Housing Needs Assessment After a Local Disaster

A Final Report on
Housing Recovery Research Conducted in Eight Iowa Cities
Two Years Following the Iowa Floods of 2008

Part Four: Geographic Information Systems (GIS) Mapping

Prepared for the Iowa Department of Economic Development

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Community and Economic Development

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Overview

Iowa State University and Iowa State University Extension and Outreach Community and Economic Development (CED) received a contract from the Iowa Department of Economic Development (IDED) to develop a methodology to assess housing needs following natural disasters.

The primary components of this research project are analyses of the economic impact the 2008 Iowa floods and the impact of the national recession on the speed of recovery; assessment of quantitative statistical data measuring the loss of housing and the types of replacement housing needed to meet expected community growth levels; Geographic information systems (GIS) mapping of planning scenarios; and development of a template for regional planning agencies and community leaders to use addressing future disasters.

The research project was augmented with two forms of qualitative research—focus groups and key informant interviews, as well as quantitative research in the form of an online survey. The data from focus groups and key informant interviews provide context and meaning to the statistical data in that they tell the story, in the participants' own words, of their communities' experiences during the flood, in the days immediately following the flood, and in the long months of recovery. These data gathering methods also provided information about participants' interactions with the variety of agencies and programs that these communities had at their disposal to undertake the work of long-term recovery. The online survey was used to capture additional input from stakeholders who were unable to participate in any of the city-based focus group sessions or who had stated a preference to receive an electronic survey rather than being interviewed individually.

IDED, the Iowa Finance Authority (IFA) and the Rebuild Iowa Office (RIO) selected eight Iowa cities of various sizes and types to gain an understanding of how program implementation differed by the size and type of community being served and to identify the unique challenges these communities have encountered in their recent experiences with the loss of housing due to a natural disaster. The cities chosen were Cedar Rapids, Charles City, Columbus Junction, Coralville, Iowa City, Mason City, Waterloo and Waverly.

This report describes the geospatial analysis process for the eight study communities and provides individual maps and summaries for each location.

Geospatial Analysis

Introduction

A key component of this study was the development of a method for assessing longer-term housing impacts on a given community following a natural disaster. Inherent problems always exist with this type of effort. First and foremost is identification of a consistent data source that includes benchmark data prior to the natural disaster. Just as critical, the same source should provide data for a period or periods of time following disaster. Third, the data need to have spatial dimension so that actual impacts of the flood, tornado or other disaster can be targeted and not be reliant on place aggregate data. In other words, the disaster zone needs to be isolated within the community in order to identify disaster impacts. Fourth, housing units impacted with that zone need to be identified. Fifth, subsequent housing unit development within the impacted zone, as well as the broader community, should be identified to determine how the area has compensated for lost housing units.

Regardless of whether or not the abovementioned problems are overcome, there still exists the issue of exogenous effects on the local housing market beyond the natural disaster. For instance, in the context of today's housing market, to accurately detail a local disaster's impact on housing the question must be raised: "Are housing starts related to the local economy or are they are they the result of replacing housing units lost due to the natural disaster?" To assess the impacts of the local economy for this phase of the study, an analysis of job creation and subsequent effects on housing demand was conducted (see the part one, "Economic Impact Evaluation of a Natural Disaster").

Obviously, all housing units are not created equal. New housing units may be more costly than units lost to a flood or other natural disaster. While housing units may be replaced on a larger scale, affordable units may be replaced with much costlier units aimed at a different market. Total housing units may actually increase within a given market, but replacement units may be beyond the financial means of households displaced by a natural disaster. Thus, an examination of this affordability gap also needs to be made as part of the larger impact study, requiring access to the value of homes within a given community.

Finally, data sources must be current and universal. Unlike the US Census, floods and tornados do not occur every ten years. While the American Community Survey is conducted annually, problems with the margin of error associated with the sample size can make the utility of the data at the neighborhood or small town level questionable. Therefore, data to assess the housing impacts of natural disasters on communities need to be collected at least annually (to allow for longitudinal comparisons) through either complete or large samples (to allow for no or low margins of error). Data should also be universally available for any community in Iowa.

Methodology

The first step in the geospatial analysis process was identifying the optimal data to measure the impact of the flooding consistently across the study communities. The research team developed a matrix of data needs required to meet the study objectives. Next, the research team examined several potential sources for the data needed. Multiple sources were sought in part to provide validation of study findings. While this search did take time, it allowed the research team to determine what not to do in the future.

Potential Data Sources Examined but Not Utilized

One of the sources the research team attempted to contact for data was the investor-owned electric utilities, under the assumption that a lost customer would be recorded by address. Most multiple-family homes would likely have multiple units. An address taken off the grid within the floodplain more than a year later would be considered a lost housing unit or units in the case of multiple meters. Investor-owned utilities often have excellent geographic information systems (GIS) capacities associated with their grids. It was hoped that the data and format would be a natural for this type of study.

However, for a number of reasons, the investor-owned utilities covering the eight communities were reluctant to release these data and GIS files. There were both corporate and public policies governing data release. Keep in mind that a for-profit corporation collects these data on private citizens. The research team was ultimately informed by one utility that barring a court ruling, they would not be a position to release the data.

A second potential source approached was the public water utilities. Again, as in the case of the electric utilities, data are kept by address. The assumption was that a water meter that was disconnected following an event in a disaster area but not been reactivated over a long

period time would provide an indication of a lost housing unit. Subsequently, requests were made from each of the eight cities' public utilities for longitudinal data on water hookups from before and after the 2008 flood.

The research team discovered that in most cases, water utility data management focuses upon a recording and billing function. Data were not generally found within a GIS framework. Obtaining longitudinal data on hookups by address also proved problematic. Finally, the data management systems of some city utilities were such that only an output of a dot matrix printout was available. To use this information, all the data would need to be re-entered, new data fields established and GIS coordinates added for each data point. While in general these data systems may work adequately for water billing purposes, they have limited applications for either housing impact assessments or long-term geospatial planning.

County or City Assessor's Data

The county assessor is charged with the valuation of real property so property taxes may be calculated and assessed. Therefore, data generated by the county assessor should indicate both declines in housing value from disasters and increased value on parcels where new housing construction takes place. The Iowa Assessors website describes the assessors duties as follows:

> The Assessor is charged with several administrative and statutory duties; however, the primary duty and responsibility is to cause to be assessed all real property within their jurisdiction except that which is otherwise provided by law. This would include residential, commercial, industrial and agricultural classes of property. Real property is revalued every two years. The effective date of the assessment is January First of the current year. The assessor determines a full or partial value of new construction, or improvements depending upon the state of completion as of January First (http://iowa.iowaassessors.com/assessorsduties.php).

Within two years of a disaster event, valuation of lost housing stock should have occurred and subsequent new property development noted. Assessors not only work with the real property such as a building, but also the value of the lots or parcels on which buildings may be located. Hence, an empty parcel where a building once stood, but was destroyed by a disaster, should be assessed based on the value of the empty lot, whereas if a building were constructed on an empty lot subsequent to a disaster, the post-disaster assessment of that parcel would include the value of the building. Cities with populations of more than 10,000 may elect to have to have their own assessor.

Housing stock severely damaged or destroyed by disaster should be reflected by a large drop of the assessed valuation. Where damaged or lost property is not taken into account, there are processes through which property owners can appeal their assessment to avoid paying property taxes on damaged or lost property. These data are also collected and maintained based upon addresses and lots.

What perhaps is most appealing about assessor's data as a source of information on the impact of disasters on housing pertains to the fact that most counties and cities have digitized these data and have them mapped on GIS. Furthermore, searchable databases are frequently available on county and city assessor websites. Information for each lot includes descriptions of buildings, the number of housing units (if a multifamily building or buildings), pictures of the property, and a series of maps showing its location. Therefore, assessors' data files can be validated lot by lot on their websites if questions or inconsistencies arise on any given parcel.

Issues with Assessors' Data Collection

While all counties and many cities with populations of more than 10,000 assess the value of the property within their jurisdiction and manage data collection for purposes of property tax assessment, there are no universal standards as to how that data is managed. Each county has proprietary rights to the data and can construct it own data management system. Each local jurisdiction can develop its own geospatial analysis or mapping systems. There are no standards, no commonality as to how counties store and manage these data.

Furthermore, there is no universal procedure for requesting these data. Some counties will simply provide data upon request. Others require the completion of a formal application. And even though these data are subject to the records laws of Iowa Code Chapter 22, counties and cities can and do charge to defer costs related to compiling the data.

Data from the various assessors' offices were stored and transmitted in many forms. Excel, pdf, GIS (shp, prj) and cvs files were among the formats in which data were sent. There is also no standard method of recording or labeling data. As an example, some datasets did not distinguish parcels with multifamily units from those with single-family households, or did not indicated how many households were on a parcel. Each dataset had to be interpreted and labeled in a fashion that allowed for consistent analysis across the eight study sites.

Another limitation of the assessors' data is the time delay between when a new home is constructed and when it is actually assessed. While parcels with major losses to homes should be recorded, all new housing construction

within a community may not be. To offset this time gap, housing permit data were used to obtain the number of housing starts from 2008 to 2010. Data from building permits for housing units and the value of these units are submitted monthly by larger communities to the US Census Bureau and by smaller cities on annual basis (http://censtats.census.gov/bldg/bldgprmt.shtml). Seven of the eight communities in this study submitted these data with Waverly the lone exception. For Waverly, the study used assessor and local housing permit information to estimate new housing starts and their value. December 2009 was chosen as a cutoff date because it is likely that the housing covered by those building permits would have come online in 2010 or early 2011.

