A WATER AUDITING PROGRAM IN THE BRIGHTMOOR AND ROSEDALE AREAS OF DETROIT, MICHIGAN

by

Jennifer Lea

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This thesis was presented

by

Jennifer Lea

It was defended on

April 4, 2014

and approved by

Christopher Keane, Sc.D., Assistant Professor, Behavioral and Community Health Sciences
Graduate School of Public Health, University of Pittsburgh

Evelyn Talbott, Dr.P.H., Professor, Epidemiology
Graduate School of Public Health, University of Pittsburgh

Committee Chair: Jeanette Trauth, Ph.D., Associate Professor, Behavioral and Community Health Sciences Graduate School of Public Health, University of Pittsburgh

Jeanette Trauth, Ph.D.

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ABSTRACT

Thousands of low-income residents of Detroit are unable to afford their water bills and consequently have had their water shut-off. Lack of access to water in households threatens the health and safety of residents and their ability to remain in their homes, an issue of public health importance. Moreover, many residents lose money due to water loss from leaking faucets, pipes and toilets. Current strategies to reduce shutoffs in these communities are insufficient. The purpose of my thesis is to outline a water audit program that will identify sources of leaking water within residencies located in two diverse neighborhoods of Detroit, Brightmoor and Rosedale, and to assess these communities' need for a water auditing program and the context within which the program will operate. Data collected from the Detroit Water and Sewerage Department indicated that 835 homes of 13,682 within Brightmoor and Rosedale had their water shutoff in 2013. Data on the age and condition of homes in Brightmoor and Rosedale underscored the need to investigate and remediate leaks within resident's homes. Local organizations were contacted and interviewed to explore factors that may enhance or hinder the operation of this program in Detroit. A community water auditing program to reduce the number of shutoffs would be an appropriate step to reduce water consumption and as a result lower the amount paid in monthly water bills among a disadvantaged population, and would secondarily serve as a means for building community capacity and a sense of collective efficacy.

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PREFACE

I owe a huge bunch of flowers to my committee chair, Jeanette Trauth, for her assistance, guidance, and words of encouragement over the last several months. Your confidence in me and in my work has been invaluable. I would like to acknowledge my committee members, Christopher Keane and Evelyn Talbott, for their ideas, their willingness to take on my project, and their patience in working with me from the other end of the state.

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1.0 INTRODUCTION

Detroit, Michigan, a city surrounded by an abundance of fresh water, is facing an unprecedented issue.[1] Over the years, thousands of low-income residents of this city who are unable to pay their water bills have been living in homes with their water shut-off. Utility companies have been increasing rates while simultaneously taking aggressive action to collect overdue water bills and shut off water when bills are unpaid. Living in poverty, many residents live paycheck to paycheck and are forced to choose which bills they can and cannot afford to pay. Typically water bills are the last to get paid. Residents in this situation need to save every penny, but unfortunately, many are literally losing money due to water loss from old and/or leaking faucets, pipes and toilets.

The problem is widespread affecting young mothers, children, and the elderly. For instance, recently, at a community baby shower sponsored by the Detroit Wayne County Health Authority, several mothers reported that they did not have easy access to water to fix formula for their babies.[2] In another case, Quanda Clay, a social worker at a Detroit public school, received complaints from teachers about students coming into school smelling badly.[3] She put together shower packs that included soaps, deodorant, and shampoo and educated students on how to maintain good hygiene. However, after several weeks with only minimal improvement, she learned that several of the students were without access to water and so were unable to shower or wash their clothing regularly.[3] While this issue disproportionality affects vulnerable populations,

the issue is now beginning to affect middle class residents of Detroit as well.[4-6] This is a public health problem that needs to be addressed.

1.1 CURRENT CONDITIONS: POPULATION DECLINE

Just over 701,000 people currently live in the city of Detroit, which was originally designed for two million people. The city has experienced a population decline since the end of World War II as the industrial economy began to decline.[7] The Southeast Michigan Council of Governments forecasts that the pattern of population decline will continue and will fall from the 2010 Census figure of 717,000 to 610,000 in twenty years.[8] This is a significant decline from the peak population of over 1.8 million in the early 1950s.[8] Despite the continual population decline, Detroit is still among the top 20 largest cities in the United States.[8] See Figure 1.

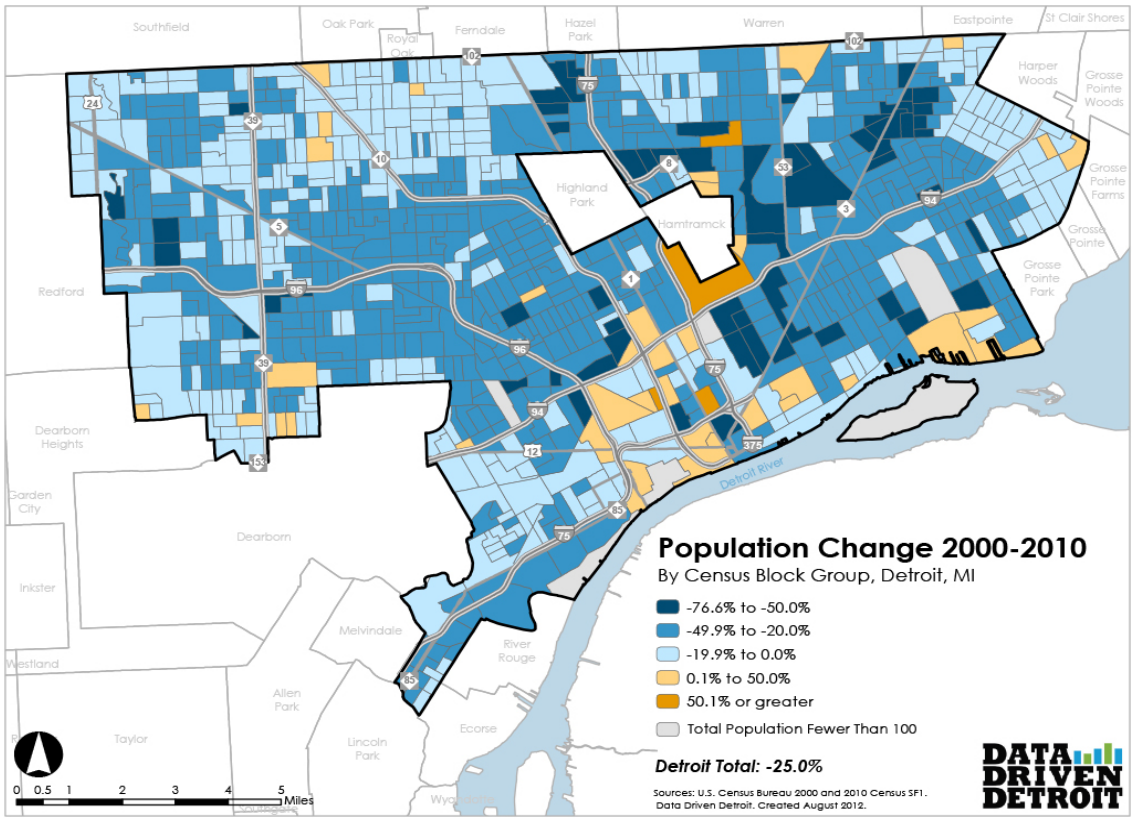


FIGURE 1: Population Change in Detroit, MI by Census Block Group. 2000-2010[9]

1.2 RISING UNEMPLOYMENT

Unemployment in Detroit has tripled since 2000—as of June 2012 the unemployment rate was 18.3% in Detroit, as compared to 8.2% nationally.[10] The number of employed residents has dropped more than 53% since 1970. In a conversation with Mary Ellen Howard, Executive Director at the Cabrini Clinic, discussing the current condition of Detroit she stated, "It's not that people don't want to work. The jobs, and especially full-time jobs, just aren't there."[2]

1.3 DECLINING HOUSING AND PROPERTY VALUES

In addition to the population decline, the city has also experienced a decline in housing and property values. The city has 20 square miles of vacant land—roughly the size of Manhattan.[8] According to the 2010 Census, there are approximately 80,000 abandoned homes within the City.[11] Many of these vacant structures are dilapidated and will quickly deteriorate. It takes a maximum of five years for a newly vacated home to reach a state that it is no longer safe to inhabit.[12] There has also been an increase in the number of home foreclosures (1 in 30 homes have been foreclosed) contributing to falling home and property values.[12] The decreasing property values add an additional level of financial stress to homeowners who are financially squeezed—unable to balance their checkbooks as housing and transportation expenses account for over 50% of their monthly income while their investment continues to decrease.[12]

1.4 A DECLINING TAX BASE

Detroit's revenue, in inflation adjusted dollars, fell 40% from 1962 to 2012.[13] The per capita tax burden on city residents is the highest in Michigan, despite relatively low levels of income. The high taxes and costs of city services do not yield enough for the city to afford improvements to water service delivery or address concerns of affordability. The current water, energy, and road systems are oversized for the current population and not sufficiently oriented to the present economy. Detroit's roads, sewers, and light structures were established to support 2.5 million people. As they are not being properly maintained, it is estimated that these systems will reach the end of their lifespans by 2030.[13]

1.5 CHALLENGES IN PLANNING FOR THE FUTURE OF DETROIT

While the city has engaged in a strategic planning process to address infrastructure problems it has met with difficulties. Developers of the strategic framework stated, "It is often difficult to enter into a planning process that talks about the future city when community stakeholders believe that their basic needs are not being sufficiently met."[8] Residents of Detroit have long been anxious about the future of the city— afraid that the city is going to relocate residents from more uninhabited parts of the city in order to create a smaller, more densely populated version of Detroit. While opposed to being relocated, the majority of residents are discontent with their current living conditions. They are concerned about the safety of their children and property, increasing taxes, the quality of city services, access to jobs, transportation costs, declining home values, the ability to keep up with a mortgage, and the growing number of vacant and abandoned houses surrounding them.[8] Detroit residents and businesses alike are concerned about whether utilities will be shut off in the more vacant parts of the city, whether families might be forced to move from their homes, or whether some city departments or community facilities will be shut down completely.[8]

