

# Community Resilience in Carlisle: Infrastructure and Ecosystems

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**Research Goals and Significance**

By using the Community Resilience Index to frame our research on the Borough of Carlisle, we hope to gain a deep and authentic understanding of the strengths and weaknesses of Carlisle's manufactured and natural capital. Our assigned topics include housing, the environment, protective infrastructure, transport, and information and communications technology (ICT). Additionally, we were tasked with examining all elements of utility infrastructure, including energy, water supply, and drainage and sanitation. Communities are directly influenced by infrastructure and programs developed by the Borough - things such as utility services, housing opportunities and rental programs, emergency communication services, and public transportation infrastructure. Each and every member of the Carlisle community relies heavily on this infrastructure for many reasons: during times of emergency when unforeseen stresses manifest themselves, for basic necessities that support citizens' livelihoods, and to protect those without the means to attain basic living standards without support. Therefore, it is critical that we understand the state of the Borough's infrastructure, both currently and how it responds to internal and external stresses. With this research, we will be able to evaluate what aspects of Carlisle's infrastructure are in need of attention, and what aspects of the Borough already ensure strong community resilience.

## **Research Approach**

We interviewed pertinent members of Carlisle's community who were able to offer their knowledge and opinions on particular aspects of Carlisle's infrastructure, and accessed public documents and data provided by the Borough and other sources to conduct research on all topics. Qualitative data was collected by conducting interviews with members of the local Carlisle government, nonprofits, community members, and company representatives. Scores for qualitative questions were generated using the best and worst case scenarios provided by the CRI as reference. A detailed response discusses the support for each score, presenting plans, programs, and existing infrastructure (or lack thereof) that led us to the ranking. Quantitative data was collected by accessing online information through local and state government websites, as well as applicable surveys, research, and studies. In some cases, interviews were followed by additional questions via email, and other appropriate or suggested officials were contacted per community recommendations. In later stages of the project, gaps in our research were identified and we began contacting other potential sources of needed information. In addition to contacting more informants, we continued to seek out information on relevant websites and requested documents from past interviewees.

## **Document Organization**

This document is organized by CRI topic. Under each topic, or indicator, is a brief (1-2 paragraph) summary of our findings, followed by a detailed report including the justifications used in the CRI online tool. The organization of our research findings roughly follows the questions on each topic of the CRI, and the numerical rankings (on a scale from 1-5) are included in bold along with answers to quantitative questions when appropriate. Each section concludes with a brief description of limitations to the report and a list of sources. For full citations, reference page 42.

## **HOUSING**

There is an overall shortage of affordable housing in Carlisle. There are programs in place to assist homeless people and to help them receive housing. However, these programs tend to have very long waitlists. It can also be confusing or difficult for residents to work through all the required layers in order to be receive affordable housing. There are extensive borough-wide plans in place to attempt to provide housing to at-risk residents, including the elderly and people with disabilities. There are also initiatives in place to increase the total amounts of available housing units. This is important because Carlisle is the fastest growing borough in Cumberland County, making construction and the availability of housing units a high priority.

Housing in Carlisle is safe overall, but there definitely are some areas in the Borough that are higher safety concerns than others. Another issue that the Borough faces is sometimes landlords are not as responsive and involved with their properties as they should be. This leads to necessary fixes in housing not being addressed by the landlords, and can cause residents to live in sub-par conditions. The Cumberland County Housing and Redevelopment Authorities (CCHRA) work to educate residents about the programs they have that can help them to fix the issue of having dilapidated living situations due to absentee landlords. These programs are available but not always sought out by community members. Plans to house residents after a catastrophe is lacking. The availability of livable, public units to accommodate the needy after such a catastrophe is also less than ideal.

There is a shortage of affordable housing in Carlisle relative to the demand. It was calculated that based on current counts of the Borough's homeless population, 940 people would be living homeless out of a population of 100,000 individuals. For this, and the following description of Carlisle's supply of affordable housing, we assign a rating of 3. The Borough's homeless placement programs have over a hundred people on the waiting list for housing. A person's status is defined as "homeless" when they are living on the street, in a shelter, in their car, and/or other places not meant for human habitation. According to the United States Department of Housing and Urban Development (HUD), people who are couch surfing are not technically considered to be homeless. Carlisle is aware that numerous people who couch surf would otherwise be considered homeless. It can therefore be difficult to estimate how many homeless people there are exactly in Carlisle.

Through several programs, people can apply and receive affordable housing. In Carlisle, these programs are in very high demand. The Housing Choice Voucher Program (Section 8), provides low income applicants with housing subsidies. It has a year to a year-and-a-half long wait for placement once people apply. Some properties that house people with different abilities have very low turnover; because people rarely move out, there are few opportunities for new residents to move in.