The research staff also found many organizational variations in how each county staffed its data management systems. In some cases, the data were available for the current year but not readily available for past years. In some cases, the GIS function of the county was found outside of the assessor's office. Compiling information from archives, current data and mapping information would sometimes involve contacting four separate individuals within the local government. One such example, local zoning maps were required to focus on parcels in multi-unit residential zones. Zoning maps were procured through the local planning offices and then overlaid in the flood zone to determine potential multifamily units lost from the flood.

To summarize, with each county maintaining its own data systems and staffing patterns, gathering the data needed to complete this study took on the characteristics of a treasure hunt. These data do have great value for not only determining property losses from natural disasters, but also as a metric of local economic performance. The data systems appear to be generally designed to address immediate management issues with little effort and resources spend on designing systems for more long-term planning and analysis.

GIS Data Libraries

To compare and contrast the study communities on like bases, the research team looked for datasets that were available for all eight communities. These datasets were readily and immediately accessible, with no fee required, at the Internet-based GIS data libraries of the Iowa Department of Natural Resources (**http://www.igsb.uiowa.edu/nrgislibx/**) and the Iowa Department of Transportation (**http://www.iowadot.gov/gis//**). The Iowa DNR also created a GIS dataset that revealed the actual ground extent of the flooding for most of the eight study cities. The dataset was created from satellite imagery acquired at the peak of the 2008 flooding. These data provided a reliable source of information with which to circumscribe the actual flood areas based on real-time data from the flood event. The collection of this data by the Iowa DNR and the production of digital information freely accessible from its website proved invaluable. The data covered an extent from the southeast corner of the state to the north-central border with Minnesota. It is not likely that these data could have been assembled by any one of the communities affected along the Iowa and Cedar River flood basins.

Geospatial Analysis

Once the data were gathered from each community and reorganized into a form that lent itself to analysis, a determination of what would constitute a lost housing unit due to the disaster (in this case the 2008 floods) was made. If the assessed valuation of a home in the flood impact area decreased by 50% or more after the flood, it was considered a "lost unit." This criterion was based on the assumption that a home that lost more than half its value would likely be uninhabitable. Few valuations of homes were near this 50% lost value; the vast majority of homes lost in the respective floodplains were valued at 0% by the assessors. The study team felt confident that the number of housing units lost from the flood is relatively accurate given that some minor reporting errors may occur.

The study was commissioned however, to identify the impact of the 2008 flood on housing in the eight study communities. Therefore, a measure of the economy was needed to determine if it sustained new construction to replace housing units. This measure was calculated for the total number of units, and value of the replacement units was compared with that of the lost units.

To determine housing impacts of a natural disaster in each community, a measure of housing units lost, a measure of new units built, and a measure of the local economy's ability to influence housing demand is needed. The following formula was constructed:

X=(UL-P)+D

Whereas:

X = Net housing need in community

UL = Units lost due to natural disaster

P = New housing units constructed

D = Housing demand from local economic performance

In other words, the net housing need in a community after the 2008 floods was calculated based upon the total number of units lost in the flood minus the total number of units built within the past two years. Housing permit data from the US Census Bureau were utilized

Table 1. An estimate of housing impacts from the 2008 flood on selected cities					
City	Units lost (2008 flood)	Permits for new units	Net difference	Economic housing demand (2008–2010)	Net difference (total housing demand)
Cedar Rapids	1,533	1,665	-132	1,616	1,484
Charles City	12	6	6	0	6
Columbus Junction	6	10	-4	6	2
Coralville	36	221	-185	215	30
Iowa City	154	701	-547	789	242
Mason City	50	111	-61	0	-61
Waterloo	52	180	-128	0	-128
Waverly*	44	47	-3	0	-3

*Waverly data was generated through geospatial analysis of 2008 and 2010 county assessor's data.

to determine the number and value gained by each municipal jurisdiction (except Waverly) from 2008 to 2010. The total number of units built or building permits issued was deducted from the total units lost according to the county assessors' data to determine a net difference in housing units lost due to the flood (see the "Net difference" column in table 1).

Then housing demand based upon job creation over the past two years was calculated to determine the overall need for housing units. This calculation assumes a unit-to-unit replacement without considering the values of those replacements. It does, however, takes into account whether a local economy has recovered and is growing post-disaster (see the "Economic housing demand (2008–2010)" column in table 1).

Thus, the changes in housing units within the municipalities are adjusted for both the 2008 flood and subsequent economic conditions (see the "Net difference (total housing demand)" column in table 1).

General Findings

In the cases of Iowa City, Coralville and Cedar Rapids, local economic growth has created a housing demand beyond the units lost from the flood. In all three of these locations, more housing units have been built or issued building permits than were lost in the floods. The economies of Iowa City and Cedar Rapids are driving the housing market to create a greater demand than could be expected by just the amount of housing lost in 2008. Cedar Rapids is generating the need for an estimated 1,484 units beyond what has been permitted and lost in the flood. Iowa City and Coralville combined need an estimated 272 units. Again, most of this additional need is based on economic conditions. Although economic trends may indicate the need for additional housing, they may also reflect increased commuting to these three cities.

Data for the remaining locations tell a much different story. Charles City and Columbus Junction lost a total of 18 housing units—much less than the aforementioned locations. Economic conditions in Charles City and Columbus Junction added no real growth in housing demand; the overall housing impacts derived from either the flood or the local economies remain negligible.

Waterloo and Mason City actually realized more new housing units in the past two years than would have been predicted by flood losses and the economic growth. Since no additional housing demand from economic growth was indicated and housing permits exceeded the loss of units from the flood, a slight excess of housing is indicated for these two cities.

Finally, replacement housing is often not the equivalent of the housing lost through flooding. Table 2 provides information on the average value of the housing units lost through the 2008 flood and the average value of the housing that has been built in each respective city since. A great discrepancy between the value of the housing lost and the value of the housing built since the flood exists in the five communities for which data are available. The discrepancy in pre- and post-flood housing values ranges from nearly $30,500 in Cedar Rapids to more than $125,000 in Coralville. In each city, the more affordable housing lost in the flood is being replaced with significantly more expensive housing. It would appear that one housing impact of the flood of 2008 is the need for more affordable housing in the affected communities.

Table 2. Discrepancy between value of housing lost and replace housing			
City	Average value per unit lost	Average value per unit built	Net difference
Cedar Rapids	$51,925	$82,415	$30,490
Charles City	n/a	$269,902	n/a
Columbus Junction	$33,682	$134,364	$100,682
Coralville	$84,559	$210,716	$126,157
Iowa City	$154,805	$190,158	$35,353
Mason City	n/a	$184,011	n/a
Waterloo	$57,061	$126,305	$69,244
Waverly*	$64,533	$182,436	$117,893

* Waverly data was generated through geospatial analysis of 2008 and 2010 county assessor's data.

Community Cases

The following breaks down the impact of the 2008 flood on housing community by community. In conjunction with GIS mapping, parcel-level analysis is made of the local assessor's data. Each map details the location of lost housing based upon an assessed valuation that declined in excess of 50% from the time of the flood to the year 2010. Each map also details the location of new housing as recorded by the assessor following the flood. In both instances, parcel-level data is recorded on the map; therefore, multiple-family dwellings are treated as single-family homes at this parcel level. However, data were further refined to include multifamily units in the tables of housing units lost, permits for new units, and average values of units lost and built.

Large-format maps for each study community are included at the end of this section.

Cedar Rapids

Cedar Rapids suffered by far the most significant numbers of homes lost, comprising more than 80% the total homes lost in the eight study communities. Figure 1 indicates parcels where housing units were lost in Cedar Rapids. The first map shows that the flood caused significant harm all along the river corridor to properties within the historically delineated floodplain and beyond. Damages occurred in several clusters of properties, mostly in and adjacent to the historic downtown area, especially on the west side of the river.

Looking more closely, it becomes evident that the greatest loss of property—perhaps not of the highest assessed value, but in terms of numbers of dwellings lost—are seen in two primary clusters. One of these clusters is to the northwest of the downtown. The other is to the south of the downtown and also on the west side of the river. This cluster is in a particularly older residential area. These properties are among the lowest in average property value of those demolished following the flood.

According to the GIS analysis using the county assessor's data, 1,533 dwelling units were lost in Cedar Rapids due to the flood. The US Census Bureau's data indicate 1,664 new dwelling units, including single-family and multi-dwelling units, built after the flood by 2010. The second map in figure 1 shows the distribution of these building permits. One primary observation stands out: the dispersion of the residential building activity away from the river area. Another significant observation is the value of the building permits, which show an average value much higher than that of the properties being replaced.

Looking carefully at the flood extent area reveals not only a high loss of dwelling units, but also many more dwellings still within the flood extent of the 2008 flood and on the historically delineated floodplain. In other words, there is room for significantly more housing damages as a consequence of any additional severe flooding in the future. These dwellings remain vulnerable, as well as any dwellings that may be rebuilt within those areas without significant investment in flood containment.

In summary, Cedar Rapids lost more housing due to the 2008 flood than the other seven communities in this study combined. Subsequent home construction has seen much this housing replaced when examined on a unit-for-unit basis. Cedar Rapids has more housing today than it did during the flood. Continued job creation in the area has helped fuel demand and has led to ongoing housing construction. What may be appearing, however, is an affordable housing gap with more expensive homes replacing more affordable homes in the market. There is a net difference of more than $30,000 in the cost of new

homes in Cedar Rapids when compared to the units lost by through the flood.