1.6 ACCESS TO WATER

The Environmental Protection Agency (EPA) defines water service affordability as water bills that do not exceed 2.5% of the median household income.[14] Using median household income to define affordability, however, does not take into consideration the range in income in a geographic area.[14] This approach to determining affordability has the potential to place a

substantially larger economic burden on the poor who may be paying more than the average percentage of their income towards their water bill.[15] Recent data indicates that the number of households with water and wastewater bills exceeding EPA's designated affordability criteria is growing.[15] Between 2002 to 2004, that number rose from 3 to 7 percent.[15,16] The Congressional Budget Office estimates that between 10 and 20% of households may be spending more than 4 percent of household income on water bills by 2019.[15]

To evaluate the affordability of water, it is important to look at the portion of income spent on water in comparison to other services or needs. This is a major concern in areas such as Detroit, where 33% of residents are living below the federal poverty line and the mean household income is $39, 838.[9] Within the United States, as many as one in five households face difficulties meeting "essential needs" over the course of a year, the most common of which, is difficulty paying utility bills.[17] Typically, low income residents spend a higher percent of their household income on water compared to wealthier residents.[17] While there are established federal programs to assist low income residents with paying gas and electric bills, there is no comparable federal program to assist with paying water bills. It is left to the discretion of the utility company to create such a program.[15] Given this lack of a safety net, the rising cost of water is an impending threat to the water security of low-income communities.[15]

There is no enforceable right to water access for those who cannot afford it. Though international law recognizes "the human right to water", there is no authority that protects that right. Michigan's laws on water shutoffs are similar to most states, expressly allowing local units of government to discontinue water service to residents who are delinquent in paying water bills, regardless of hardships.[1] In *Ripperger v. City of Grand Rapids*, the Michigan Supreme Court upheld this legal authority when Grand Rapids, in accordance with its local ordinance, shut

off water services to delinquent customers.[1,18] The local government of Detroit adheres to the same laws as Grand Rapids, granting the public water utility the power to discontinue service to customers who do not pay their bills.[1]

Despite the evidence that many people in the United States live in communities that are lacking a basic water infrastructure, federal appropriations for water projects have declined since the 1960s.[19] Water and wastewater systems throughout the country, not just those serving low-income and minority communities, have been confronted with funding needs estimated between $334.8 and $504 billion necessary to maintain the current systems and replace outdated infrastructure over the next fifteen years.[20] To finance improvements and long-term costs, water utilities raise rates and borrow against future revenues. It has been recognized that, in the face of an already glaring gap in services for low-income communities, this financial need threatens to exacerbate existing inequities in both access and funding.[15]

1.7 THE CONSEQUENCES OF LIVING WITHOUT ACCESS TO WATER

This problem is particularly acute in Detroit, with so many neighborhoods within the city disenfranchised as a result of poverty.[15] Mary Ellen Howard, Executive Director at the Cabrini Clinic, has allowed neighborhood residents without water access to fill buckets from her tap to then use in their own homes. She does laundry on a weekly basis for her neighbor who has been living without water. In describing the number of people living without water in the city she stated, “If you look carefully as you drive through the city, you may see homes with hoses leading from one house to another. There are a surprising number of people that are living off of

their neighbor's generosity, their neighbors who are willing to share their resources. Detroit is like a third world country."[2]

Although many are living without access to water in their homes, the issue is not frequently discussed among community members. Those who are living without water in their homes are reluctant to ask for help because of rumored consequences—that is, homes without access to water will be condemned and the Department of Human Services will take children out of the home. In regards to houses being foreclosed, the Detroit Water and Sewerage Department hands delinquent accounts to the city and county treasurers who add them as tax liens against the property. If left unpaid, the house can be foreclosed upon and children taken away and placed in the foster care system. While several social workers denied that children would be taken away from the home, stories published in local newspapers contradict this:

> "Without water, a home can be condemned. Without water, the state can step in and take children from their parents. And, now that water bills are being attached to property taxes, people who don't pay up can have their homes seized."[21] -*MetroTimes*
>
> "People may own their home outright, after living there for thirty or forty years, but because they can't pay a $1,200 water bill, they're going to lose their home,"[12] -*Lou Novak, as quoted in The Progressive*
>
> "If you don't pay your water bills, they cut off your water, and don't give you an opportunity to appeal. Then they transfer the bills above $100 to property tax rolls for collection. If you can't pay, your house can be foreclosed. . . People lose their homes, business and can even lose their children."[14]--*Maureen Taylor, Michigan Welfare Rights Organization*

1.8 WATER BILL PAYING ASSISTANCE PROGRAMS

For those who report that they are facing challenges in paying for their water bills, little help is offered.[3,14] When a customer pending a shutoff calls the Detroit Water and Sewerage Department a customer service representative will direct him or her to file a state of emergency and apply to an assistance program. There are two assistance programs that customers are referred to if they call the Water Department and report a pending shutoff: the Detroit Residential Water Assistance Program (DRWAP) and the Water Access Volunteer Effort (WAVE).[14]

DRWAP, which has existed since 2007, is operated by the Detroit Water and Sewerage Department (DWSD) and the Detroit Department of Human Services (DHS).[14,22] It serves residents who have had their water shutoff or are pending shutoff.[14,22] To qualify, residents must live in a single-family dwelling and have an income at or below 200% of the federal poverty level.[22] The program offers assistance of $175 annually. As of 2010, DRWAP is funded exclusively by voluntary donations from Detroit ratepayers who chose to donate 50 cents with each of their water bills.[22]

The WAVE program is a similar effort. It is a 501(c)(3) nonprofit corporation that was established in 2003.[23] Prior to the launch of DRWAP, WAVE was funded by donations from ratepayers who selected to add an extra amount to their water bills for this purpose.[23] Since 2007, it has operated as a separate entity through donations and fundraising events.[23] The WAVE Board of Directors and Volunteer Committee are comprised of members of the Detroit community and they are not compensated for their service to WAVE. All funds raised for the organization are directed towards paying water bills. Fundraising for the organization is a grass-

roots effort on the part of the staff who collaborate with local business and individuals to host several fundraising events over the course of the year.

WAVE works with DWSD and the Department of Human Services to identify residents who are unable to afford their bills, and will provide emergency funds in order to ensure services are not interrupted although funds may only be given once in a calendar year.[23] In June of 2013 WAVE reported that they have assisted over 9,100 households by paying more than $2,000,000 towards water bills that were in arrears since the organization started ten years ago. Despite modest success, DRWAP and WAVE fall short of solving Detroit's water access crisis[14]. The current focus on helping residents pay for their water bills does little to prevent the issue from initially occurring or reoccurring. The recognition that WAVE was not addressing the upstream causes of the water shutoffs led the organization to a request that I develop a program that would assess and remediate the residential water leakage problem.

Residents who contact the United Way when facing a water shutoff, have a few additional services that they may be eligible for, however they are applicable only to a limited population, primarily veterans.[24] The Wayne County Veteran Affairs Department offers assistance to veterans who are pending shutoff.[25] Operation Homefront Michigan Central Great Lakes and Operation First Response offers assistance to military personal and veterans.[25]

1.9 HEALTHY PEOPLE 2020

One of the goals of Healthy People 2020 emphasizes the need to: "create social and physical environments that promote good health for all."[26] Specifically, this includes access to resources that impact the quality of life and ability to meet daily needs.[26] Access to water in

one's household is one such fundamental resource that is necessary to survive. Lack of access to a household water supply is a major threat to the health and safety of Detroit residents. In a society that is established around access to water in individual residencies, living without such access has immediate as well as longer term effects on health.