Public housing is owned by the housing authority and tenants pay 30% of their monthly adjusted income, very similar to the Housing Choice Voucher Program. It is project-based however, so benefits are temporary. Once people move out of their residence where they are supported with Housing Choice Voucher Program funds, they have moved on from the program. The program was founded to help people find stability in housing and then help them move on to other living situations. It is not a voucher program. Additionally, Cumberland County has two projects that are considered federally funded senior housing as they house the elderly aged 62 and older. One of them is a United States Department of Agriculture (USDA) rule development project in Newville for the elderly. The other is a HUB property located in Carlisle. There is also a tax credit division which is currently the biggest division of support. This is the only section where there is growth because there is an incentive for developers to get credits. Tax credit programs range from between 20 years old to recent programs. The newest programs are ones that just opened up to more last year and the oldest go back to the early-mid 90s. Low income housing credits started during the Reagan administration. The units are mixed and include units meant for multi-families, the elderly, and the disabled. The regulations are different

and the monitoring is done by either the state or the government depending on the program. The Carlisle Town Homes Project (CTHP), which is currently in the planning phase of implementation, plans to provide 279 homes for minorities and special needs residents. Federal and senior housing has been in place since the late 70s and early 80s.

Additionally, four programs currently exist to provide subsidized or affordable housing to the Carlisle community. The first program is Louthier Place. This development was built and operates with federal housing financing. The property utilizes two federal housing programs, Low Income Housing Tax Credits (LIHTC) and HOME Investment partnership, which provides \$28,294 per unit in financing. One West Penn is another affordable apartment community containing 130 rental units, housing no more than 195 total residents. The property was developed with funding from the HUD Section 202 program, and through Rental Assistance. Up to 70% of the costs are subsidized. The second two developments are East Gate Apartments and Middlesex Senior Housing, which both provide low-income housing to senior residents through LIHTC and Community Development Block Grants (CDBGs). These properties accept Housing Choice Vouchers in some cases. Despite these resources for low income citizens, there is still a large demand in housing for people with disabilities and for homeless people. There are 52 new units planned to be constructed on the demolished Tire and Wheel brownfield site but according to employees from the Carlisle Housing and Redevelopment Authorities, they will only provide affordable housing to a small percentage of those in need.

The need for affordable housing has grown, as Cumberland County is the fastest growing county in Pennsylvania. A lot of this growth is because Carlisle is the county seat and service resource center. Since there are warehouse developments near Carlisle and the outskirts, people settle in and nearby Carlisle because they want to live near where they work to avoid transportation challenges. Because of this, the Borough sees an influx of homeless people. Services to address this issue include Carlisle Cares, NHS (Northwest Human Services), social services, mental health services, Salvation Army, and United Way.

Since there is a variety of government funded programs in Carlisle, the qualifications that a person has to meet in order to qualify are different for each program. There are waiting lists, but they usually last year long if not longer. Carlisle does have some apartment complexes that are specifically for people with disabilities or for homeless people in addition to housing for people with mental or developmental different abilities. If people are waiting for housing they often do not have a high chance of receiving it. Properties are small, few, and far between, and people who do live in affordable housing live much of their lives in them which leads to very low turnover and long waiting lists. There is a very high demand for affordable housing and not enough to go around.

One of the biggest challenges besides the lack of housing is that there is so much layering in the programs. This causes problems when people try to apply for housing. Different programs have different preferences for applying. People who apply for affordable housing often have been waiting on lists for a year and can find out that someone else got housing before them because they have a preference, such as a disability. The Cumberland County Housing and Redevelopment Authorities have regulations and have to give preferences because they are targeted to be able to help the most disadvantaged people in Carlisle.

Christina Siegel, the Housing Management Director for the CCHRA, oversees housing and voucher programs that have to meet specifically defined standards for decent, safe, and sanitary housing. We have scored Carlisle's safe housing stock a 3.5 based on the following research, and our inability to quantify the percentage of houses within Carlisle which have passed national safety standards, as the CRI requests. People assisted by the CCHRA are living in decent, safe, and sanitary units. The CCHRA works extensively with landlords to make sure that they are giving their clients a

satisfactory residence. A challenge CCHRA faces is not having control over the units with supportive or unsupportive landlords. The housing stock is aging and there are many areas within it that have been identified as needing improvements and accessibility enhancements. Projects have not been completed yet to attempt to address this issue.

Carlisle has a very robust code enforcement department that frequently inspects owner occupied and rental units for code deficiencies. It is unlikely a resident will be burdened with an absentee landlord who does not want to pay to fix, maintain, or update their units. To counteract the potential problem of absentee landlords, CCHRA offers owner occupied units programs to help correct code deficiencies. These programs help owners maintain their properties and get them back to code standard. CCHRA is also starting to explore a rent-rehab program to help improve the rental stock in Carlisle. Housing options are often unjustly distributed. For example, lower-income people often only have the option to live in the least maintained properties. The CCHRA has noticed this problem and is starting to explore options about incentivizing property owners to make their properties more attractive to people. Programs like this already in place this include an owner occupied rehab program, where people can call and request an inspector to identify what codes may be violated.