Charles City

Digital mapping data of the flood extent for Charles City was not available, so the floodplain delineation was used to identify the affected dwellings along with topography and the drainage patterns of the landscape. As seen on the first map of figure 2, five of the lost dwellings are located on the delineated floodplain and four are not. Upon closer examination, these four were found to be within primary drainage collection areas leading into the floodplain. At total of 12 dwellings were lost due to flooding. The City of Charles City reported to the US Census Bureau six new housing permits from 2008 to 2010. By the end of 2010, there was a net loss of six units in the city.

Among the locations of the new building permits, one appears to be located within the floodplain area. All other new construction locations appear to be well outside the floodplain. On both maps in figure 2 it is interesting to note that the stream long the north side of the city and Cedar Creek junction just to the northwest of a dense residential area.

Probably due to the relatively small numbers of housing units involved, the differences reported between the average values of the dwellings lost and those of new building permits is substantial. The average value of dwellings lost is $30,240 and that of the new building permits is $228,493, a difference of $198,253.

Columbus Junction

From data supplied by the City of Columbus Junction, four dwelling units were lost due to the flood of 2008. These losses were the fewest of any of the eight communities studied. The first map of Columbus Junction in figure 3 shows the location of the parcels related to those losses. The city is situated in such a way as to make its business and commercial center more susceptible to the rages of floods. The few personal residences impacted are lying on the edge of the flooded area.

According to the information from the US Census Bureau and supplied by the city, 10 new building permits were issued since the time of the flood. This information did not include the locations of these new constructions so they are not indicated on the map. According to this study, using these available data, the average value of the dwelling units lost is $27,638 and the value of the new building permits is $134,364, resulting in a difference of $106,726.

The second map demonstrates the location of the dwellings lost in relation to the landscape. This particular junction of the river has an extensive low-lying region upon which the commercial entities of the city have been built. The land rises to the west with some flooding still seen among the low-lying hills and valleys leading to the river.

Coralville

The flood damages in Coralville may not have been as severe for residential parcels as for commercial. Yet, the first map in the Coralville layout in figure 4 shows two very specific areas of dwelling losses, both of which are located well within the historically delineated floodplain.

The dwelling losses are dramatically contrasted to the new dwellings shown on the second map of the layout. The green dots on the first map indicate a dispersion of these new dwellings more to the northern edges of the city. The GIS analysis using the county assessor's data from 2008 and 2010 show the loss of 36 dwelling units (with valuation declines in excess of 50%).

With a robust economy that is creating jobs, the new building permits as reported by the City of Coralville to the US Census Bureau numbered 221. The loss of the 36 units combined with a gain of 221 leaves Coralville for the two years following the flood with a net gain of 185 housing units. So, the loss was more than compensated by new construction when considering the raw numbers of units.

However, there is a significant difference between the average housing value lost and that of the average value of the new dwellings. According to the building permits, the average new value is $210,716 and according to the assessor's records the average value of the housing lost is $84,559, a difference of $126,157. This difference is serious when considering the ability of a homeowner to replace housing lost due to the flood and be within the context of the new construction.

In consideration of future flood events it seems advisable to target the new construction outside the potential flood areas. Yet, the cost of replacement housing may be high in view of affordability for the owners of the housing lost. It was outside the scope of this part of the study to determine what happened to the owners of the lost, more affordable dwellings.

Iowa City

Iowa City suffered significant residential loss and damage along the north loop of the Iowa River. As in the case of many of the study communities, the average value of the lost housing is less than that of subsequent dwellings built after the flooding. The second map in figure 5 illustrates the vast variation in location of dwellings lost and of those built after the flood.

The first map focuses on the area of dwellings lost to the flood. Those on the south side of the river are situated in a traditional housing pattern with smaller lots and a higher density. These parcels are located within the historic floodplain of the river. The two large lots on the north side of the river are a newer development of residences of lower density on one large lot. Although a newer development, this housing was built well within the known floodplain and the extent of the 2008 flood.

The analysis using the county assessor's data indicates that 154 dwelling units with an average assessed value of $154,805 were lost due to the flood. With Iowa City's growing economy, data reported to the US Census Bureau by the city show that 701 new building permits have been issued since the flood at an average value of $190,158. The difference between the average assessed value of the lost dwellings and that of the new dwelling building permit data is $35,353. While the gap in value is not as stark as some of the other cities of this study, it follows the trend in all of the study communities of an increase between the two values.

The dispersal of the building permit locations demonstrates a vast scattering of new dwellings. The discussion in part one of the comprehensive housing needs report, "Economic Impact Evalution of a Natural Disaster," explains the dispersion and the high number of new building permits. There is one last item of note. Although the area of the northern loop suffered significant flood damage, the second map indicates that at least two building permits have been issued on parcels within the 2008 flood area.

Mason City

The 2008 floods caused residential housing losses in Mason City in areas where one expects to find them: in built-up areas on the floodplain.

The digitized flood extent record for Mason City was not available, but by using the historically delineated floodplain and drainage flow of the landscape, a close proximity of the flooded regions of the city may be estimated. Within that area, 50 dwellings were lost and most of them within the floodplains of the streams and rivers. The average assessed value of these dwellings was $95,000. Since the time of the flood event, building permits have been issued for 111 new dwellings, according to data received by the US Census Bureau from the City of Mason City. These residential permits' average value is $184,011. The emerging affordability gap within Mason City measured by the difference of the average value of dwellings lost by the average value of dwellings constructed is significant at $89,011.

The first map in figure 6 shows in close-up the locations of dwellings lost in one area along the river. The second map presents the locations of the 111 new permitted residential construction sites in relationship to the dwellings lost and the overall spatial layout of the city. Most new construction appears to be occurring in the south side of the city.

None of the new construction is sited within the floodplain. Most of this new construction is of higher price and in areas on the periphery of the city, further extended from the city core.

Waterloo

As with all of the other cities in the study, dwelling losses in Waterloo all occurred within the historically delineated floodplain. It might be stated that this flood revealed the relative accuracy of the floodplain maps, as floodwaters aggregated or submerged the ground mostly within the defined floodplain (figure 7, map 1). The second map of the Waterloo map layout shows that one of the dwellings lost was located within a drainage stream of the Cedar River, yet within a designated floodplain region.

The first map demonstrates the proximity and relationship of dwellings lost and the location of the floodplain, the flood extent and the river itself. All areas would appear to be vulnerable to such flooding as hinted to by the landscape itself.

The second map shows the locations of the new building permits issued after to the flood event. The pattern indicates a move to the fringes of the built-up area and much of the new construction appears to be away from the danger of flooding streams. However, the map shows that several permits have been issued in more vulnerable areas as well. These permitted locations could be considered vulnerable they are located within the floodplain and areas near or in the flood extent of the 2008 flood.

As noted in the discussion of the Cedar Rapids maps, the parcels in Waterloo that experienced damage from the flood are located in the same areas where housing escaped extensive damage. A careful observation of the second map shows there is much housing within those vulnerable areas.

The GIS analysis using the Black Hawk County Assessor's records of 2008 and 2010 shows that 52 housing structures at an average assessed value of $57,061 were lost because of the 2008 flood. New building permits reported to the US Census Bureau by the city showed there to be 180 new dwellings with an average value of $126,305. The economic demand of the area helped to produce sufficient new housing to replace the number of dwellings loss. However, the difference in value between the lost

dwellings and the new construction is $69,244—more than the average value of the dwellings lost.

Waverly

An obvious observation drawn from the maps of Waverly in figure 8 is that a significant portion of the city lies within the historically delineated floodplain, making much of the residential dwellings vulnerable to the effects of flooding. To discover that many of the destroyed properties are within that area is indeed not surprising.

The spatial analysis and mapping using the county assessor's records show those dwellings that lost 50% or more value during the time of the flood of 2008. Waverly lost 44 dwelling units to the flood. These dwellings had an average assessed value of $64,533. Subsequent dwelling development resulted in 47 residential building permits for new construction with an average value of $182,436 from 2008 to 2010.

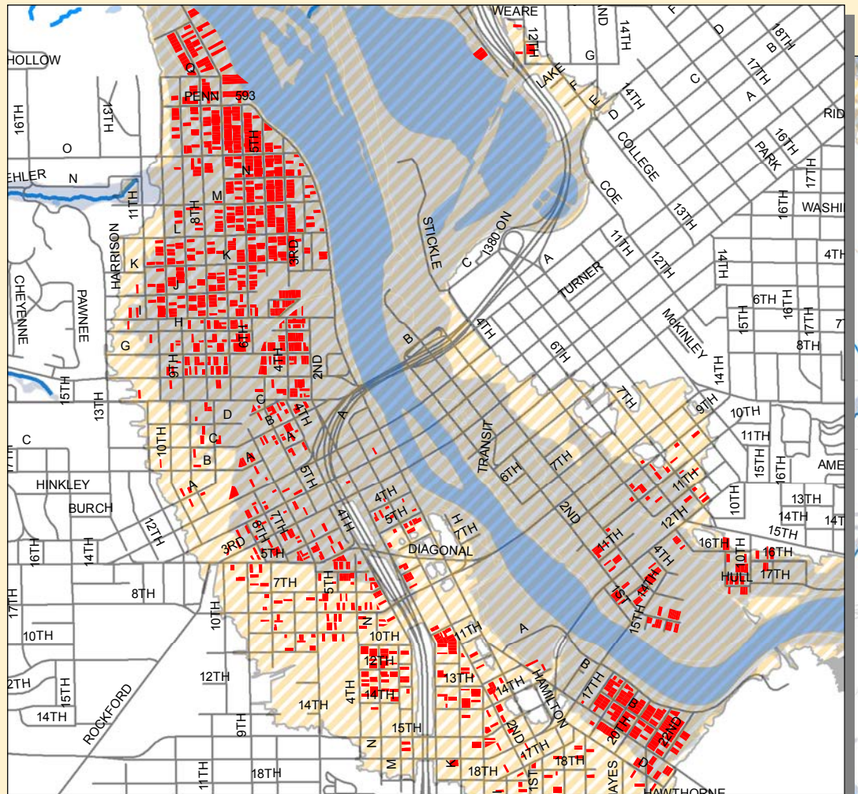
The first map shows the residential distribution of the lost dwellings and the second map shows the distribution of new dwellings in relationship to those lost. New residential construction is shown to be significantly more expensive and is sprawling away from the core of the city.