1.10 THE PURPOSE OF THIS THESIS

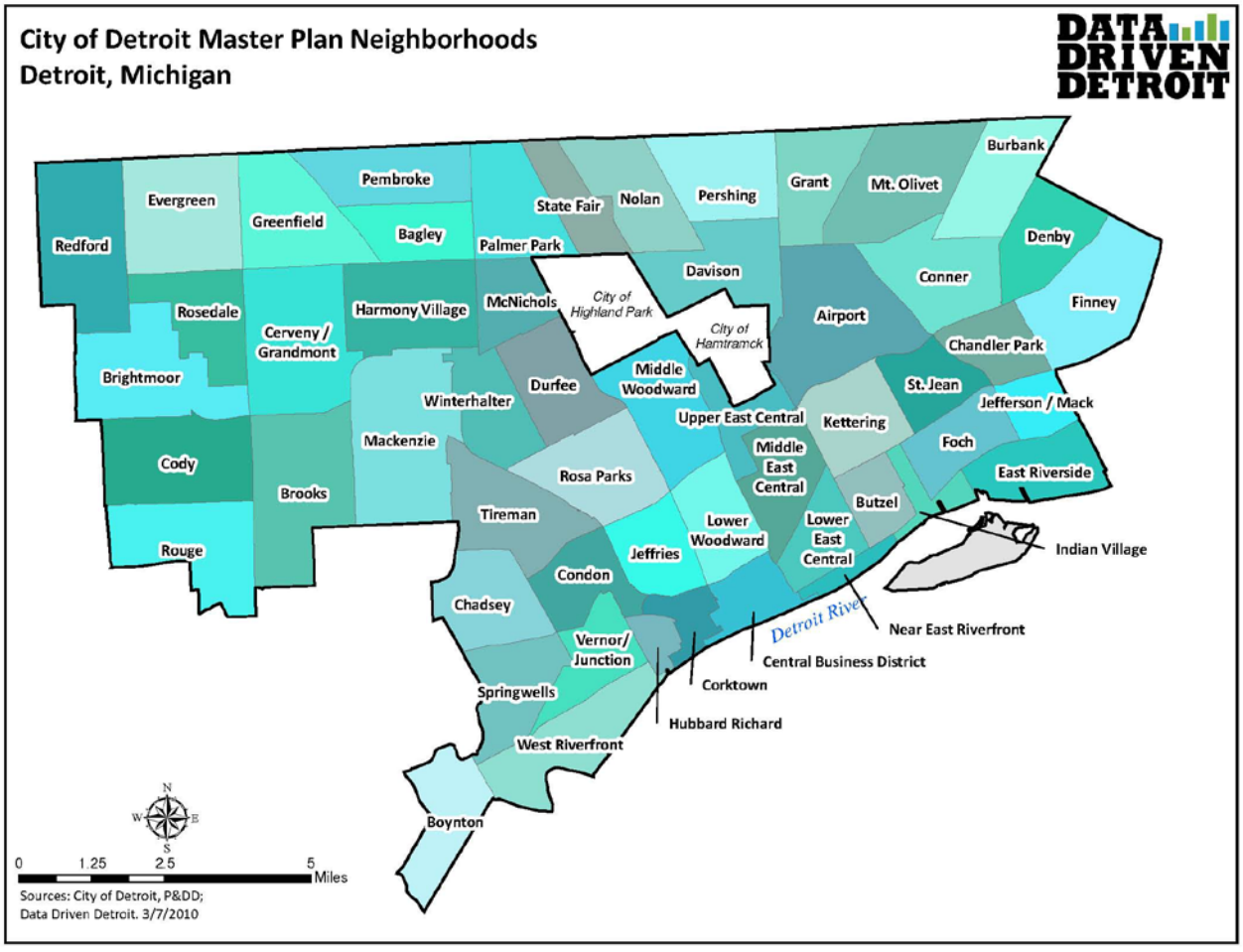


FIGURE 2: Neighborhoods of Detroit, Michigan[9]

The problem of water shutoffs can be found throughout every neighborhood in Detroit, but the focus of this paper will be on the neighborhoods of Brightmoor and Rosedale. See Figure 2 to identify the neighborhoods on the western edge of Detroit. These two areas are very different from one another and as such will provide a picture of how this issue is affecting diverse neighborhoods within Detroit. Although these neighborhoods are different from each other in terms of socioeconomic status, both are plagued by a high number of water shutoffs. Lack of access to water in households across Detroit, and within these neighborhoods, threatens the health and safety of residents and their ability to remain in their homes.[27] Therefore, the purpose of this thesis is to develop a home water audit program to identify sources of leaking water in residences that can be remediated in order to reduce residential water and sewage bills. The proposed program is designed to be implemented by the Water Access Volunteer Effort (WAVE), a community-based organization concerned with reducing the number of water shutoffs within low-income Detroit homes.

The focus of the study is to:

1. Learn about the community's need for a water audit program and the context within which the water audit program will operate; and,
2. To make recommendations regarding feasible components of a home water audit program to identify water sources within the home that can be remediated by utilizing community resources.

2.0 LITERATURE REVIEW

2.1 WATER CONSERVATION

The concept of water conservation and managing water as a resource gained popularity in the 1950s when the President's Water Resources Policy Commission published: "A Water Policy for the American People." The report emphasized management and conservation of water in order to protect the country's development.[28] At the time of the report, conservation was defined as the reduction of water use and water loss. More recently the term refers to an effort to reduce water use by improving the efficiency of water services.[28] As it has become increasingly apparent that water is a scarce resource, and as urbanization and growing populations have placed increased demands on this resource, emphasis has been placed on improving resource use.[29]

The current water conservation strategy is commonly referred to as demand management, a method of conservation which aims to minimize the overall demand for water. It has been recognized that demand management programs are among the cheapest, least resource intensive and sustainable methods of water conservation. Various types of demand management programming include: increasing system efficiency, promoting reuse, substituting resource use, increasing end use efficiency and improving consumer education.[30,31] The latter two subjects, increasing end use efficiency and consumer education are particularly relevant to this discussion.

Increasing end use efficiency includes developing strategies so that consumers use less of the resource for the same purpose.[30] Consumer education focuses on teaching users about the scope of their water use and the full cost of their resource use rather than simply the price charged—this includes comprehensive education about the environmental impact of water use and a detailed water analysis (i.e. a water audit).[30]

2.2 WATER AUDITS

In the 1930s through the 1960s water professionals viewed water conservation as the establishment of a reservoir to capture runoff that would flow into the ocean or an otherwise unusable body of water.[32] In the 1970s that perspective changed and water professionals became aware of the importance of minimizing waste water in order to protect a limited resource.[32] Long-term water conservation became the focus, emphasizing: "Water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies."[32,33] It is out of this type of conservation effort that demand side management developed—to practically reduce water waste in homes.[32]

The public's perception of water conservation typically centers on water restrictions due to drought, which is a short-term drought management tool. To expand this perspective conservation groups stress that the primary incentives for undertaking efficiency programs also include reducing demand in order to extend water supply, or to reduce customer cost.[32] Most utility-sponsored programs expand on this by emphasizing long-term improvements in efficiency while maintaining quality of life standards. Regardless of the approach, conservation programs are designed to answer questions such as:

- What level of water reduction is needed?
- What type of users will be most impacted?
- What type of use is consuming the most water?
- Where is the conservation potential?
- How can water conservation and cost savings both be maximized?

The purpose of such programs is threefold: to enhance quality within operations and management systems, to reduce environmental impact, and for broad community benefit.[32] Community benefit includes environmental justice, fewer social equity issues, creation of water conservation jobs, and customer savings.[34]

Within the United States demand management strategies have included water audits, which came at a time of increased interest in water conservation due to multiyear periods of drought across the country in the mid-1900s.[35] Water suppliers have been delivering water to households for almost 200 years, making these old systems subject to large water losses due to leakage.[35] Thus, the idea of conducting a water audit was originally developed to ensure efficient delivery of drinking water from the treatment plant to customer's homes and businesses.[35] Over time that idea has been applied to investigating the water delivery systems within individual homes, in order to determine more efficient ways individuals can manage their water use.[35] Conservation efforts have been successful in lowering customer demand for water via the implementation of water efficiency measures such as low flow toilets and water aerators.[35]

The auditing process quantifies water consumption and water losses that occur in a system. Although, what is meant by the term "audit" is clear, how an audit is performed is not clearly defined.[35] While it is an examination of a system to check for accuracy, indicating

different ways that customers use water, *how* this is done varies according to the group that is conducting the audit.[36] Audits may be conducted as online self-evaluations based on general information, or they may be site-specific investigations conducted by professionals.[35] Utility companies often provide residents with inserts in their water bills, informing them on how they can conduct a home leak-detection themselves.[37,38] Most audit programs are offered by water utility companies and are instituted after a period of sustained increase in water consumption as an alternative to expansion.[39]

2.3 RETROFITTING, REPLACEMENT & REBATE PROGRAMS

As utilities companies have realized a need to develop long-term conservation strategies, many companies have instituted site-specific audits consisting of leak detection and an evaluation of the customer's water use. Audits typically include an analysis of home water use and auditors provide an evaluation report after the audit is complete and offer incentives for home changes.[39] Residential program offerings typically include free efficient plumbing fixtures (low flow showerheads and faucet aerators), rebates for high efficiency clothes washers and high-quality toilets, and comprehensive assistance for low-income customers.[40] Audits, usually conducted by a representative from the water department, are most commonly administered after a customer makes a request of the company.[39]

Retrofitting and replacement programs are often offered subsequent to water audits, after conservation potential has been identified, to ensure that the program is appropriate for the consumer.[31] The water audit should provide data on the combination of measures and instruments that would yield the most water conservation for the best cost.[31] Identified measures

then inform strategies for remediation—namely, indicating the methods and instruments that would be most advantageous for conservation.[31]

Replacement or retrofitting water-using appliances, as a method of conservation, is based on the assumption that demand for water is not primarily a demand for the resource itself, but for the service that the water provides.[41] Retrofitting is designed to improve an existing fixture, typically targeting plumbing fixtures, as opposed to replacing an existing fixture. Fixture replacement programs are a more involved method of improvement and may operate several different ways—offering and installing water-efficient fixtures at no cost to the customer, providing rebates for consumer purchased fixtures, or arranging for suppliers to provide fixtures at a reduced cost. Retrofitting may be done without a professional, thus retrofitting *kits* are often distributed through community organizations or to individuals after a water audit. Rebate programs are not as commonly used as retrofit and replacement programs, although that has changed more recently as utility companies have been offering rebates for replacing old toilets.[39]

The amount of water savings achieved after the implementation of newer technologies varies, predictably, due to the household appliance water use before and after retrofitting.[42] The significance of reducing toilet leakage for water saving potential has been repeatedly pointed out by retrofit programs in New York, Jordan Valley, Tampa, and San Francisco.[37,42,43] Studies conducted to determine the value of retrofitting appliances have found several independent variables that can be used to predict the effectiveness of these programs—those with the most potential are houses with the largest number of residents and older homes. Households with more occupants use water appliances with more frequency, requiring more water and placing more stress on the appliance.[29] Older homes are less likely to have water efficient appliances, rather are more likely to have appliances that deliver larger volumes per use and are more apt to

have leakage.[29] To target these households, some companies have sought houses with larger numbers of residents and those with the least efficient appliances for such programs. Companies can determine high occupancy from household surveys or census records, while property parcel or permitting records may indicate the age of appliances inside a house.[29]

Several studies have been conducted to identify the most cost-effective, water saving methods to promote in-home conservation. Data indicates that "retrofit" programs can reduce indoor water consumption by approximately 12%, while replacing household appliances with more efficient options can reduce water consumption by 35-50%.[43,44] Replacing toilets and fixing leaks offers the greatest water savings, accounting for 70% of total savings.[42] Retrofitting toilets, fitting them so they are ultra-low flow, has been found to reduce the water required to flush a toilet by 52-59%, or a reduction of 9,000 gallons of water per year from 16,000 to 7,000 gallons.[45] While critics of the ultra-low flush toilets state that they must be flushed several times, research has demonstrated minimal change in the number of flushes per day per person (5.11 to 5.36 flushes).[45]