A referral system is also in place that relies on homeowners who want to make repairs to their homes advocating for the needs of their residence. The CCHRA program's role is educating the community on what the Borough has available. CCHRA sends out fliers about their programs, puts information about them programs in newsletters, and advertises in newspapers. There is also continual talk within the Borough to determine what steps they can take to educate the community about available programs. Five people in the Borough took advantages of the rent-rehab program in the last year, and a total of seven or eight people did countywide. That is within the expected yearly averages, and mostly depends on the amount of funding available for these projects.

While there is not a government plan in place for providing emergency shelter and temporary housing, organizations such as Safe Harbor and Carlisle Cares try to find ways to stretch beyond their capacity and house people during emergencies. However no data was available to describe emergency shelter resources for Carlisle's population for 72 hours. This, and the lack of a formal shelter plan, grants this section a score of 2.5 as described in the following.

Housing opportunities are critical in times where energy supplies to critical places such as hospitals are insufficient. In these times, at risk residents such as the elderly are transported to emergency shelters with heat that can serve their needs better. The published plans that detail how the affordable housing programs should house people do not address how their process alters after a catastrophe. This most likely would cause an overly and unnecessarily hectic response after such an event

There are county-wide plans to better the supply and quality of housing options. This includes both public and private facilities. There are eleven non-profit housing corporations in the county overall, some of which are located in Carlisle. During a catastrophe that displaces specific people from their prior housing, they would be able to reside in these homes for a set duration of time. This ranges from a few weeks to months to years depending on the severity of the issue and the sensitivity of the resident. However, this is insufficient: if a large number of residents were displaced by a catastrophe that rendered their old housing units unlivable, the current housing options in place would not be able to accommodate the influx of people.

Limitations: Overall there was not much information about how the housing process works after a catastrophe that could cause residents to look for alternative sources of safe and reliable housing. The percentage of houses within the city that have passed national safety standards was unknown. The

percentage of the city population that could be served by city's access to stock of emergency shelters for 72 hours was also unknown.

Sources:

- Kate Molinaro and Chris Varner
- Kate Molinaro and Christina Siegel
- Affordable Housing Online. "Carlisle, PA."

## **ENERGY**

Overall, energy supply in Carlisle is good. Houses are connected to the grid and receive power from the substation downtown. PPL adequately provides the upkeep and maintenance services of the infrastructure to a high degree. Important assets to the community have access to backup power sources and alternative means of power generation, but not every house has these features. Carlisle's power grid is also connected to the neighboring municipalities' power systems which provides a backup in case areas of Carlisle's grid stop functioning. In the grand scheme of things, Carlisle's energy system is very reliable and very seldom experiences breakages. When disruptions occur, they are dealt with quickly.

There are operations in place to help everyone afford energy. There are also numerous measures in place to attempt to decrease Carlisle's overall power usage. Carlisle does an adequate job notifying residents of the inherent dangers associated with the electricity generation and distribution systems. These programs extend to both emergency responders and the general public. More renewable electricity resources are coming to Carlisle in the near future, which will help diversify the total types of energy generation as well as will make the Borough more environmentally friendly.

There is an extensive, affordable, and reliable electricity distribution network of electricity and gas in the Borough, however no numeric is available regarding percent income spent on electricity or gas. We score this section a 4.5. All houses have potential to be connected to the Borough's energy grid. Whether or not they are is up to the discretion of the homeowners, but there is significant infrastructure in place to physically connect every house in the Borough to the electricity distribution system, allowing them energy access. Nearly all homeowners take advantage of this opportunity. The electricity system is highly reliable, operating above 99.9% of the time. The costs of these systems are affordable to all homeowners. There are initiatives in place such as operation HELP and WRAP, to help anyone, including lower class residents, to afford extra heating during the winter or higher efficiency power systems to curtail electricity usage.

The usage of alternative methods of electricity generation in Carlisle on a household level is not prominent in the Borough. Some households and larger buildings have alternative sources of power to provide heating services in events of power outages. One form of this is by generating electricity from rooftop photovoltaic panels, for example, and selling that power into the grid. However, not all facilities have these technologies so in extreme cases at-risk residents, such as the elderly, must be evacuated to planned spaces that have these alternative forms of energy generation. Carlisle Cares is one example of a facility that people are evacuated to in case of emergencies.