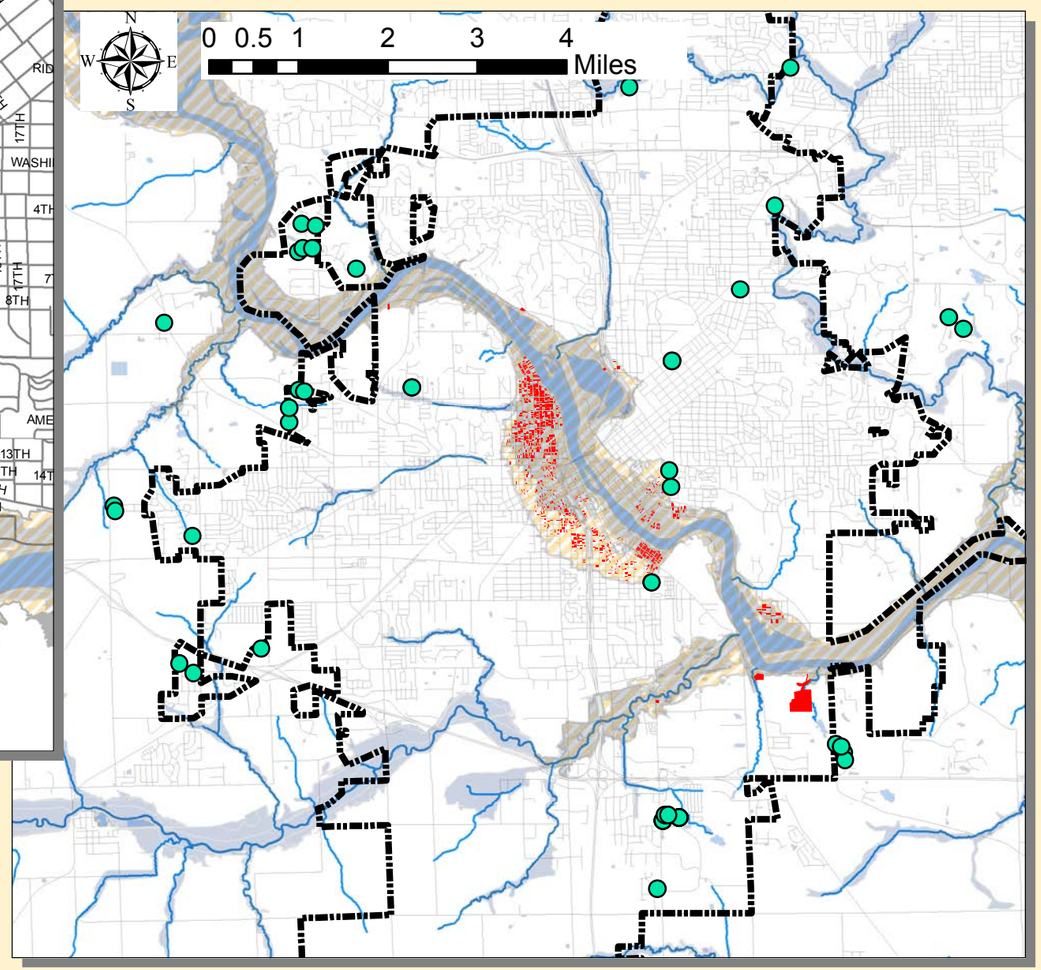
Several of the newly permitted constructed dwellings are shown to be immediately in the area of this current flood. Other permits were issued to allow construction in or adjacent to drainage areas that are actually part of the floodplain, although separated from the river. Also note that in the region of the floodplain (light blue) that a considerable amount of housing was not damaged to the point at which it needed to be demolished. These dwellings may continue to be vulnerable to future flood events.

Cedar Rapids, Iowa
Housing Needs Assessment
2008 Flood

Housing Units Lost	= 1223
Permits for New Units	= 1665
Net Difference	= -132
Economic Housing Demand	= 1,616
Net Difference (Total Housing Demand)	= 1,484

Total Housing Value Lost =	$ 79,600,964
Total Value of Units Built =	$137,221,756
Average Value per unit lost =	$51,925
Avg. Value Per Unit Built =	$82,415
Net Difference =	$30,490





Cedar Rapids, Iowa
Housing Needs Assessment
2008 Flood

Legend

- City Limits
- Roads
- Streams
- Rivers
- Flood Plain
- Flood Extent
- Housing Lost
- New Housing

Map Created by IDRO, ISU Extension
Alan D. Jensen AICP, GIS Specialist
Date: October 14, 2011
Data: Iowa City Property Records,
Johnson County Assessor, Johnson County GIS
Iowa Department of Natural Resources
Iowa Department of Transportation
Iowa State University GIS Facility

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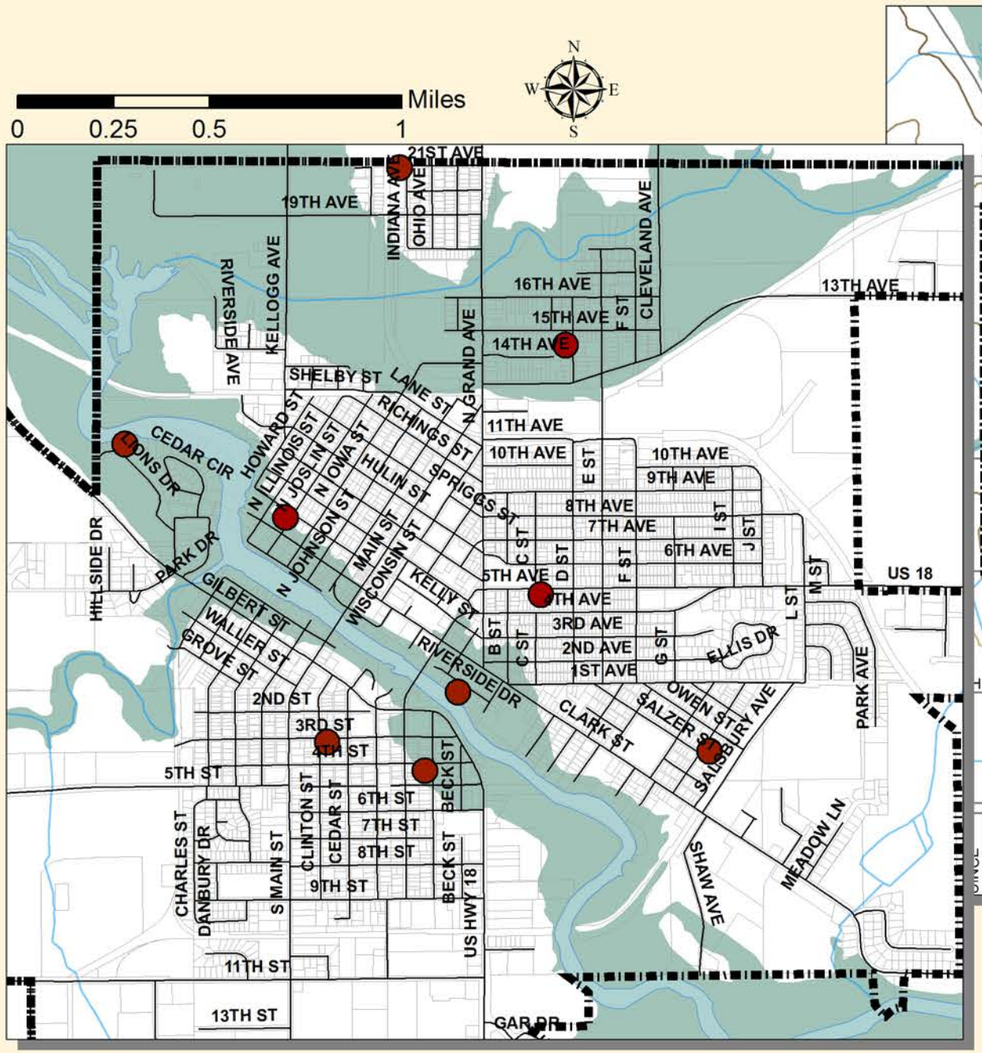
Charles City, Iowa
Housing Needs Assessment
Flood of 2008

Housing Units Lost = 12 dwellings
New Housing Units = 6
Net Difference = 6

Economic Housing Demand = 0
Net Difference (Total Housing Demand) = 6

Value of units lost = $ 302,400
Value of new units = $1,142,464

Average Value of units lost = $ 30,240
Average value per new unit = $228,493
Net Difference = $198,253



Charles City, Iowa
Housing Needs Assessment
Flood of 2008

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Legend

- City Boundary
- Roads
- Cedar River
- Streams
- Flood Plain
- Dwelling Units Lost
- New Dwelling Units

Elevation in Feet

- 984
- 985 - 1017
- 1018 - 1050
- 1051 - 1083
- 1084 - 1115

Map Created by IDRO, ISU Extension
Alan D. Jensen AICP, ISU GIS Specialist
Date: October 18, 2011
Data: Floyd County Property Records, Floyd County Assessor
Iowa Department of Natural Resources,
Iowa Department of Transportation,
Iowa State University GIS Facility