2.4 CASE STUDIES

Sydney, Australia

The Sydney Water Company Every Drop Counts (EDC) program, conducted between 2000 and 2002, involved over 200,000 households in Australia.[46] Through the program, residents received a water audit conducted by a certified plumber who would check for leaks and provide general advice on water savings in the home.[37] Plumbers offered minor changes including replacement of inefficient showerheads, and installation of tap flow regulators and

toilet cistern flush arrestors.[42] Suggestions were offered for retrofitting and appliance replacement, but no incentive was provided for customers to comply with the advice. Customers were charged $22 (AUD) for a visit, although those that could prove low income status were given the service 'free of charge.'[42] In comparing a sample of participants to a control group, the program achieved savings of approximately 12% of estimated indoor water demand.[42]

New York City, New York

The impact of toilet leakage on water saving potential has been demonstrated through the use of toilet retrofit programs in New York and Jordan Valley Water Conservation District.[37,42] Under New York City's Toilet Rebate Program, at least 70% of the toilets in apartment buildings were required to be replaced. That is, nearly 50,000 apartment buildings participated and had their toilets replaced through the program. The Department of Environmental Protection evaluated the project, and found that their sample of apartment buildings reported that water consumption had declined by approximately 37%.[47] In a similar program, conducted in Jordan Valley, Oregon, the reduction in leakage resulting from toilet replacements accounted for 44% of water savings. These particularly high levels of savings were attributed to the high levels of leakage prior to the retrofit.[43]

In a study conducted across multiple cities, plumbing contractors were hired to replace old fixtures and retrofit appliances in 96 homes. The researchers conducted several measurements over time and found that the homes reduced their water demand by 39% from baseline due to the leakage from the old fixtures.[45,48] The program in Tampa was the most effective. There was a 49.7% reduction of water use per capita. Additionally, residents were satisfied with their new efficient appliances, most of whom stated they preferred the updated appliances.[45] It has been found that a comprehensive replacement of household appliances (such

as showers, toilets, and clothes washers) with highly efficient appliances can reduce indoor water consumption by between 35% and 50%.[49]

Ashland, Oregon

Ashland, Oregon, is a small city of approximately 20,000 people. The city's water division treats and transports an average of 6.5 million gallons of water daily in the summer, and 2.5 million gallons daily in the winter.[50] In 1991, the city council adopted a water efficiency program with four major components: system leak detection and repair, conservation-based water rates, a high-efficiency showerhead replacement program, and toilet retrofits and replacements. The city estimated that this program would save 500,000 gallons of water per day.

Implementation of the program began with a series of customer water audits, which in turn lead to high efficiency showerhead and toilet replacements, followed by rebates for efficient clothes washers and dishwashers. Implementation of the program began in 1992 and by 2001 almost 1,900 residences had received a water audit. Almost 85% of those homes participated in the showerhead and toilet replacement programs. Evaluation of the program demonstrated that Ashland was able to reduce its water demand by 395,000 gallons per day (16% of winter water use), and households saved electricity due to the use of efficient showerheads. The cost of the program was $825,875 and total estimated cost savings was between $6,874,125 and $10,174,125.

Phoenix, Arizona

In 2002, the Phoenix Water Services Department was providing water for approximately 1.3 million people. [50] As the population in Phoenix and the surrounding areas was steadily increasing, the area's water sources were becoming depleted and other water supply options presented both environmental and financial problems. Understanding the gravity of the situation,

the state legislature required that after 2025, Phoenix and the surrounding communities must not pump groundwater faster than it can be replenished. Weighing potential options, it was determined that promoting conservation was the best solution to the problem. One of the major tenets of the program was indoor residential water conservation, specifically promoted through: fixture replacements in homes built before 1980, water audits and plumbing retrofits and public education. The audits were conducted by high-school students in order to help low income residents with repairs and replacements. The voluntary residential conservation program retrofitted more than 170,000 homes, resulting in savings of 40 million gallons per day in 2002.

3.0 METHODS

I was originally presented with the opportunity to explore the issue of water shutoffs in Detroit during my MPH Practicum with Mary Ellen Howard, the Executive Director at the Cabrini Clinic. The Clinic was established in 1950 in order to address some of the health needs of those without access to care, providing free services to those without insurance. In her tenure as executive director she heard countless stories of patients living in homes that have had their water shutoff due to their inability to pay their bills. Many of these individuals are working, but as bills accrue, "people find themselves falling behind. You either pay for gas or your pay for water. If you don't pay the gas in the winter, the pipes will burst, so the gas bill is usually the one that wins out." Worried about patients with compromised health living without access to water, and the insidious effects on health, Mary Ellen asked me to investigate the issue.

I began by researching the issue—searching for articles and newspapers that discussed the situation in any capacity. Although there are many people that advocate internationally on the human right to water and sanitation, there was a clear lack of research on how this problem affects those in the United States. In order to gain an understanding of the issue, ideally, I wanted to meet with residents to hear their stories to understand why water shutoffs occur so frequently. However, since I was only going to be living in the city for three and a half months, I could not ethically justify engaging residents when I was unable to guarantee any benefits to them for their investment in my project. Instead, I engaged with various organizations that have

some involvement in the issue of utility affordability and the welfare of Detroit residents in order to gain a formative understanding of the issue. I volunteered with many of these organizations to gain entrée within the community, and informally interviewed community leaders to understand how they perceive the issue. I focused largely on understanding why there are so many shutoffs, what services are available to residents after their water is shutoff, and what is being done to prevent that number from continuing to rise.

In order to determine what type of intervention may prevent water shutoffs from occurring, I spoke with several organizations and individuals and asked what they thought would be effective. Several different organizations suggested designing a program that would evaluate water use in resident's homes to reduce the amount of water users consume. When I asked Carla Walker-Miller, Executive Director of WAVE, about what she thought would be effective in reducing the number of water shutoffs in Detroit, she suggested an auditing program. She stated that the houses in Detroit have inefficient plumbing systems. Many of the homes use a water-based heating system, have old and leaky pipes, and make use of appliances that waste water. Considering this, Carla suggested a program that evaluates the state of pipes and fixtures in the home. She stated that when she moved into her house she had to spend over $6,000 on plumbing due to leakage. Within Detroit, most residents are not aware of how they may be wasting water, but even if they were aware most would be unable to afford the repairs. Hence, an important second phase to an auditing program would be to use that data to develop a strategy for remediation.

My thesis assesses the potential for a water audit program in two areas of Detroit in order to reduce household water consumption and the cost of water bills. The thesis explores the community's need for a water audit program and the context within which the proposed program

would operate. The proposed audit program could be used to identify water sources within the home that could then be remediated by the community. Specifically, I will explore three research questions.

1. Is there a need for a water audit program in the Brightmoor and Rosedale communities?
2. What type of water audit would best meet the needs of residents in this area?
3. What would be required of WAVE—a community based organization dedicated to providing emergency funds to homeowners to maintain their water service—to implement this program?

To answer the first question, information was gathered regarding current efforts to reduce the water shutoffs in Detroit. Data was gathered to confirm the number of water shutoffs in several different neighborhoods in Detroit. A Freedom of Information Act (FOIA) Request was submitted to the DWSD for data on the number of water shutoffs in the two neighborhoods in 2013, and the potential for water shutoffs over the course of the next year. This request was honored and the data was then compared with maps of several different neighborhood factors including income, education, and poverty data. This comparison was evaluated to confirm the need for a program that would promote water conservation to help resident's save on their water bills.

To answer the second research question, "what type of water audit would best meet the needs of Detroit residents," an evidence base was needed on low cost and effective practices for reducing residential demand for water. This information was initially obtained from the literature search followed by contact with several different water utility companies that were identified in the literature review for their conservation programs. The companies were contacted for information regarding the specific details of how their programs operate and their

effectiveness. Several of these organizations replied with data or with documents that describe the underlying assumptions of their conservation practices.

In order to answer the third research question, “what would be required of WAVE to implement this program,” data was obtained from an interview with the executive director of WAVE.

4.0 FINDINGS

4.1 QUESTION 1

Is there a need for a water audit program in the Brightmoor and Rosedale communities?

4.1.1 Characteristics of the Population and Place

Detroit has experienced a decline in population between 2000 and 2010. This was accompanied by a simultaneous decrease in median household income, an increase in the percentage of people unemployed, and an increase in the percentage of people who fell below the federal poverty line. While these same trends occurred across the nation, the increase in unemployment and in the percentage of people living below the federal poverty line were much more severe in Detroit. See Table 1.

TABLE 1: Population Characteristics of Detroit, Michigan and United States, 2000-2010[51]

	Detroit, 2000	U.S., 2000	Detroit, 2010	U.S., 2010
Total Population	951,270	281,421,906	713,777	308,745,538
Population Under 5	76,232	19,175,798	50,146	20,201,362
Population Under 18	295,709	72,293,812	190,347	74,181,467
Population 65+	99,056	34,991,753	81,925	40,267,984
Median Household Income	$29,106	$41,994	$26,955 (2008-2012)	$53,046
% Below the Federal Poverty Line	26.1	11.3	33.2 (2005-2009)	15.1
% Civilians Unemployed	13.8	3.7	28.4	9.6
High School Diploma or GED Equivalent Only	53.6%	49.7%	57.3%	67.7%

At the neighborhood level, the challenges facing Detroit over the past several decades have been mirrored within Brightmoor. The joblessness, population decline, and the percent of the population living in poverty that have plagued the city are even worse in this neighborhood. See Table 2. The population of Brightmoor peaked in the early 1980s and has been steadily in decline as residents have moved away. [9] The population decline in Brightmoor has exceeded the decline experienced within Detroit—36% population loss in the neighborhood compared to 25% overall within the city between 2000 and 2010. Rosedale, an adjacent community differs from Brightmoor in several different respects—average household income and levels of unemployment and poverty. See Table 2 and Figure 3.