Carlisle licenses its electricity from one company, Pennsylvania Power & Light Corporation (PPL), which deals with the generation and distribution of power within the Borough. There is one substation in downtown Carlisle that specifically transforms power from high voltage lines to insulated lines that can be directly used by household appliances and wall sockets. All power to the Borough comes through the high voltage line. In case of an emergency or power outage, there seven substations

in neighboring townships that can be connected to Carlisle's electric grid to provide backup power. Houses do not experience power outages on a frequent basis and any outages experienced in the system are addressed and rectified in a very short time period, sometimes within the hour that they are reported in. In the case of extreme weather events, such as deep snow, Carlisle has contacted colleagues and professionals in other states versed in repairing power lines in conditions that PPL workers are less experienced in.

All houses (100%) are authorized to be connected to the borough-wide electricity grid. The gas and electric systems are very safe, and earn a rating of 5. This grid is a radial system, meaning all power lines stem from one main station (the substation located in the downtown area). Not every house, however, has access to a reliable alternative energy source such as gas or oil to help generate power and heat if the main electricity system fails. To allow a degree of fallback, the Borough's grid is connected to seven neighboring municipalities' grids. This allows Carlisle to receive power from these sources if something were to happen to Carlisle's energy infrastructure. This allows the energy system to have a great deal of redundancy and reliability of built-in backups. Unfortunately, these outside sources to power are also subject to failure from similar events that might disrupt Carlisle's power distribution system, such as falling trees during intense winter storms. The grids do not contain enough spare capacity to fully support normal Borough functions, so borough-wide power usage would have to be reduced in these times.

Intrinsically, the electricity distribution system has inherent risks and dangers associated with it, as the extremely high voltage wires pose a threat to anyone who comes into contact with them. This can take the form of high-voltage wires lying on the ground that are a risk for pedestrians. PPL, Carlisle's energy provider, follows National Electric Safety Codes to regulate the installation and maintaining of energy related infrastructure. This covers bases including clearances, thickness/protection for wires, and various other standards. PPL also undertakes projects to educate the public on safety around electrical systems (including how people should operate around downed power lines and substation systems. There are groups that specifically educate first responders about these hazards, and also demonstration trailers that are distributed to schools and events to spread safety practices as far as possible.

In case of an emergency that would cause Carlisle's substation to fail thus ceasing power supply to the grid, Carlisle's electricity system is redundant to the point where there can be alternative power sources feeding into the grid from up to seven neighboring substations. A comprehensive backup network grants the following section a 4.5. The total amount of power provided from these substations to the grid is insufficient to maintain typical Borough functioning - power usage must decrease. There are not many initiatives to provide Carlisle residents with extensive amount of backup fuel generation mechanisms, such as oil or gas systems. These are largely reliant on the residents implementing and maintaining the systems. Nearly all of the electrical services are provided on a broad scale to the Borough by PPL - Carlisle only licenses electricity from the provider.

Carlisle has a radial electricity system, which is normally less reliable and resilient to stresses than the alternate grid system. This is because there are less total connections feeding power back into the system. However, Carlisle's system has the opportunity to connect to other grids, allowing the Borough to experience an extra degree of redundancy. Vital aspects of the community (such as the hospital or data backup centers) have emergency generators that are able to restore power in these specific areas to assure Borough functionality will not slip greatly.

The physical electrical infrastructure is in good condition - whenever capacity needs to be increased, lines are updated. Poles are replaced when the need arises (for instance they begin to rot). When electricity-related infrastructure fails, areas are repaired on an as needed base - vital community



assets such as hospitals have power restored first, and then the power outages that relate to the rest of the community are addressed. In addition to distribution, the substations are checked on regular intervals to assure that they are fully functional. Carlisle is also starting to utilize batteries to capture excess power on the grid. These would be able to feed energy back into the electricity system when demand exceeds amount provided by the electric company, or when power generation is no longer functional.

Limitations: The exact locations and functionality of specific generators was not able to be disclosed. Additionally, there was a lot of ambiguity regarding specifics of alternate energy generation tactics utilized by the Borough and its residents. Specifics about the amount of income the poorest 20% of the population spends on electricity is not known. Information regarding specifics about how certain infrastructure components are checked for functionality was unclear.

Sources:

- Carlisle, PA Website. “Carlisle 2015 Annual Water Quality Report.”
- Carlisle, PA Website. “Water Plant.”
- eCode360. “Zoning Legislation Chapter 255, Article 194.”
- Mark Malarich

## **WATER SUPPLY**

Water distribution and treatment in Carlisle is very good. Water is safe for the vast majority of residents to drink. There are minimal complaints from residents about the quality of the Borough’s water. All houses are supplied by this water source. There is plenty of excess capacity in the treatment system to accommodate more water usage by residents or new developments. Carlisle’s water is tested regularly and always exceeds regulations.

Carlisle Borough directly receives water from only one water source, the Conodoguinet Creek. If something were to happen to this water source then the Borough would not be able to receive potable water from the creek and Carlisle would be at risk as it would not be able to provide the Borough with adequate water. There is a one day supply of water kept in the Borough’s storage tank that could supply backup water. Additionally, Carlisle could receive water from the neighboring township’s water supplies, as there is infrastructure in place connecting the water supplies. However, this would also not be sufficient to meet the Borough’s demands. Infrastructure is aging and needs to be replaced to extend total lifespan in the upcoming years. Carlisle has had no experiences failing to provide water to the Borough in an adequate capacity in recent times.