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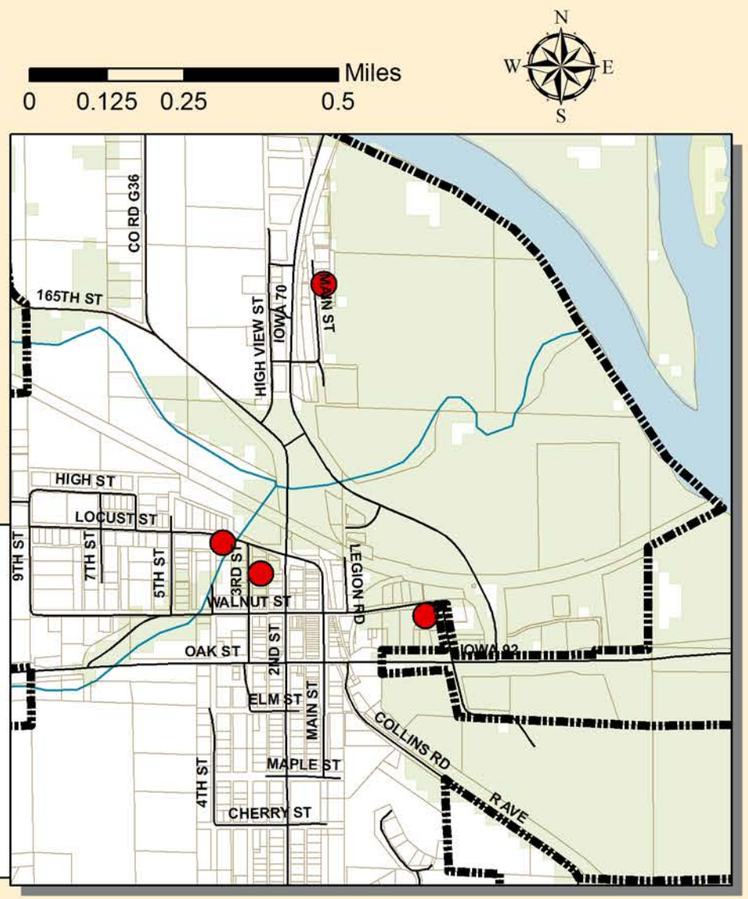
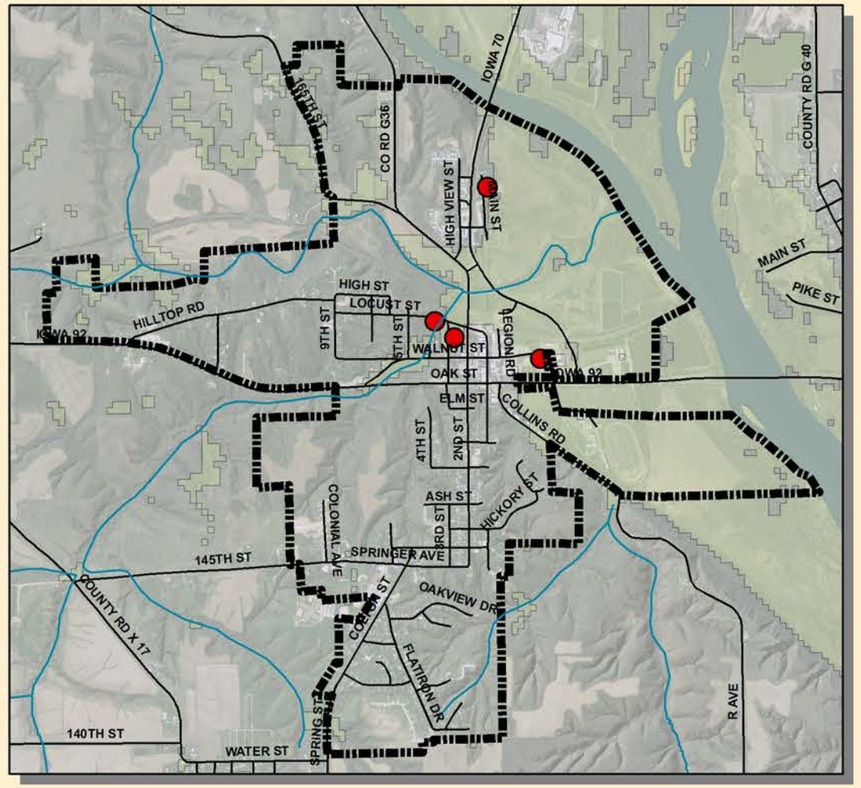
Columbus Junction, Iowa
Housing Needs Assessment
2008 Flood

Housing Units Lost, based on data from the City = 4
New Housing Units based on Housing Permits = 10
Net Difference = -6
Economic Housing Demand = 6
Net Difference (Total Housing Demand) = 0





Value of Housing Units Lost = $110,550
Value of New Housing Units = $1,343,640

Average Value of Housing Units Lost = $27,638
Average Value of New Housing Units Lost = $134,364
Difference = $106,726

Columbus Junction, Iowa
Housing Needs Assessment
2008 Flood

N
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Legend

- City Boundary
- Roads
- Parcel Borders
- Streams
- River
- Flood Extent
- Dwelling loss

Map Created by IDRO, ISU Extension,
Alan D. Jensen AICP, GIS and Community Development Specialist
Date: October 7, 2011
Data: Louisa County Assessor
Iowa Department of Natural Resources
Iowa Department of Transportation
Iowa State University GIS Facility

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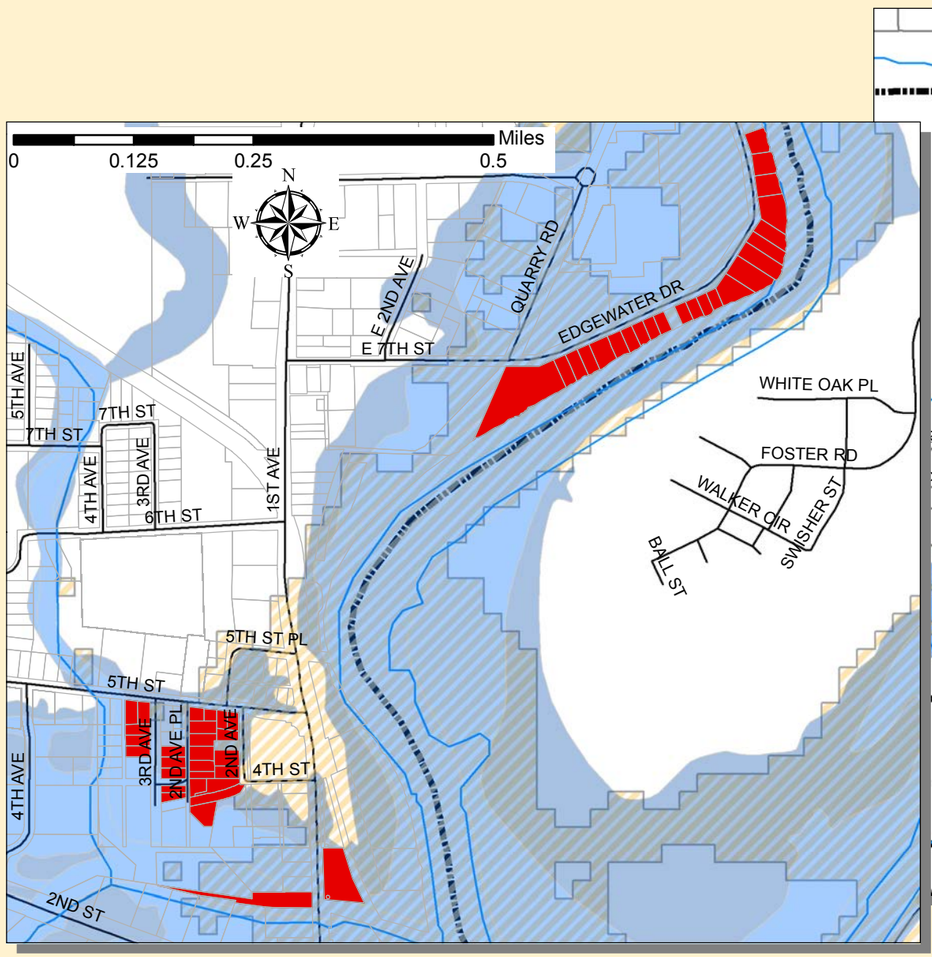
Coralville, Iowa
Housing Needs Assessment
Flood of 2008