TABLE 2: Population Characteristics of Detroit, Michigan and the Neighborhoods of Brightmoor and Rosedale, 2010

	Rosedale	Brightmoor	Detroit
Total Population[11]	16,121	12,836	713,777
Population Under 5[11]	863	1,061	50,146
Population Under 18[11]	4,008	3,834	190,347
Population 65+[11]	1,692	869	81,925
Mean Household Income (2005-2009)[52]	$61,535	$34,126	$39,838
% Below the Federal Poverty Line[52]	20.4	41.1	33.2 (2005-2009)
% Civilians Unemployed[53]	18.3	32.2	28.4
High School Diploma or GED Equivalent Only[53]	(48.5%)	(61.8%)	(57.3%)

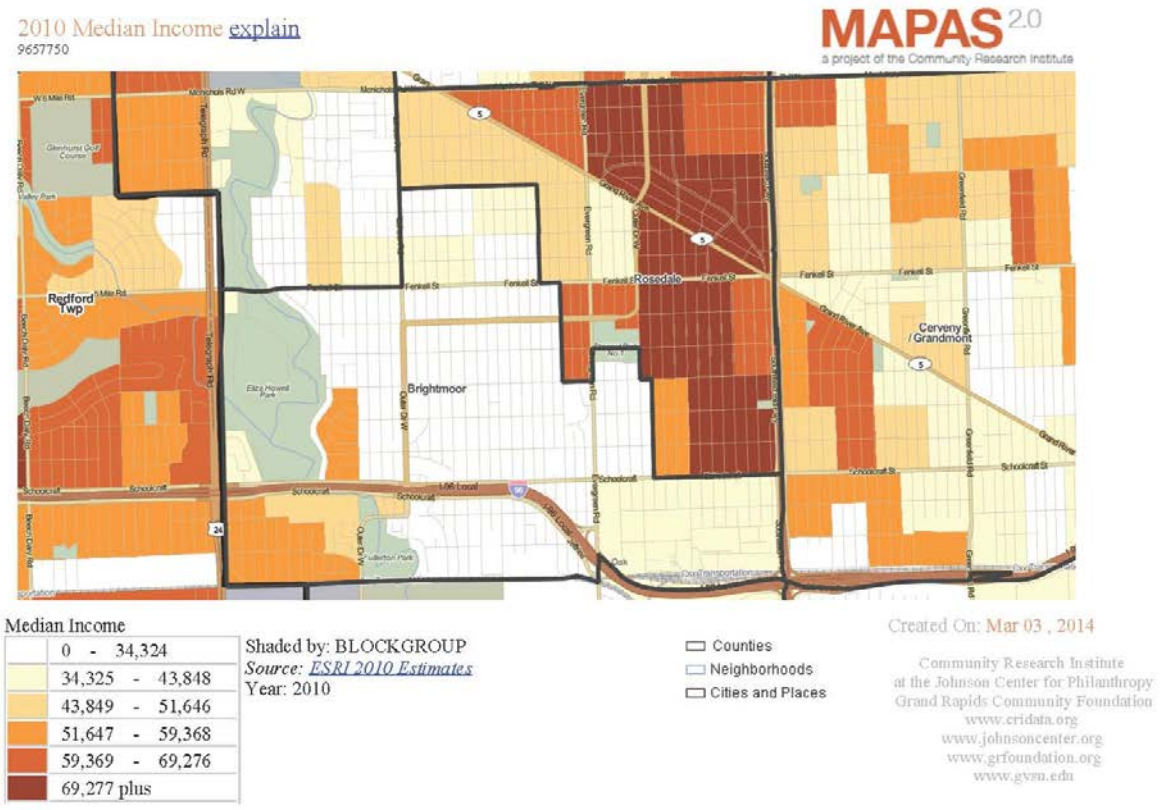


FIGURE 3: Median Household Income in Brightmoor and Rosedale Neighborhoods, 2010

While Rosedale is better off, in terms of socioeconomic status, the numbers of homes that had a water shutoff is considerably higher than in Brightmoor—10.9% of Rosedale households had their water shutoff in 2013 compared to 1.43% in Brightmoor. See Table 3.

TABLE 3: Housing Characteristics of Detroit, Michigan and the Neighborhoods of Brightmoor and Rosedale

	Detroit	Brightmoor	Rosedale
Population (2010)[11]	713,777	12,836	16,121
Total Number of Housing Units (2010)[11]	349,170	6,940	6,742
Housing Density per Square Mile (2010) [11]	2,516.5	1,763.5	2,727.2
% Vacant Houses (2010)[11]	22.8	29.4	11.7%
Average number of residents per home (2010)[11]	2.7	2.6	2.7
% of Houses Built Before 1970 (2009)[54]	90.7	86.3	96.4
Number of Houses with Water Shutoff (2013)	**n/a**	**99 (1.43%)**	**736 (10.9%)**

4.1.2 Water Shutoffs in Brightmoor and Rosedale

Over the course of several years, some residents of Detroit have lived without access to water in their homes because of an inability to pay their water bills. In 2007, Detroit's Metro Times reported that as many as 45,000 residents received water shutoff notices a year.[21] In 2009, members of the American Federation of State, County, and Municipal Employees (AFSCME) Local 207 reported to the People's Water Board Coalition that over 40,000 families had their water shutoff that year. Members of the coalition and the Michigan Welfare Rights Organization investigated the issue and it became apparent that the issue is unfortunately ubiquitous in Detroit. Some residents experience shutoffs for only a matter of days while others have their water shut off for extended periods of times. In addition, many residents face repeated shutoffs as they struggle to find a stable financial position.

Data on water shutoffs for 2013 was acquired from the Detroit Water and Sewerage Department (DWSD). This is the most reliable data available. Based on this information, a total of 835 (6%) of the residencies in the Brightmoor and Rosedale neighborhoods had their water shutoff in 2013. The DWSD was unable to state the total number of people were affected by these shutoffs. However, based on the average number of residents per household (see Table 3), as many as 257.4 residents in Brightmoor and 1,987.2 residents in Rosedale may have been affected.[55]

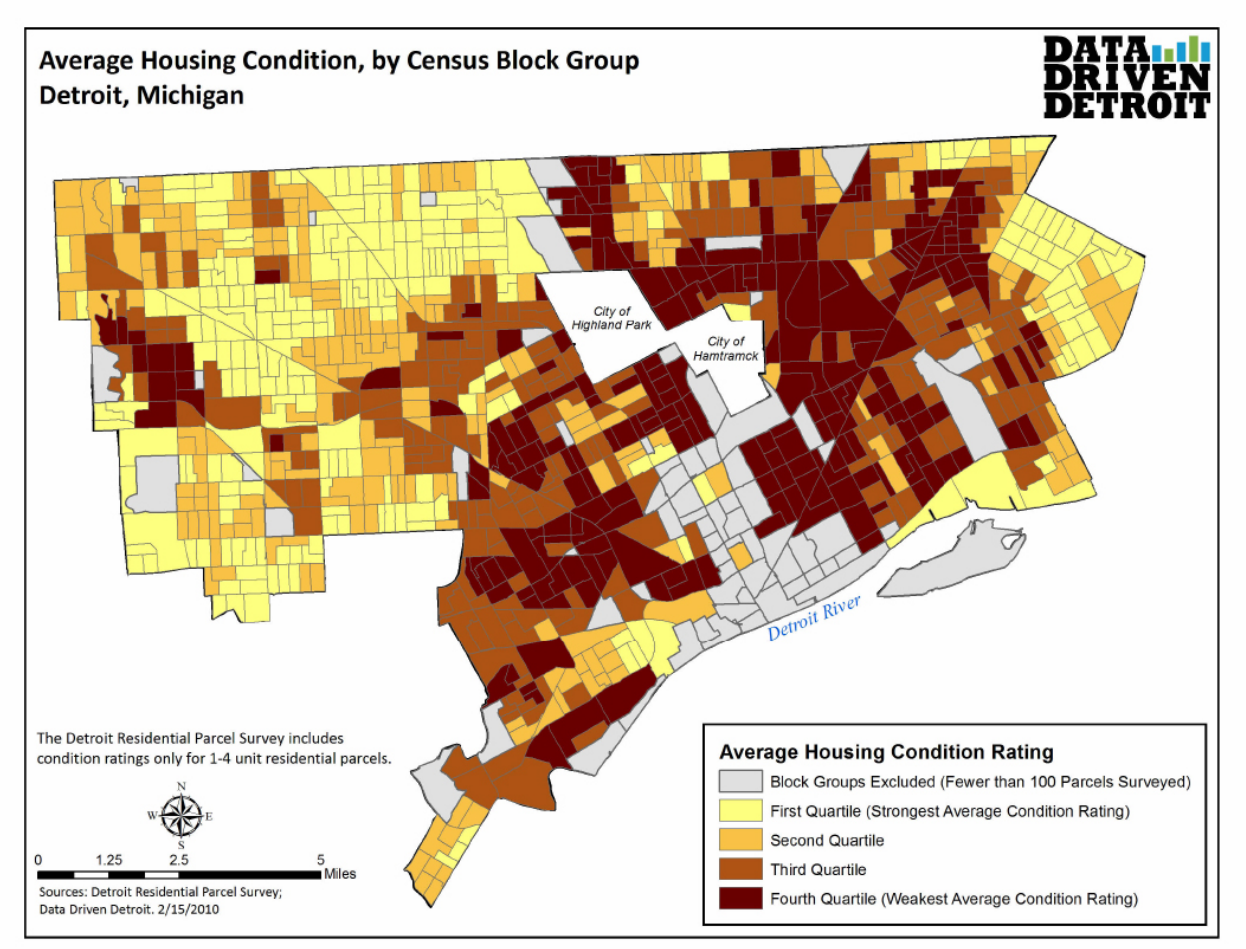


FIGURE 4: Average Housing Condition in 2009, by Census Block Group, in Detroit, MI[9]

4.1.3 The Condition of Housing in Brightmoor and Rosedale

The Detroit Residential Parcel Survey[54] was conducted in order to evaluate the condition of every individual parcel within Detroit. Data from that survey appear in Figure 4. After researchers answered several questions about each parcel, houses were ranked as good, fair, poor, or demolish. Good houses were well maintained, structurally sound, and needed no more than 2 minor repairs. Fair homes were maintained, structurally sound, had minor exterior damage, and needed three or more minor repairs, one major repair, but the property could be rehabilitated fairly inexpensively. Poor homes were not structurally sound, had major exterior damage, and major repairs needed. Homes in the fourth quartile were classified as needing to be demolished for not being structurally sound. The condition of the housing in Brightmoor and Rosedale fell into the following categories. See table 4 below.