Everyone (100% of the population) in the Borough of Carlisle is supplied with treated and closely regulated potable water. A CRI rating of 5 is supported by the following paragraphs. This water is sourced from the local Conodoguinet Creek, located under two miles north of downtown. The water is imperfect when drawn from the stream, but is purified at the facility. This process includes combining the water with chlorine, fluoride, and a corrosion-control chemical to avoid corrosion in the extensive 80 miles of water distribution infrastructure underneath Carlisle streets and residences. These additives prevent hazards from entering the water and help improve consumer’s health. Carlisle’s water does not violate any EPA health standards, especially relating to important hazards such as lead, copper, or turbidity. All vital components of the water distribution/treatment system are connected to backup generators, allowing them to function even if the Borough’s power supply fails.

The water report describes that lead, a harmful hazard for any individual, especially children or pregnant women, has potential to appear in consumer's water due to seeping in from resident's plumbing systems (which the Borough has no control over). If lead is an issue, residents are recommended to let their tap water run for up to 2 minutes before drinking it. The anti-corrosive agent added to the water in the treatment facility helps prevent the water from leaching residual lead in the pipes. Residents with special medical circumstances, including those having received medical organ transplants, those who have contracted HIV/AIDS or other immune disorders, and some elderly/infants are more at risk to react to the residual contaminants in the water that do not pose a risk to the vast majority of residents. Extra care must be taken in providing water (either on the distributor's end or the consumer's end) to address this issue.

Carlisle's water is "hard," meaning that it is alkaline from contact with limestone, and does not appeal to all Borough residents. There have been occasional complaints about the water smelling abnormal, which can be attributed to harmless sources such as algae on the Conodoguinet giving off harmless odors or the chlorine added during purification. There is only one water source and treatment plant that distributes water directly to the Carlisle Borough. Costs are determined by user rates. The more water a resident uses, the higher price they must pay for the water. The water is tested in comparison to safety regulations regularly to assure that the quality of water that residents receive is grade A.

There are pipes that connect the surrounding town's water supplies with Carlisle's, which allow for Carlisle to receive potable drinking water from surrounding communities with alternative water sources in case of emergencies. This is not regularly used, however. These extra connections are planned to only be utilized if something were to happen with the Conodoguinet and Carlisle was not able to retrieve potable drinking water from it anymore. Factors largely affecting Carlisle's water supply include: excess nutrients and soil runoff from agricultural sources, construction, and urban runoff. Carlisle could do a better job protecting this valuable resource by practicing proper fertilizer/nutrient management tactics, including decreasing the amount used and only using when necessary. There is plenty of excess capacity in the water distribution system: Carlisle can withdraw 7 million gallons of water/day from the creek, but currently only distributes 3 million gallons a day to residents. This excess capacity is very vital and helps improve city resilience in events, such as fires, where large quantities of water are mandatory to have available. The Borough's infrastructure could handle this added demand if needed.

The Carlisle water supply has roughly 8 "interconnects," or intersection points where water can be drawn from neighboring municipalities in the case of a major event or disruption. 100% of population can be supplied water by alternative methods for 72 hours during disruption, therefore earning a 4 based on following descriptions. These are relatively reliable sources in the event of emergency because all of the other municipalities draw their water from alternative sources, broadening the resource base and diversifying the system. Specifically, this allows for 1.5 million gallons of potable drinking water, or half of Carlisle's daily need, to be given to Carlisle in case of an emergency. This is not enough to meet the demands of the entire Borough, but it can facilitate continued functioning of vital assets (such as hospitals or schools). Water is kept in recently constructed tanks that have a 1 day supply of backup water stored at all times that could be supplied to the entire Borough. There is a capital improvement plan in place to evaluate the mechanisms for treating and delivering water safely to citizens. This is currently updated annually. Additionally, the Borough has undertaken a comprehensive evaluation of the water system, a 15-year improvement plan focusing on bettering water distribution and quality.

The Borough has identified and acted upon certain protective measures necessary to assure that the watershed remains in high quality via the Annual Water Quality Report. These measures include: addressing problems with nonpoint (general) source pollution, continuing to regulate industrial and municipal pollution and discharges into the river, and reducing agricultural runoff into the Conodoguinet. However, Carlisle could be more aggressive on watershed protection issues by further reducing agricultural runoff and also filtering urban runoff to a higher degree. The infrastructure that the Borough relies upon is old and well past its planned obsolescence date. There are plans for the Borough to begin replacing this infrastructure in the upcoming years in a large, expensive project.