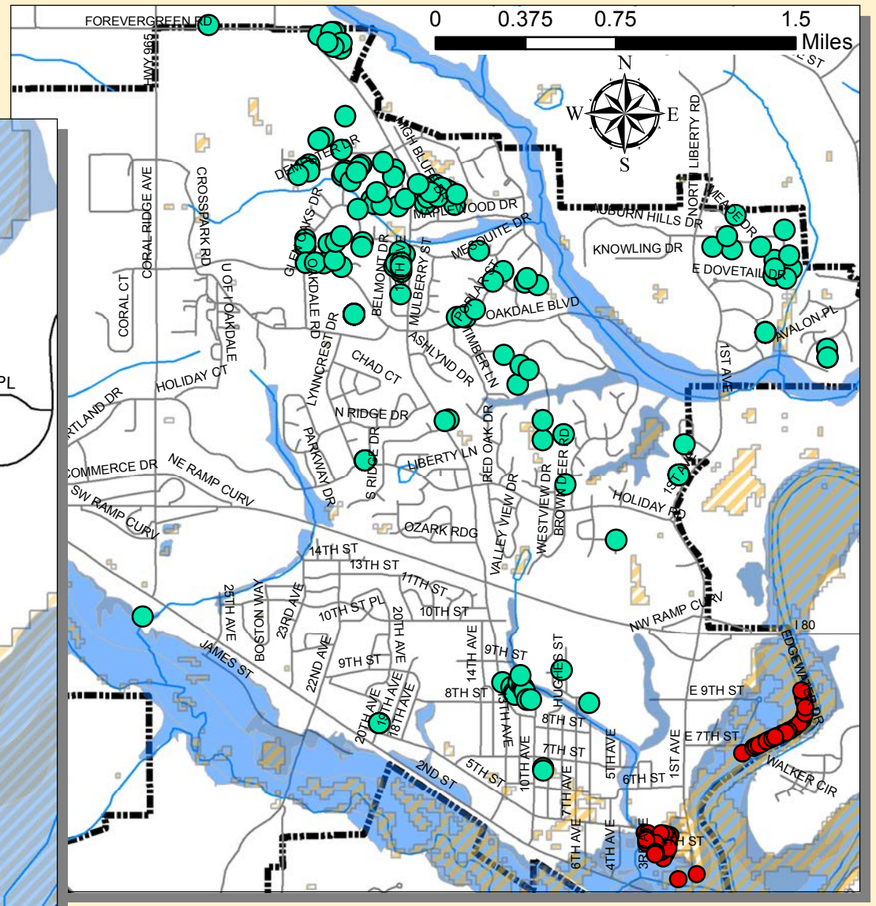
Housing Units Lost = 36
New Housing Units = 221
Net Difference = -185

Economic Housing Demand = 215
Net Difference (Total Housing Demand) = 30

Housing Value Lost = $5,985,700
New Housing Value = $39,240,900

Average Value of New Dwellings = $210,716
Average Value of Dwellings Lost = $ 84,559
Total Difference = $126,157





Legend

- City Boundary
- Parcel Boundaries
- Roads and Streets
- Rivers and Streams
- Flood Plain
- Flood Extent
- Dwellings Lost
- Dwellings Lost
- New Dwellings

Map Created by IDRO, ISU Extension
Alan D. Jensen AICP, GIS and Community Development Specialist
Date: October 17, 2011
Data Sources: Johnson County Assessor, Johnson County GIS
Iowa Department of Natural Resources
Iowa Department of Transportation
Iowa State University GIS Facility

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Geospatial Technology Program
Extension Community and Economic Development

Waverly, Iowa
Housing Needs Assessment
Flood of 2008

Housing Units Lost = 44
New Housing Units = 47
Net Difference = -3

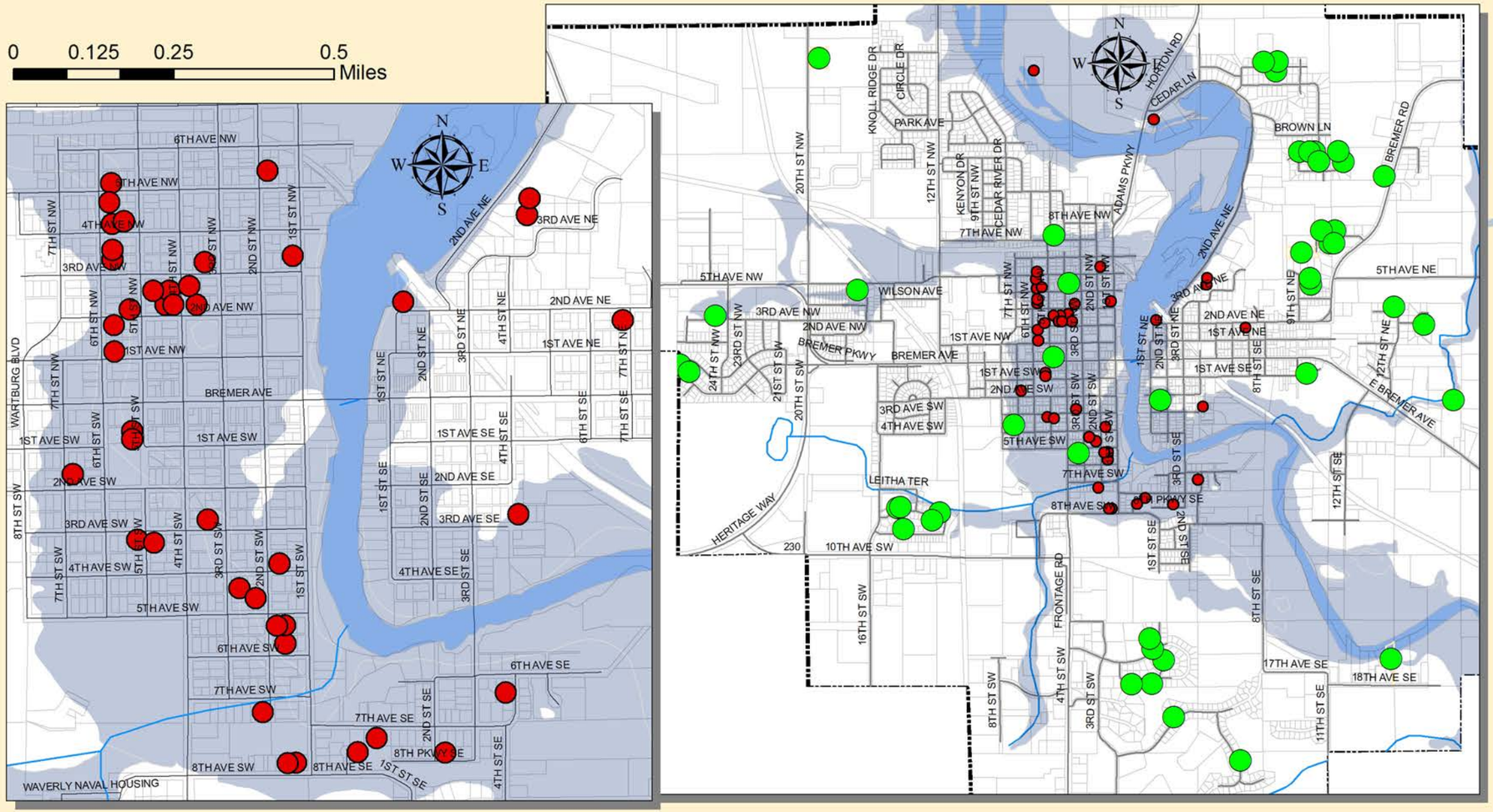
Economic Housing Demand = 0
Net Difference (Total Housing Demand) = -3

Housing Value Lost = $2,698,257
New Housing Value = $8,574,500

Average Value per New Unit = $182,436
Average Value per Unit Lost = $ 64,533
Net Difference = $117,893

0 0.125 0.25 0.5 Miles

0 0.25 0.5 1 1.5 Miles



Waverly, Iowa
Housing Needs Assessment
Flood of 2008

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Legend

- City Boundary
- Roads
- Waverly_Parcels
- Rivers and Streams
- Flood Plain
- Housing Lost
- New Housing

Map Created by IDRO, ISU Extension,
Alan D. Jensen AICP, GIS & Community Development Specialist
Date: October 7, 2011
Data: Bremer County Property Records, Bremer County Assessor,
Bremer County GIS, City of Waverly
Iowa Department of Natural Resources
Iowa Department of Transportation
Iowa State University GIS Facility

GIS Training and Services
Geospatial Technology Program
Extension Community and Economic Development

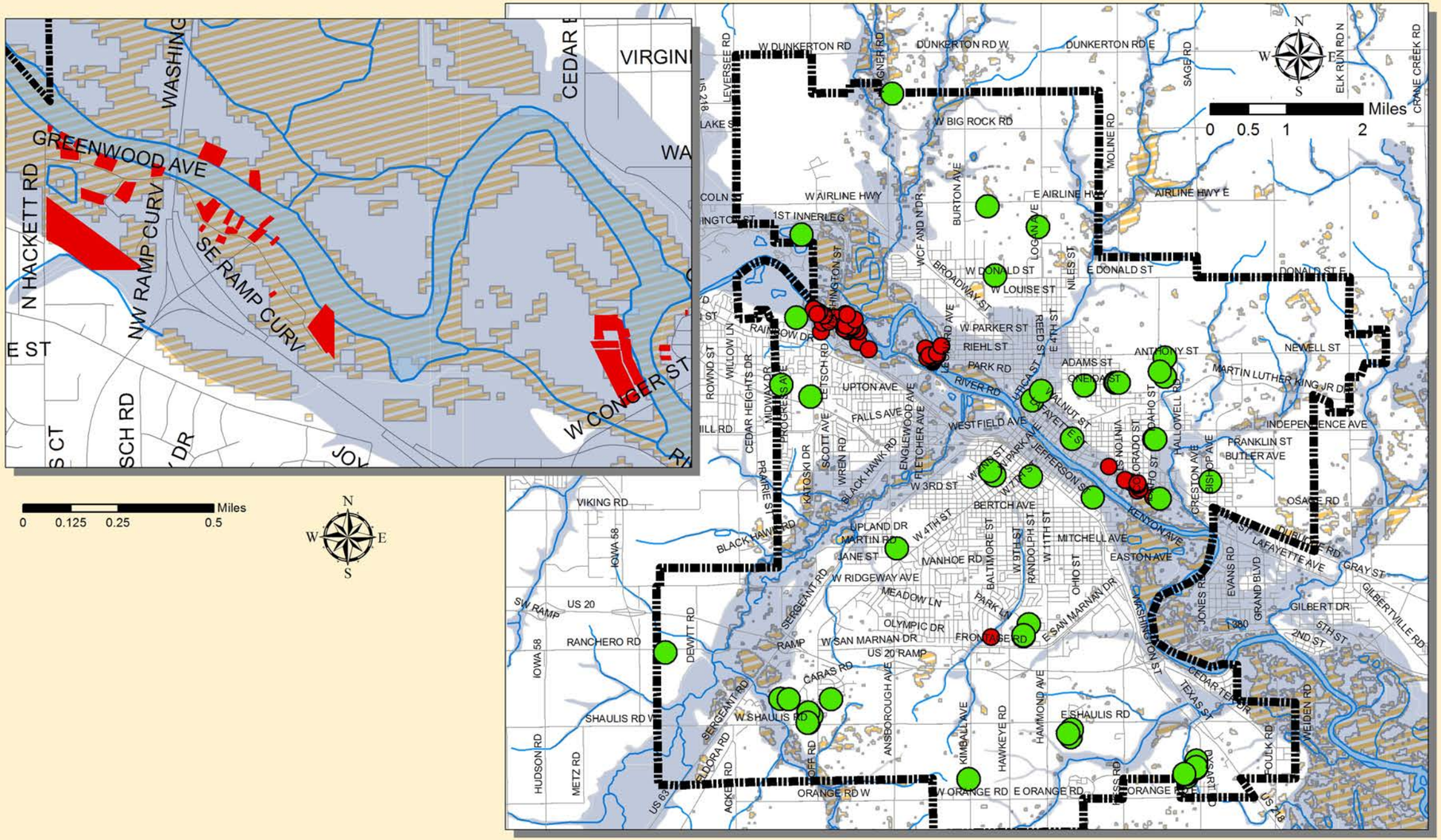
Waterloo, Iowa
Housing Needs Assessment
Flood of 2008