TABLE 4: Condition of Homes in the Neighborhoods of Brightmoor and Rosedale (2009) [54]

	Brightmoor	Rosedale
Good	4,487 (80%)	6,442 (99%)
Fair	676 (12%)	66 (1%)
Poor	249 (4%)	6 (0%)
Demolish	230 (4%)	7 (0%)

4.1.4 The Age of Housing in Brightmoor and Rosedale

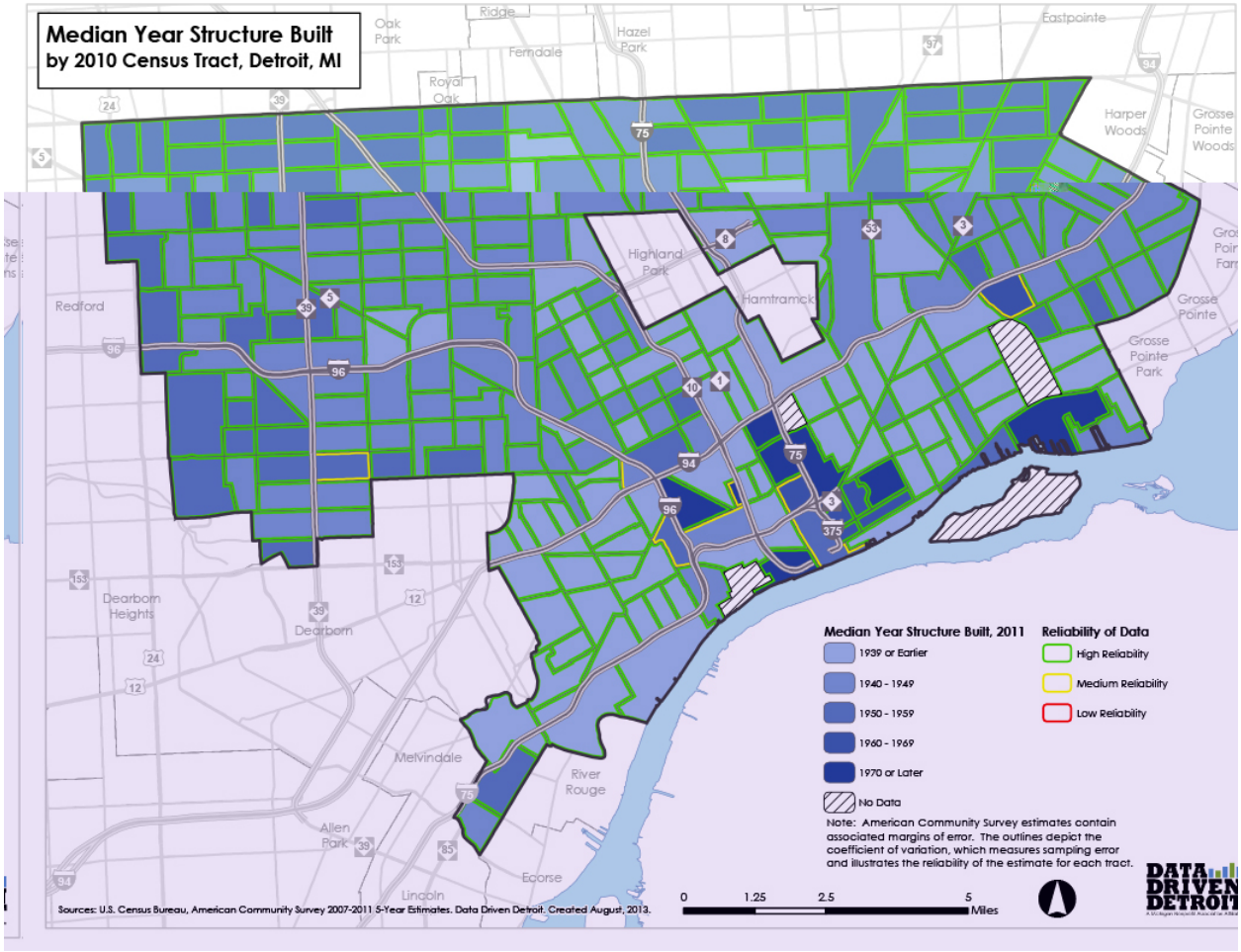
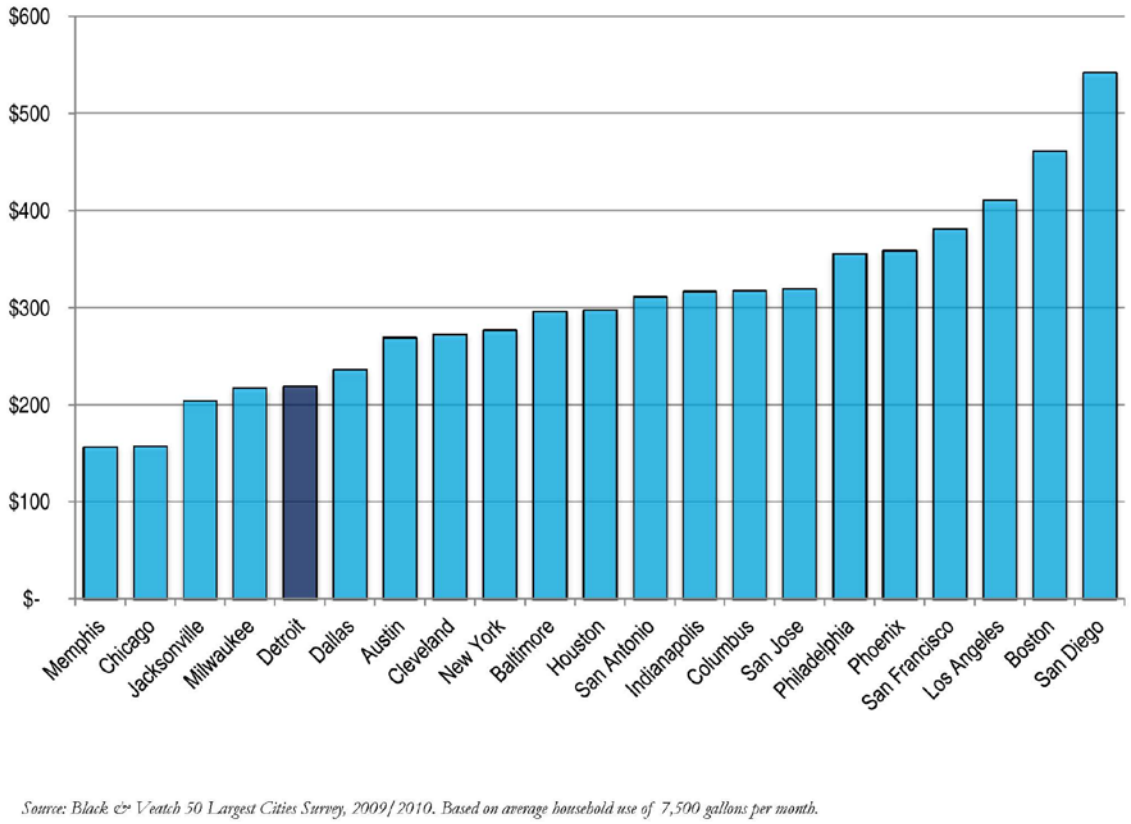


FIGURE 5: Median Year Structure was Built, Detroit, MI[9]

Of the houses in Rosedale, 96.4% of the houses were built before 1970.[11] As is evidenced in Figure 5, most of the homes in the Brightmoor and Rosedale areas were built between 1950 and 1959. The majority of homes built before 1994 are equipped with inefficient plumbing fixtures and appliances, using 30-40% more water than modern units.[45] According the literature, leakage from pipes and water appliances was found to be highest in homes that were built in the

1970s or earlier.[56] Considering the age of the structures in Detroit and the current price of water in Detroit, updating water using appliances could save residents hundreds of dollars.[57] See Table 5.

4.1.5 The Cost of Water in Detroit



Source: Black & Veatch 50 Largest Cities Survey, 2009/2010. Based on average household use of 7,500 gallons per month.

FIGURE 6: Detroit Retail Water Rate Comparison with Peer Cities

The rate charged for water in Detroit is low when compared to other cities across the country, yet, affordability is recognized as the primary reason that many residents face water shutoffs. See Figure 6. Among low-income households, affordability is a not only a question of the economic burden a water bill places on a resident, but also on whether that resident is being forced to forego other essential services in order to be able to pay for water.[14]

Water rates are rising nationwide and, given the substantial upgrades and repairs needed by many water systems in the United States, show no signs of slowing down.[15] In the past 12 years, water prices have risen 119% percent in Detroit.[58] The cost of water is expected to continue rising by 5 to 15% every few years, a level that exceeds inflationary costs.[58] As water rates escalate, a customer's bills may increase anywhere from one or two dollars to $20 or more a month.[6]

Some of the residents within the Brightmoor and Rosedale neighborhoods, many of which are already struggling financially, are unintentionally wasting water in their homes. Given this situation, a water audit program that identifies leaks in plumbing and inefficient appliances and water devices is a first step in saving on customer's water bills, making the bills more affordable for residents.