Limitations: There were no plans found that detailed how specifically water would be provided to assets in the Borough after a catastrophe were to happen. Finding out specifically how the infrastructure connects with different borough's water supplies works would be helpful. There were no specifics on how Carlisle addresses the possibility of lead ending up in consumer's waters from private tanks.

Sources:

- Carlisle, PA Website. "Carlisle 2015 Annual Water Quality Report."
- Carlisle, PA Website. "Water Plant."
- Carlisle, PA Website. "Wastewater Treatment Plant."
- Cumberland County Website. "Cumberland County Municipal Waste Management Plan Update
  - & Revision
- Carlisle Urban Redevelopment Plan. "Wastewater Treatment in Carlisle, PA: A Case Study."
- Carlisle, PA Website "Wastewater and Water Plant Laboratory."
- Carlisle, PA Website. "Wastewater Treatment Plant."
- eCode360. "Zoning Legislation Chapter 255, Article 194."
- Mark Malarich
- Vaughn, Joshua.

## **DRAINAGE AND SANITATION**

Sanitation of wastewater in Carlisle is very adequate. Sanitation is safe, reliable, and affordable. Any blockages or problems with the system are immediately addressed. The plant operates under strict regulations from many third party organizations. The plant is very good at satisfying the criteria of these regulations and has not had an infraction in 219 months. The plant also produces biosolids, which can be used as fertilizer for the many agricultural operations in the Borough. The sanitation system is separate from the stormwater system, which causes an increase in stormwater to not directly affect sanitation levels and overload the wastewater treatment plant. There is plenty of excess capacity built into the system to accommodate spikes in amounts of wastewater without being overwhelmed.

Infrastructure used in the wastewater transportation and treatment is aging and well past its planned obsolescence date. There are numerous plans in place to repair this infrastructure in the next 10 to 15 years. However, this would result in higher costs for the consumers. Also, the fixes would be temporary measures taken to repaired connection between pipes and fix places where plants have breached the pipes, causing leakages to occur. This means the lifespan of current systems will only be lengthened, and the infrastructure will have to be replaced fully in an additional 50 years.

Sewage services are provided to all households located within the Borough boundaries. Every home is connected to and served by the sewage system; the safe, reliable, and affordable sanitation

earns a CRI rating of 5. This system pipes waste to a nearby treatment facility, located on the Conodoguinet. The plant is operational 365 days a year, and the water is frequently tested and the levels are reported back to the Pennsylvania Department of Environmental Protection (PADEP) and the Federal Environmental Protection Agency (EPA). The system has operated for 219 consecutive months without any infractions of regulations.

There is a component of the system that converts wastewater into biosolid sludge. This sludge is kept on the facility's boundaries until the tanks are full, then it is spread over several surrounding farms for fertilization of non-human consumed crops. Throughout this whole process, strict guidelines and regulations are followed. Overall, this process provides many economic advantages for the Borough as fertilizer costs are reduced and total waste from the systems also decrease. Farmland also benefits from the added nutrients in the biosolids, benefitting agriculture. This system is operated by a subset of the overall municipal waste sector that allows the products of wastewater treatments to comply with federal regulation relating to minimizing the amounts of pathogens and inorganic metals in the waste. Overall, Carlisle is able to do this through their National Pollutant Discharge Elimination System (NPDES) permit.

The system has proven to be reliable, and when accidents do occur, strict and efficient response teams are available to respond. All pipes flow downhill, which further reduces the risk of blockage. The physical infrastructure is separate from that of the stormwater drainage system, which causes the sewage treatment plant to not be overwhelmed by large amount of water after a storm event that could also be contaminated by harmful substances in the wastewater treatment system. Carlisle's sewage infrastructure is old, initially implemented in 1914. It was planned on being replaced after it reached its lifespan of about 50 years. However, it has been over 100 years since the infrastructure was replaced. In 2014, the Borough began planning a \$30-\$50 million project to replace the aging infrastructure, which would result in higher costs for consumers: specifically, a 6% rise in sewage rates. Carlisle does not receive public funding to improve sewers. Instead, the Borough must borrow money or use money in the \$3.3 million sewer reserve fund to finance the project. This improvement of infrastructure is expected to be completed within the next 10 to 15 years, and will serve the Borough for an additional 50 to 75 years.

The wastewater facility meets the regulations set forward by the PADEP and the EPA. With a recent \$18 million upgrade in 2012, the facility currently also meets regulations complying with the Chesapeake Bay initiative. This compliance is paramount because the water that the plant discharges flows into the Susquehanna River and eventually into the Chesapeake Bay. The wastewater expelled by the system could affect a wide range of areas if not addressed and treated properly. There is no available evidence that suggests Carlisle has not been in compliance with any regulations imposed upon the Borough.