Housing Units Lost = 52
New Housing Units = 180
Net Difference = -128

Economic Housing Demand = 0
Net Difference (Total Housing Demand) = -128

Housing Value Lost = $ 2,967,190
New Housing Value = $ 22,734,989

Average Value per Unit Lost = $ 57,061
Average Value per New Unit = $126,305
Net Difference = $ 69,244



Legend

- City Limits
- Roads
- Rivers and Streams
- Flood Plain
- Flood Extent
- Housing Lost
- Housing Lost
- New Housing

Map Created by IDRO,
ISU Extension Community and Economic Development
Alan D. Jensen AICP, GIS and Community Development Specialist
Date: October 17, 2011
Data Sources: Waterloo Property Records,
Black Hawk County Assessor, Black Hawk County GIS
Iowa Department of Natural Resources
Iowa Department of Transportation
Iowa State University GIS Facility

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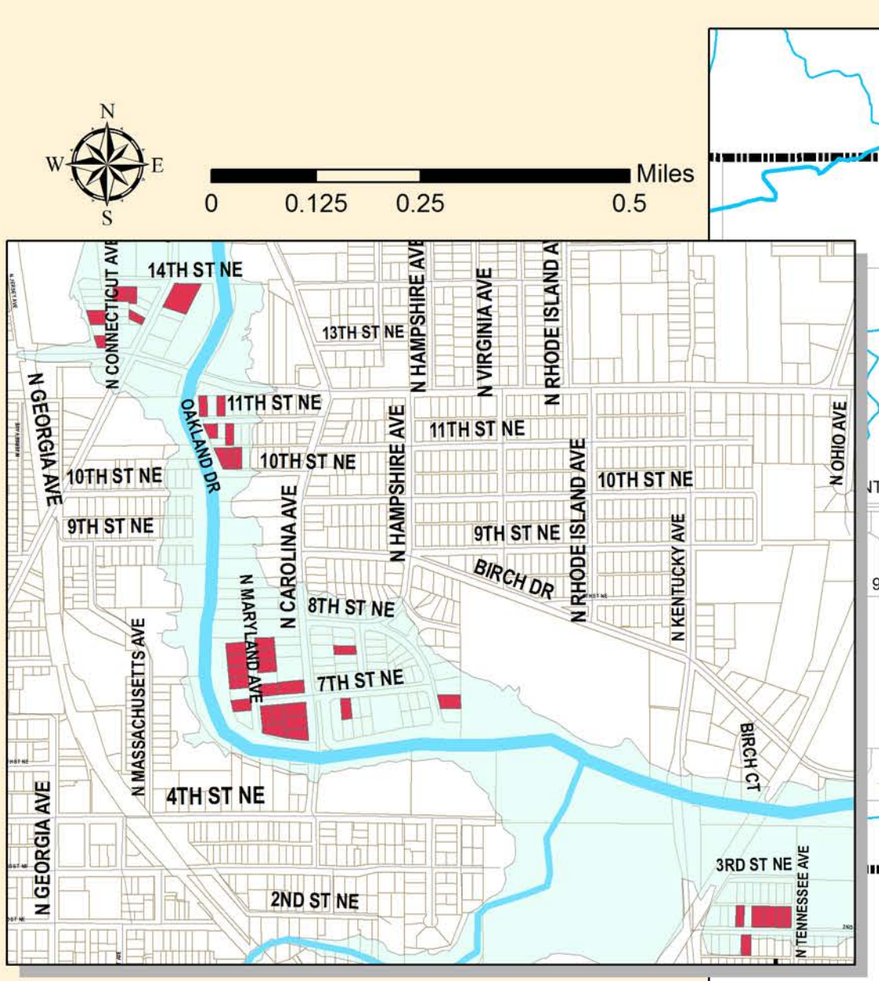
Extension Community and Economic Development

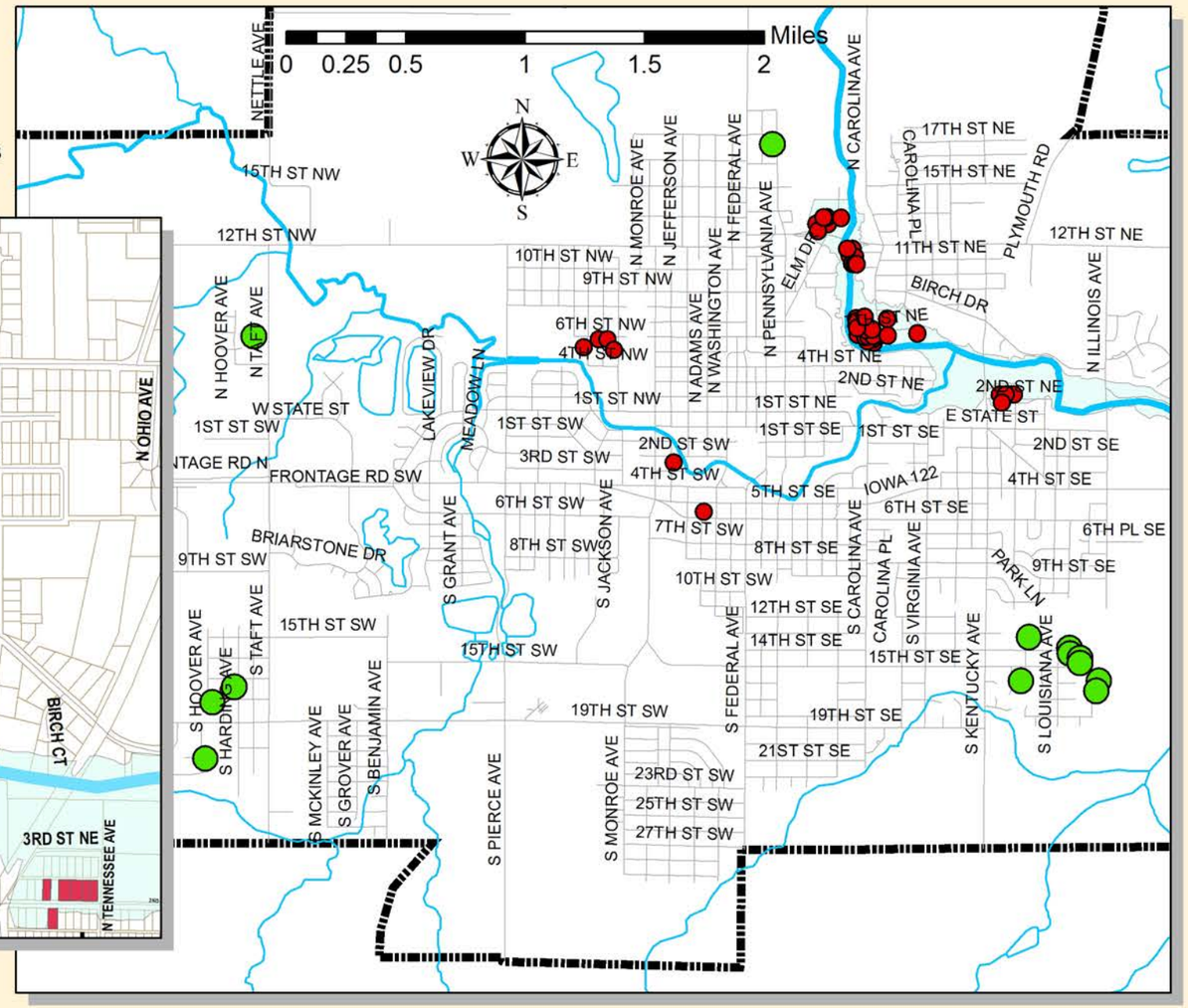
Mason City, Iowa
Housing Needs Assessment
Flood of 2008

Housing Lost = 50
New Housing = 111
Net Difference = -61
Economic Housing Demand = 0
Total Net Difference = -61

Housing Value Lost = $ 4,750,000
New Housing Value = $33,120,000

Average Value of Housing Lost = $ 95,000
Average Value of New Housing = $184,011
Net Difference = $ 89,011





