighted Vacant Lots

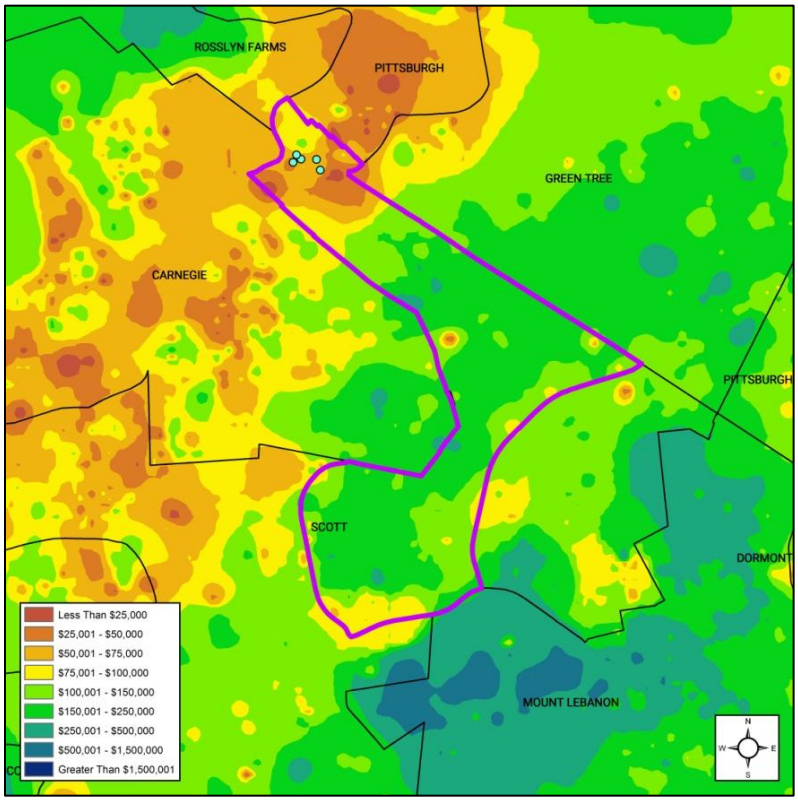
The next major trend involves the negative effect blighted vacant lots have on home values. In every model, **blighted vacant lots are estimated to decrease surrounding home values between 3.8% in Low submarkets and as high as 11.5% in Average submarkets. On average across Allegheny County, the Pooled model estimates the negative effect to be 6.0%.** All models were statistically significant.

Green Infrastructure

Two of the six models were found to hold no statistical significance. The remaining models are in varying states of statistical significance with values ranging as low as -69.8% in the High submarket model and as high as 12.7% in the Moderately Low Submarket.

This lack of observed trend likely stems from the limited number of sites included in the models. While a few of the models are statistically significant, the limitations in the number of study variables may have affected the results. The most distinct example can be found in the High submarket model which yields a -69.8% effect on surrounding property values. While this value is highly statistically significant, further analysis of the data uncovers the potential for biased results. To begin, only four sites out of 90 green infrastructures improvements were found within High markets. These four sites were in proximity to only eight sales over the 3 year study period. These eight sales were located and plotted. Below, in Figure 5.2, one can see a selection of these sales mapped.

Figure 5.2 Mapping Sales Affected by Green Infrastructures in High submarkets.



These sales, while taking place in a High submarket, were located in weaker sections within the submarket. To put this in perspective, the mean sale price of these eight homes were $86,598 while the High submarket at large had a mean sale price valued at $239,613.

It's these eight sales which were used to estimate the effect of green infrastructures on home values across High submarkets. Therefore the result of green infrastructure coefficients being highly biased across all the models by other external variables not accounted for is very likely. In order to gain a clearer understanding of how green infrastructure improvements affect home values in these higher markets, additional sites and thus data points need to observed and analyzed for the results to not only be statistically significant but also relevant. Additional Test of Significance for Green Infrastructure

While a trend was not observed in the models for the green infrastructures variable, another test was conducted to establish if, with a degree of statistical confidence, there is any positive effect garnered from the introduction of green infrastructure. This additional test looked to confirm that green infrastructure improvements play a more positive role in housing values than a blighted vacant lot. **This statistical test was completed for the Pooled model and concludes that statistically, green infrastructure across Allegheny County all else equal, plays a more positive role than blighted vacant lots in terms of housing values.**

This test was conducted in the Pooled model in order to confirm that the coefficient related to green infrastructure sites was statistically greater than the coefficient related to blighted vacant lots.