There is also a wastewater plant laboratory, which is in charge of making sure all discharges meet regulations set forward by governmental regulations. This sector is also in charge of regulating and inspecting large users of the sewage system to assure that all pre-treatment measures and regulations are followed on consumer's ends. By doing this, the treatment process, sewage treatment workers, and the surrounding watersheds all are protected to a higher degree. The major customers for the Borough of Carlisle include industries and institutions such as Frog Switch, Carlisle Syntec Systems, Hoffman Materials, Orograin Bakeries Manufacturing, Giant Foods, and Dickinson College. This laboratory is funded sustainably through collecting money from consumer's infractions, fees and fines. The lab also generates funding by testing other township's infrastructures and sewage.

The Borough's waste system relies upon pipes that access all regions of the community. There is only a single pipe in most cases. This has the potential to produce problems if blockage or leaks

occur, as there are lack of detours that the wastewater can take to avoid these blockages. No data exists signifying the last date at which the Borough's wastewater contingency plan was updated, reducing the sections score to a 4. According to the director of Public Works, Mark Malarich, such blockages occur roughly 6 times a year, primarily in winter months when temperatures drop. However, there are response teams and staff and equipment prepared to respond to such an accident, and response times are immediate, within 10 to 30 minutes depending on the time of day. All waste infrastructure requiring electricity inputs have dedicated generators. Backup generator systems provide necessary backup power to the infrastructure if needed, causing minimal reliance on grid power and transportation of the physical wastewater to occur within the system. Pipes have a 7 million gallon capacity per day, and are only filled to 3.5 million gallons per day regularly, leaving a large margin for overflow and increased capacity or usage. This should allow for accommodations in relation to wastewater treatment continuing as normal if there was a surge in water that needed treatment. This is vital in the brownfield sites redevelopment, for the added infrastructure and developments in these areas will produce more wastewater, which will need to be treated.

Carlisle does not have to expand current infrastructure capacities to compensate for this added draw. However, a recent study done by a private engineering firm found that excess water that entered the sewer system through groundwater infiltration and runoff diluted the system, causing higher levels of certain chemicals to be used. This had negative impacts on the environment, including on certain microorganism counts. During heavy rain events, the total amount of water entering the system increases drastically, up to 12 million gallons of water per day which is 5 million gallons per day higher than the maximum amount of water the system and current infrastructure can reliably handle.

This study sparked a 10-year capital improvement plan, costing between \$30 million and \$50 million, which is largely focusing on fixing broken connections between pipes, removing any plants that have grown into the system and to seal any leaks that may be in the pipes. These tasks would minimize the amount of water that inadvertently leaves or enters the system. The Borough is hopeful that they do not have to replace any entire pipes, causing the extent of the project to be less invasive and less expensive than the alternative. This would hopefully provide the Borough an additional 50 years before the entire sewage infrastructure would have to be replaced. The wastewater treatment facility has operated for 219 consecutive months without an infraction on any of the guidelines set forward by the PADEP, the EPA, and the Chesapeake Bay Initiative. There appear to be a lack of plans specifically talking about how a disruption in the sewage transportation or treatment system should be addressed on a Borough level, however.

Limitations: The number of years since the city's wastewater contingency plan was updated was not known. Specifics plans talking about how wastewater treatment operations would continue after a shock event were also lacking. There was some confusion in separating information about stormwater sewers from sanitation sewers in some instances.

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#### **UTILITIES**

Carlisle Borough has a very robust utility network. Power lines, potable and wastewater pipes, and landfill capacity, are all able to handle high demands. As described in more detail below, the proactive measures taken by Carlisle to develop in a goal-oriented and sustainable way do not seem to mesh well with PPL's contract by contract demand. Dickinson will soon add its own solar generated power to the grid, adding a degree of diversity in terms of power generation.

Carlisle relies on one source, the Conodoguinet Creek, for all its potable water. Comprehensive evaluation of water demand and system needs normally take place every five years, however, they have recently taken place annually. Perhaps this has been influenced by an unpredictable and changing climate, and events such as the Flint water crisis. The new water plan is to be released soon. Should Carlisle suddenly need an alternate water supply, its pipe infrastructure is connected to neighboring municipalities. The plan for wastewater management is less robust; however, it serves the Borough effectively. The Borough reacts to issues with outdated equipment as it is discovered, as less forward thinking has been devoted to the wastewater sector.

Household waste infrastructure has undergone progressive planning as well. In an effort to incentivize reduced household waste destined for a landfill, the Borough's contracted waste management collectors only pick up city specific bags. At \$3.50 each, consumers are hopefully incentivized to use them wisely. Recycling is free, and composting is available depending on the resident's proximity to Dickinson's campus-wide bins.