4.2 QUESTION 2

What type of water audit would best meet the needs of residents of Brightmoor and Rosedale?

4.2.1 Sources of Household Water Consumption

On average, an American home wastes more than 10,000 gallons of water every year due to running toilets, dripping faucets, and other household leaks.[32] A faucet that drips 60 times a minute adds up to over 3 gallons each day, or 1,225 gallons each year. That is enough water lost to fill more than twenty-two 55-gallon drums. [35] Toilet flushing is by far the greatest source of

water consumption in a home, using 40% of the amount of water consumed in a home.[35] Most in-home water leakage can be attributed to outdated toilets, specifically, leaky toilet flaps.[35] Other sources of water use, and percentage of water consumed by a family of four: bath/showering 32%, laundry 14%, dishwashing 6%, cooking/drinking 5% and bathroom sink use 3%.[34] Replacing a toilet installed before 1992 can save four gallons or more a flush; water efficient clothes washers use up to 50 percent less water than standard models; rebates up to $100 are available for both items.[32]

Older homes are less likely to have water efficient appliances, and are more apt to have appliances that deliver larger volumes of water per use and have leakage.[59] The water department within Ashland, Oregon reported that homes built between the 1950s and the 1980s have toilets that use at least 5-8 gallons of water per flush, and homes that were built between 1980 and 1994 use 3.5 gallons per flush.[59] Now toilets are designed to use only 1.6 gallons per flush.[59] Considering that the vast majority of homes in Brighmoor and Rosedale were built before 1970, and the average number of persons living in each home, there is a great potential for cost savings per day even if just the toilets were replaced or retrofitted.

4.2.2 Model Water Audit Programs

Many water companies across the nation offer free conservation kits with tools like toilet leak detection kits, low flow showerheads and garden hose nozzles and information about water efficient landscaping.[32] Seeing a need for conservation, many water departments have implemented larger programs to reduce water consumption.

In the town of Cary, North Carolina, the water resources department has hired a Conservation Program Supervisor to manage their efforts.[60] Water audits are offered to

customers that contact the finance department, as a part of an educational outreach initiative to teach customers about their own water use. To recruit residents they advertise on their website, on brochures, and as part of seasonal campaigns. The audit piece concentrates on indoor and/or outdoor water use dependent on customer preference, although both approaches are centered on leak detection. The Water Conservation Program Specialist conducts the audit and reviews all results with the customer then offers suggestions for remediation.[60]

The conservation efforts conducted by the Metro Water District of Southern California are guided largely by a Memorandum of Understanding Regarding Urban Water Conservation. The California Urban Water Conservation Council, a group of water providers and conservation groups, came together in 1987 to increase the water supply (while preventing further environmental damage) and designed the Memorandum as a framework for conservation efforts.[32] The group stressed the necessity of conserving and recycling more water rather than increasing the amount of water supplied to meet the needs of a growing population.[32] The parties identified "Best Management Practices" intended to reduce long-term demands which included: initiation of a conservation coordinator to manage city wide efforts, incentivizing long term conservation, and customer education on conservation practices.[61,62] The management practices emphasize developing partnerships with stakeholders who serve the target market in order to gather insight on messages that may be most influential.[61,62]

The residential conservation program established by the California Urban Water Conservation Council provides site-specific leak detection assistance that may include a water conservation survey, water efficiency suggestions, and/or a leak inspection dependent upon resources available.[61] The residential conservation program provides incentives, in the form of rebates, for customers who replaced existing appliances with new efficient ones.[61] The program

also emphasizes the importance of public education piece through at least quarterly contact with the public, an actively maintained website, and water supplier contacts with the media.[61,62]

Residents of California may apply for conservation programs through the California American Water, Water Wise home survey. Through this program a water conservation specialist visits a customer's home free of charge to help inspect irrigation systems, bathrooms and kitchens for leaks and provide tips on ways to improve the water efficiency.[63] Rebates are then offered for a variety of water appliances.

The Water Conservation Specialist in Ashland, Oregon has focused largely on reducing outdoor water use due to the increase in water usage during the summer months.[64] The Specialist personally works with customers that contact the water department with questions about high water usage to review and reduce their water use. The approach taken emphasizes reviewing water use to demonstrate to a customer the potential for savings. In terms of outdoor water use, the customer and specialist review the landscape and determine the amount of water necessary for maintenance (often the customers are watering twice as much as necessary). In terms of indoor water use, customers are provided with WaterSense showerheads and faucet aerators. These are installed by the Specialist. Rebates for toilets, washing machines, and dishwashers are provided as well. The water department estimates that approximately 5.2 million gallons of water were saved in 2013 from these programs.[64]

The Phoenix, Arizona water department conducts a water audit and retrofitting program that targets residents living in low income areas of the city.[50] The department chose to take this approach to promoting conservation because it produces permanent change in water use without relying on behavioral changes.[50] A new toilet does not require a change in the customer's behavior, yet results in significant and sustainable water savings.[65] To recruit residents to

participate, staff canvas a targeted neighborhood that is likely to have a large number of low efficiency toilets and other fixtures; residents who are interested in the program are scheduled for an audit.[50] The program costs approximately $75,000 per year, which covers 300 homes.[66]

The city of Phoenix funds the contractor and plumbing supplies using rate revenue, although there is also a matching federal grant used to purchase the toilets for the program. [66] A general contractor is used to conduct the program since they are familiar with water conservation techniques and education techniques, which are crucial elements to the success of the program. The contractor then refers services out to a plumber as needed. [66] The audit takes approximately a half day and the program includes: replacing all toilets that have a flush volume greater than 1.6 gallons, installing aerators or replacing faucet fixtures and showerheads, fixing minor leaks in pipes and irrigation systems, and repairing leaking hose bibs. [66] The contractor also reviews indoor and outdoor water use, offers advice on conservation throughout the property, and provides the resident with a list of other repairs needed that are not provided by the city contract. [66]

Based upon the reported auditing programs, reasonable components to consider for a program in Detroit include: customer education on current water usage, a home inspection for leakage in pipes, and a home visit to evaluate appliances. To remediate inefficient water use potential options are to offer rebates for new water appliances, replace inefficient devices such as toilets and washers, and retrofit old appliances. The payback time for these efficiency upgrades is estimated to be less than five years.[45] The potential savings due to remediation, calculated according to the water rate in Detroit, is illustrated in Table 5.

TABLE 5: Potential Savings Due to Remediation, Based on the Water Rate in Detroit[57]

Replacing a Toilet Installed Prior to 1992	$120
Replacing Showerhead	$115
Replacing Faucet	$115

4.3 QUESTION 3

What would be required of WAVE to implement this program?

4.3.1 The Water and Sewerage Department

The Detroit Water and Sewerage Department (DWSD) is owned by the city of Detroit, functioning as a non-profit agency per Michigan statute.[22] The current uncertainty associated with Detroit's financial position has had, and continues to have, dramatic impacts upon DWSD's daily operation.[22] DWSD has encountered downgrades in their bond rating unrelated to its own financial or operating performance, but rather due to the financial situation of the city of Detroit.[22] Although, the DWSD has claimed financial independence and has improved fiscal performance, it is not reflected in the agency's rating or capital due to its ties to the city.[22]

The city's five water treatment plants pump more than 600 million gallons of drinking water across Detroit's 139 square miles each day, billing residents for the volume used. Meanwhile, abandoned buildings across Detroit are subjected to metal scavengers that tear out pipes and leave water flowing, often going days before the leak is detected.[58] These buildings

become flooded by torrents of water that stream through the bowels of homes, buildings, and warehouses. [58] In cases where the water in an abandoned building is turned off, residents or squatters often bypass the meter and manage to steal water. [58] The water department does not have the resources to track every leak, or the number of the employees to visit every abandoned structure. [58,67] Technology is available to track leaks but such technology is an expense that Detroit, with a network of 100-year-old cast iron pipes, cannot afford. As Detroit goes through the process of reallocating funds after declaring bankruptcy, the porous water system is one illustration of how the city's resources are draining.[67] In a city with an estimated $18 billion debt, the department has a debt of about $5.9 billion. The water department has lost more than 400 jobs in the last few years and one study has proposed cutting half of the 1,700 positions left. All of these are important factors affecting the current established water rate in Detroit and are crucial to reducing the impact of the water shutoffs, as they are often very intertwined with the structures that underlie the issue.[68]

4.3.2 Water Access Volunteer Effort

Carla Walker-Miller, Executive Director of WAVE, started this organization based on her desire to help residents in dire situations. It was her own experience spending $6,000 to fix and replace pipes in her own home that prompted conversations with friends and neighbors about the need for a residential water audit program. In an interview with Ms. Walker-Miller, she explained that WAVE is a small organization that is looked upon favorably by Detroit residents because it has been run successfully by volunteers who provide for those who have had their water shutoff. While WAVE does have criteria for residents that they assist, they are viewed in a positive light by residents because they use all of their revenue to aid those in need.

Nonetheless, because they do not have their own staff, the organization can only serve a limited population. Without any advertising, the organization already has more requests for help than they are able to meet.

The organization is currently working on obtaining grant funding in an effort to hire staff and expand their programs. If funding becomes available, Carla stated, "There are some individuals in the organization who could take on a more direct role [in establishing new programs] and we plan to explore this in the near future." When asked directly, Carla did state that the organization does not presently have the capacity to expand and add an additional program. Carla stated that she is the President and Chief Executive Officer of another company in Detroit, and she sits on several boards and volunteer committees across the city. She has, however, been informed that because of the DWSD's sustained financial stress they will become more aggressive in shutting off delinquent accounts in 2014.

4.3.3 Resources Available

Although WAVE does not presently have the capacity to implement a new program, there are several other organizations within Detroit that have a vested interest in helping residents secure water access. These organizations are potential stakeholders for this program and will be crucial in garnering community support.