Regression Results by Submarket

Pooled

Model	R^2	Stable Vacant Lot	Blighted Lot	Green Infrastructure
Pooled n=41,124	64.08%	0.016***	-0.060***	0.007

Stable Vacant Lots

The results show that an additional stable residential vacant lot within 500 feet of a home, on average throughout Allegheny County and all else equal, is estimated to **cause an increase of 1.6% in housing value** and **is highly statistically significant.** [26]

Blighted Vacant Lots

The results show that an additional blighted residential vacant lot within 500 feet of a home, on average throughout Allegheny County and all else equal, is estimated to **cause a decrease of 6.0% in housing value** and **is highly statistically significant.**

Green Infrastructure

The results show that an additional installation of green infrastructure within 500 feet of a home, on average throughout Allegheny County and all else equal, is estimated to **cause an increase of .07% in housing value** but **is not statistically significant at any reasonable statistical level.**

High Submarket

Model	R^2	Stable Vacant Lot	Blighted Vacant Lot	Green Infrastructure
High n=12,157	63.95%	-0.002	-0.076***	-0.698***

[26] Highly Statistically Significant - Passes at the .01 alpha level (99% Confidence)
Statistical Standards are slightly relaxed - Passes at the .05 alpha level (95% Confidence)
Statistical Standards are greatly relaxed - Passes at the .15 alpha level (85% Confidence)
Not statistically significant at any reasonable statistical level - Does not pass at the .15 alpha level.

Stable Vacant Lots

The results show that an additional stable residential vacant lot within 500 feet of a home, on average throughout High submarkets and all else equal, is estimated to **cause a decrease of 0.2% in housing value** and **is not statistically significant at any reasonable statistical level.**

Blighted Vacant Lots

The results show that an additional blighted residential vacant lot within 500 feet of a home, on average throughout High submarkets and all else equal, is estimated to **cause a decrease of 7.6% in housing value** and **is highly statistically significant.**

Green Infrastructure

The results show that an additional installation of green infrastructure within 500 feet of a home, on average throughout High submarkets and all else equal, is estimated to **cause a decrease of 69.8% in housing value** and **is highly statistically significant.**

Moderately-High Submarket

Model	R^2	Stable Vacant Lot	Blighted Lot	Green Infrastructures
Moderately High n=11,157	49.23%	0.015***	-0.053***	-0.129*

Stable Vacant Lots

The results show that an additional stable residential vacant lot within 500 feet of a home, on average throughout Moderately High submarkets and all else equal, is estimated to **cause an increase of 1.5% in housing value** and **is highly statistically significant.**

Blighted Vacant Lots

The results show that an additional blighted residential vacant lot within 500 feet of a home, on average throughout Moderately High submarkets and all else equal, is estimated to **cause a decrease of 5.3% in housing value** and **is highly statistically significant.**

Green Infrastructure

The results show that an additional installation of green infrastructure within 500 feet of a home, on average throughout Moderately High submarkets and all else equal, is estimated to **cause a decrease of 12.8% in housing value** and is **statistically significant only when testing standards are greatly relaxed and are therefore not reliable.**

Average Submarket

Model	R^2	Stable Vacant Lot	Blighted Lot	Green Infrastructures
Average n=3,155	43.85%	0.022***	-0.115***	-0.157*

Stable Vacant Lots

The results show that an additional stable residential vacant lot within 500 feet of a home, on average throughout Average submarkets and all else equal, is estimated to **cause an increase of 2.2% in housing value** and **is highly statistically significant.**

Blighted Vacant Lots

The results show that an additional blighted residential vacant lot within 500 feet of a home, on average throughout Average submarkets and all else equal, is estimated to **cause a decrease of 11.5% in housing value** and **is highly statistically significant.**

Green Infrastructure

The results show that an additional installation of green infrastructure within 500 feet of a home, on average throughout Average submarkets and all else equal, is estimated to **cause a decrease of 15.7% in housing value** and is **statistically significant only when testing standards are greatly relaxed and are therefore not reliable.**

Moderately-Low Submarket

Model	R^2	Stable Vacant Lot	Blighted Lot	Green Infrastructures
Moderately Low n=8,414	32.77%	0.028***	-0.106***	0.127**

Stable Vacant Lots

The results show that an additional stable residential vacant lot within 500 feet of a home, on average throughout Moderately Low submarkets and all else equal, is estimated to **cause an increase of 2.8% in housing value** and **is highly statistically significant.**

Blighted Vacant Lots

The results show that an additional blighted residential vacant lot within 500 feet of a home, on average throughout Moderately Low submarkets and all else equal, is estimated to **cause a decrease of 10.6% in housing value** and **is highly statistically significant.**

Green Infrastructure

The results show that an additional installation of green infrastructure within 500 feet of a home, on average throughout Moderately Low submarkets and all else equal, is estimated to **cause an increase of 12.7% in housing value** and is **statistically significant when testing standards are slightly relaxed.**

Low Submarket

Model	R^2	Stable Vacant Lot	Blighted Lot	Green Infrastructures
Low n=6,241	35.32%	0.011***	-0.038***	0.023

Stable Vacant Lots

The results show that an additional stable residential vacant lot within 500 feet of a home, on average throughout Low submarkets and all else equal, is estimated to **cause an increase of 1.1% in housing value** and **is highly statistically significant.**

Blighted Vacant Lots

The results show that an additional blighted residential vacant lot within 500 feet of a home, on average throughout Low submarkets and all else equal, is estimated to **cause a decrease of 3.8% in housing value** and **is highly statistically significant.**

Green Infrastructure

The results show that an additional installation of green infrastructure within 500 feet of a home, on average throughout Low submarkets and all else equal, is estimated to **cause an increase of 2.3% in housing value** and **is not statistically significant at any reasonable statistical level.**