Mason City, Iowa
Housing Needs Assessment
Flood of 2008

Legend

- City Boundary
- Parcel Boundary
- Streets and Roads
- River and Streams
- Flood Plain
- Housing Units Lost
- Housing Lost
- New Housing

Map Created by IDRO, ISU Extension
Alan D. Jensen AICP, GIS Specialist
Date: October 14, 2011
Data: Mason City Property Records,
Cerro Gordo County Assessor, Cerro Gordo County GIS
Iowa Department of Natural Resources
iowa Department of Transportation
Iowa State University GIS Facility

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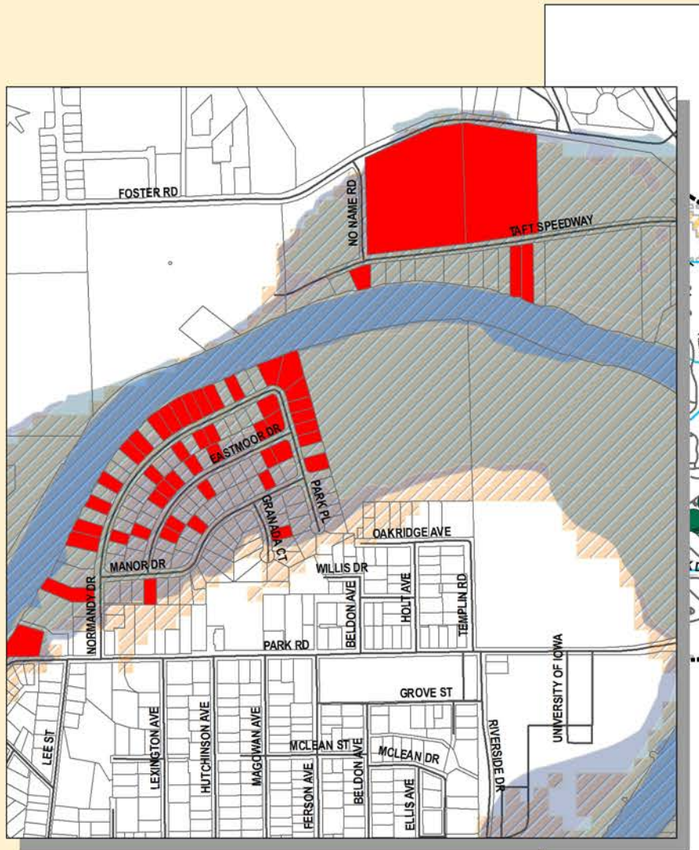
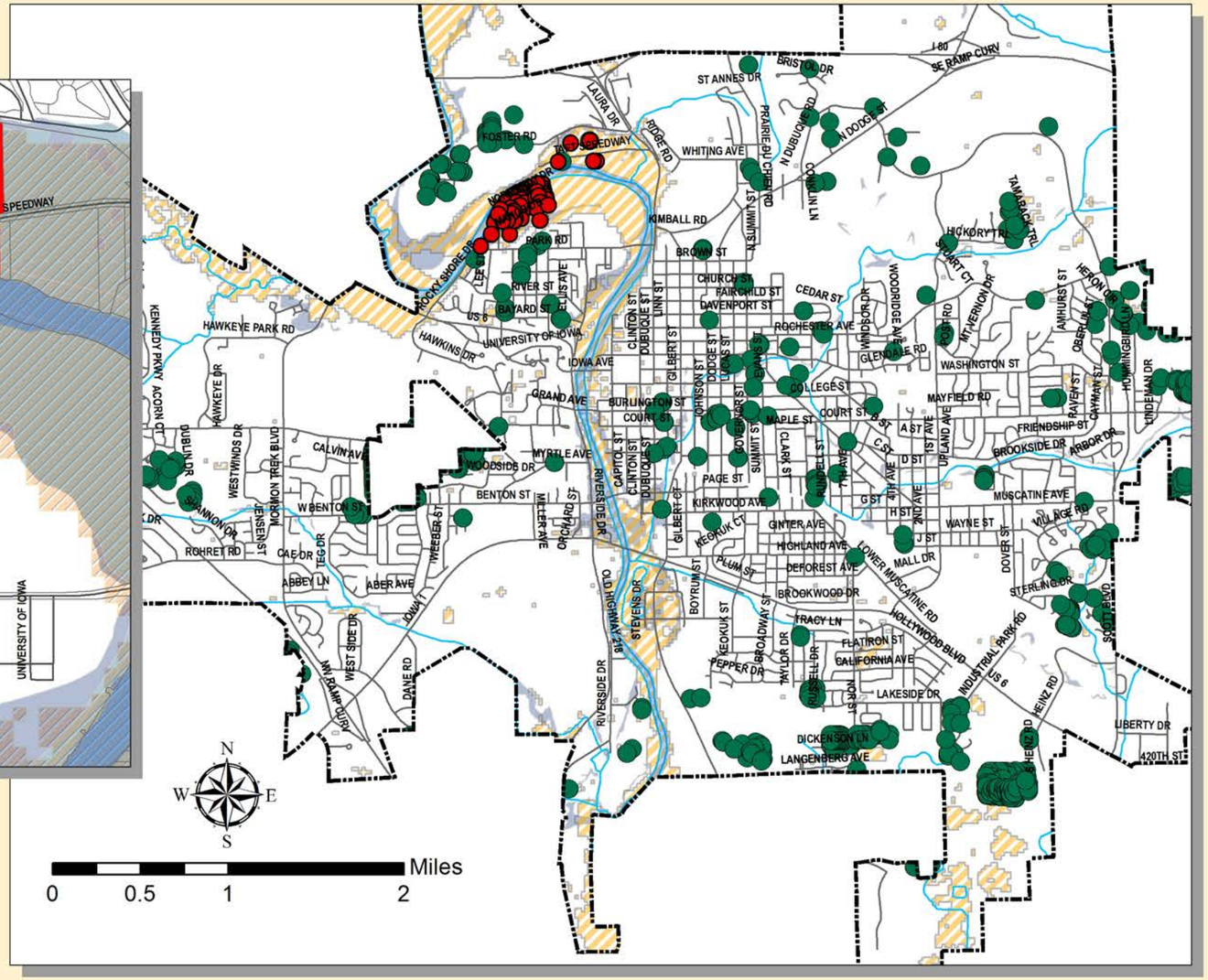
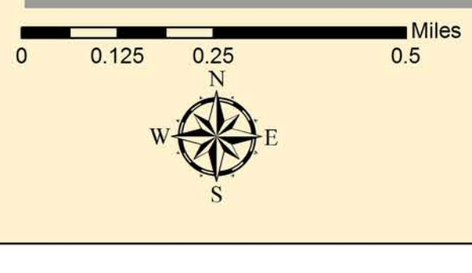
Iowa City, Iowa
Housing Needs Assessment
2008 Flood

Housing Lost = 154
New Housing = 701
Net Difference = -547
Economic Housing Demand = 789
Total Net Difference = 242 Total Housing Demand

Total Housing Value Lost = $ 11,256,980
New Housing Value = $129,561,308
Mean Value Unit lost = $154,805
Mean Value New Housing = $190,158
Net Difference = $ 35,353







Iowa City, Iowa
Housing Needs Assessment
2008 Flood

N
W E
S

Legend

- City Limits
- Roads
- Streams
- River
- Flood Plain
- Flood Extent
- Housing Lost
- New Housing Units

Map Created by IDRO, ISU Extension,
Alan D. Jensen AICP, Extension Geospatial Specialist
Date: October 14, 2011
Data: Iowa City Property Records, Johnson County Assessor,
Johnson County GIS
Iowa Department of Natural Resources
Iowa Department of Transportation
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Observations and Recommendations

Observation 1: Privately- and publicly-owned utilities are not practical sources for GIS housing data.

Although privately-owned electric utilities have excellent GIS capacities associated with their grids, they are reluctant to share the information. Publicly-owned water utilities in general did not provide data in a GIS format. Use of their data would be highly labor-intensive, requiring re-entering the data and establishing new data fields and GIS coordinates for each data point. Therefore, electric and water utilities are impractical as sources of housing data.

Observation 2: While assessor's offices are excellent sources of GIS data, limitations exist when conducting long-term planning and analysis.

Assessor's data is a reliable source of information on the impact of disasters on housing because most counties and cities have digitized these data and have them mapped on GIS. Furthermore, searchable databases are frequently available on county and city assessor websites. Information for each lot includes descriptions of buildings, the number of housing units (if a multifamily building or buildings), pictures of the property, and a series of maps showing its location. Therefore, assessors' data files can be validated lot by lot on their websites if questions or inconsistencies arise on any given parcel.

However, data management systems, staffing patterns and data request procedures vary from county to county and community to community. Compiling information from archives, current data and mapping information sometimes required contacting several individuals within a community's local government.

Possible Solution: To provide more accessible housing data for Iowa, statewide standards for data management should be set.

Observation 3: The housing market gap should be evaluated by units lost and by the difference in the value of replacement housing

All eight study communities are in the process of constructing new housing, whether in response to homes lost during the flood or to economic demand. However, a great discrepancy exists between the value of lost homes with the value of housing built since the flood. The new housing is significantly more expensive than the housing that was lost. As a result, households who lost their homes during the 2008 flood are being priced out of the communities' housing markets.

Possible Solution: To avoid a lack of affordable housing following a natural disaster, communities should focus on the types of housing lost as well as the total units lost.

Observation 4: The impact of natural disasters on housing tend to be more significant in low-growth or declining economies.

The geospatial analysis revealed that the impact of the 2008 flood in terms of housing tended to be greater in the study communities that are also experiencing little growth or declines in their economies.