People's Water Board Coalition is a collection of social justice and environmental organizations that advocate for access, protection, and conservation of water. Their mission is based on a belief that water is a human right, and all people should have equal access to clean water. The organization has primarily staged efforts to prevent the water department from privatizing. Members of the organization have close ties to union workers within the Detroit

Water and Sewerage Department. Using these ties, several members of the water board have learned how to turn water on water within homes that have been disconnected and have gone on "guerrilla outings" to turn on water for residents that have faced shutoff. However, utilities stiffly penalize customers who reconnect their homes without prior authorization.[69]

The Michigan Welfare Rights Organization (MWRO) is an organization that aids low income workers and homeless people find services to aid them out of poverty. It also brings together low-income workers together to advocate for social justice and change in the current policies surrounding healthcare, food stamps, and utility shutoffs. Several of the employees and volunteers of MWRO have been working to raise awareness about the number of water shutoffs in Detroit and even developed a plan for a new and affordable rate structure along with the DWSD that was never implemented.

The Sierra Club works closely alongside of the People's Water Board Coalition and Michigan Welfare Rights to advocate for water accessibility and protection. While the Sierra Club typically has more of an environmental focus, the Detroit club also has an environmental justice program that advocates for low-income and minority communities.

EcoWorks is an alternative option to spearhead the program, if they have the willingness and have the capacity to add the audit to the work they already conduct. EcoWorks is an organization within Detroit that aims to establish social, economic, and environmental health for everyone. Their mission is to create "opportunities to learn and practice the sustainable use of energy and natural resources through the innovative education, job training, consulting, social business, and advocacy."[70] The organization was established in 1981, former known as WARM, and has served the Detroit area in several capacities—they conduct energy audits to save

consumers money on their energy bills, deconstruct old homes and reclaim all useable materials, and educate youth on making their communities more sustainable.[70]

EcoWorks has already been incredibly helpful by sharing experiences and data that inform the basis the program, recommending a community based approach, and will be invaluable in establishing community relationships. As EcoWorks is already known throughout Detroit for their energy assessment, their backing would be advantageous in garnering community support. As they already work with high school students and AmeriCorps volunteers to conduct home energy audits, the relationships between the organization and parents in the community have already been established. The program, called the Detroit Youth Energy Squad (D-YES), works with a team of students during the summer to install energy saving supplies in homes across Detroit while teaching residents how to save money on their utility bill. These students earn a stipend for their work, as well as providing them with opportunities to learn job skills. Additionally, EcoWorks already conducts a program that analyzes water bills for property managers, so they are already familiar with the deteriorating infrastructure in Detroit and the need to fix or repair much of it. Due to their previous community work and their sustained community involvement the organization would likely be a more appropriate fit than WAVE in garnering the community support necessary for a community based participatory project.

To gain entrée into the community Blight Busters, the Brightmoor Alliance, and the Grandmont Rosedale Development Corporation will be asked to participate as stakeholders. The Brightmoor Alliance and Grandmont Rosedale Development Corporation are community groups in their respective neighborhoods.[66,71] As the government system in Detroit is disenfranchised neighborhood community groups have taken on increased responsibility to address the needs within the community. It would be important to recruit help from within these organizations as

they already serve as central rallying points. As Detroit functions as a closely knit community, these organizations have access to resources (space, people, and funders) that may be necessarily to the success of the program. Members of these groups are likely to be well tied in with the community and aware of needs, may serve as crucial key informants, and will be able to recruit other participants that will be able to contribute to the design and implementation of the program.

In its 25 years of existence Blight Busters has worked with over one hundred thousand volunteers to paint 684 homes, board up and secure 379 abandoned buildings, renovate 176 houses, and build 114 new homes.[66] Founder John George started the organization by carting around plywood in his truck, driving around the City to board up abandoned homes in order to reduce crime in the neighborhood.[72] Blight Busters has grown tremendously and works not only to reduce blight, but also create community in a neighborhood through hosting community events throughout the year.[72] The organization works primarily in the Brightmoor neighborhood, but has a reputation across Detroit for stabilizing and revitalizing neighborhoods.[72] Blight Busters has a reputation for listening to resident's concerns and working cooperatively within the community.

Establishing a partnership with them will provide residents with a basis for trust, ultimately a foundation through which the participatory component can build from. Having discussed the program with John George previously, he was very interested in the issue and would be willing to be involved in future discussions. Additionally, Blight Busters helped to build and establish a space in Brightmoor, known as Artist Village. This space is frequently used for community events within Brightmoor and would be an ideal meeting space for community meetings to plan the audit.

It is also necessary to involve the DWSD in the creation of the program, as they will be impacted by the decreased water demand. As many community members are reluctant of the DWSD, blaming the department for inexplicably high water bills, they will only be involved in a limited capacity. Plumbers Without Borders, a small non-profit organization based out of Seattle, will serve as a helpful organization to consult with in designing the remediation strategies after the auditing process is complete.[73] As the organization was only established in 2010 it is small, but after talking to them about the issues facing Detroit, they stated they would be willing to offer insight as needed.[73]

4.3.4 Participatory Based Approach

It is well known in the Detroit community that residents are over-researched and uninterested in projects that provide no incentives.[3,74] Upon first entering Detroit I was warned repeatedly that residents would be hesitant to work with me because I am not from Detroit and could not guarantee any benefit to the community.[74] It has been suggested that countless studies have been conducted by researchers who gather data and do not do anything for the residents.[3] Hence, the design, implementation, and evaluation of a proposed water audit program will need to adopt a community-based approach. In moving forward, WAVE will need to contact several local organizations to serve as stakeholders and to help recruit community support. Upon garnering support from stakeholders, WAVE may then recruit community members to design the program according to what methods they identify as most appropriate for these two neighborhoods.

The purpose of community-based research projects is to further understand issues affecting the community and to plan, implement, and evaluate programs that will address such

issues in a way that will benefit the community. Rather than being passive participants, using this strategy will allow neighborhood residents to be participants, preventing them from feeling like research subjects.

5.0 DISCUSSION

Many living in Detroit are facing the daunting, nightmarish reality that they cannot afford to live. [75] The urban poor within Detroit are regularly burdened by unpredictable incomes and unreliable job situations.[76] While the price of water in Detroit is low in comparison to other cities, the average income of those living in Detroit is also significantly lower, thus a water bill can be an incredible expense. When viewed in relation to all of the other expenditures a family has to afford—transportation, food, rent, gas, electric, insurance—even a small water bill may break the bank. Considering the age of homes in Brightmoor and Rosedale, the high percentage of homes built prior to 1970, there is a great probability that these homes would benefit from new or remediated appliances.

After interviewing Carla Walker-Miller of WAVE, it became apparent that the organization's desire to assist residents exceeds their current capacity to do so. While the organization has expressed interest in starting a program to prevent shutoffs, their limited funding and human resources would not be conducive to adding additional programs. Coordinating efforts to work with high school students and local residents would require a significant amount of organization that it is unlikely WAVE would be able to provide. It would be more appropriate for the organization to function as a stakeholder and for EcoWorks to spearhead the program.

The data received from the DWSD, through the FOIA request, was counterintuitive. The poorer of the two neighborhoods, and the one known as dangerous neighborhood, faced fewer water shutoffs during 2013 than the wealthier neighborhood. After discussing this apparent irony with several members of the Detroit community, there was still no answer. This data may serve as grounds for conducting a second study, using the information given through the DWSD to gather qualitative data exploring why the number of shutoffs in the Rosedale area was higher than anticipated.

The major limitation to this study is the lack of input from residents who have had their water shutoff. Interviewing residents directly about their situations would have been ideal but was not feasible due to the length of the time of the study and the challenges to gaining entrée in Detroit neighborhoods. Additionally, due to the rumored consequences of shutoffs, the risk of participation would greatly outweigh the possible benefits.

Potential challenges to implementing this program are the length of time it may take to gain entrée with community members and the time commitment required to properly engage the community. However, using local organizations will minimize the time required to gain entrée as these organizations will already have rapport within the community. Funding is also a potential challenge, but there are federal grants available for conservation programs such as this one. Additionally, Mary Ellen Howard has already received $10,000 from an individual donor for a program to reduce shutoffs, and other donors have expressed similar interest.

6.0 CONCLUSION AND RECOMMENDATIONS

Identifying sources of unnecessary water loss in homes would provide the necessary data to design a program to remediate loss, ultimately leading to a reduction in the amount of water that residents are charged for on their water bill. As the literature stresses the importance of replacing or retrofitting toilets, shower heads, and faucets the auditing program should include a careful evaluation of these devices. Additionally, as the homes in these neighborhoods are older, pipes need to be assessed for leaks. After identifying inefficiencies, remediation of leaks and retrofitting or replacing the old appliances found in the homes would create a substantial reduction in water without reliance on lifestyle alterations. Plumbers Without Borders will be a valuable asset in this process, as they have expressed interest in the program and may be able to assist in the remediation process.

This auditing program should also include education for the residents of each home involved in the program, using water bills to inform residents about their household water usage. This piece would inform residents on their potential for water savings as to maximize the potential for savings. The educational piece should also involve an interview to gather quantitative data that would be useful in evaluating the program. This interview would focus on household water consumption and length of time a resident has lived without access to water.

Using the community to design, market, and perform the audits would be advantageous to the community and the program in several ways. In keeping with the goal of community-

based work, it would expand the capacity of the community as members learn to work together to produce change. Second, employing high school students to conduct the audits would create jobs within the community and would provide the opportunity to teach the youth professional skills. Finally, it will empower and build self-efficacy within residents.

The prevalence of water shutoffs in Detroit presents a great public health risk to the health and safety of residents in Detroit. The current strategies to reduce shutoffs are insufficient, and with a threat of an increase in shutoffs, prevention needs to be emphasized. Considering the current state of Detroit, and the Brightmoor and Rosedale neighborhoods, a water auditing program to reduce the number of shutoffs would be an appropriate step to thwarting more residents from reaching this situation.

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