There has been no strategic, city-wide planning for the electricity infrastructure required to meet the changing needs of the Borough into the long term. Because there is no city electricity plan, this category was ranked at a 1. Electricity and power is supplied by PPL and United Gas Improvement (UGI), two companies that contract independently with borough residents and businesses. These companies work within Carlisle's Municipal Authority's jurisdiction to keep electrical infrastructure current and working to capacity. PPL performs regular checks of all equipment and electrical infrastructure, and failures are dealt with on an as-needed basis. When capacity needs to be increased for any number of reasons, including expanding a business or a new warehouse development, the company requires consumers to submit a proposal of the intended electricity consumption so that infrastructure such as lines and transformers may be updated and analyzed for PPL's ability to provide the needed amount of power. More common infrastructure, such as poles, are replaced when the need arises, for instance when they begin to rot. Although PPL did not disclose details about their strategic plan for providing consistent services to Carlisle into the long term, they confirmed that systems are in place to evaluate and examine all electrical infrastructure on a regular basis, with no intent of limiting capacity or failing to upgrade necessary components.

Because Pennsylvania operates under PPL, the third-party supplier is in charge of power generation and distribution. There is one substation in downtown Carlisle that transforms the high voltage electricity into electricity that can be used by the general public. This energy is sent out from the substation in a radial network, spreading out over the greater Carlisle area. The PPL generated electricity is the main source of electricity distribution in the Borough. PPL sources their power from approximately 65 different supply sources, giving Carlisle's diversity in electric systems a score of 4 (PA PowerSwitch). There is a solar panel field near the Bellaire Elementary School and a planned solar field to be constructed in a current field near Dickinson Park recreation facility. These will also add power to the grid, which PPL and SolarCity will help finance, adding some degree of variability and diversity to the energy system. If needed, Carlisle's radial power distribution system could be converted into a grid system by connecting the ends of the system to neighboring Borough's power supply lines, adding electricity inputs from another source. There are backup generators in important parts of the Borough, including wastewater/water treatment and distribution centers and the hospital.

The water supply system is currently in the process of being evaluated, and a comprehensive evaluation will be presented in the coming year. This evaluation will examine current and future water requirements, taking into account the water source, storage, and delivery. The plan will look ahead 15 years (Mark Malarich), supporting a score of 4. The current Capital improvement plan is used to evaluate water supply every five years, but has recently been updated annually. This plan assures that all Borough residents receive potable water. It also informs of the measures taken to purify water, including infusing the water with chlorine, fluoride, and anti corrosive agents.

The Borough relies upon the Conodoguinet for its water supply, and has done so since the 1870s. Although it is a single water supply, the river has never failed to provide adequate water. A large part of this is due to the nature of the river: it is a large river that has a lot of smaller tributaries, causing it to be less likely to completely dry up or be affected by an extreme event to the point where it would no longer supply water. The sheer amount of excess capacity currently experienced into the water distribution system is beneficial to the Borough. The 3.5 extra million gallons per day of potable water that could be distributed by the system but are not consumed is proof that there is some sort of buffer and resilience to the system. Because of this excess capacity, smaller dry periods will not have as large of an effect on water levels. Additionally, the Borough's water supply pipes interconnect with at least 8 other municipalities, allowing Carlisle to "borrow water" from these townships if the need ever arose. Because of this reliability, the water system is scored as a 5. Carlisle residents do not draw water from the ground via wells.

There is a limited plan for providing sanitation infrastructure into the long-term, leading the strategic plan to be ranked at 3.5. Current programs focus on maintaining the functionality of existing pipes and facilities, and are largely reactionary in dealing with outdated equipment. There has not been a long-term, city-wide plan for expanding or upgrading the existing waste removal system. However, between 2007 and 2012, a major construction upgrade project was undertaken and completed at Carlisle's wastewater treatment plant. This upgrade increased sanitation standards for wastewater and enabled Carlisle to comply with the Chesapeake Bay Initiative, a new set of mandated regulations for all watersheds feeding into the Chesapeake Bay. The sanitation plant is currently following guidelines set forward by this Initiative, the Federal Environmental Protection Agency, and the Pennsylvania Department of Environmental Protection, and has done so without an infraction in over 200 months. This causes there to be no reason to suspect sanitation patterns in regards to compliance with regulations will falter in the future.

However, it has been over 100 years since this infrastructure was replaced. In 2014 the Borough began planning a \$30 million to \$50 million project to replace the aging infrastructure. The Borough is planning on completing these projects in the next 10-15 years. Once implemented, the new system should last between 50 and 75 years before needing replacement. However, this added development will increase costs for residents. The excess capacity of the wastewater collection/distribution system allows for new developments within reason to be added without worrying about expanding the current water distribution and treatment infrastructure.

Switching gears to solid waste management services in the Borough, the strategic plan received a score of 4. In 1988, the state of Pennsylvania passed the Municipal Waste Planning, Recycling and Waste Reduction Act (Act 101). This required counties in Pennsylvania to prepare, adopt, and implement a Municipal Waste Management Plan within county boundaries. Counties must acquire permits to dump and have capacity to dump all of the county's waste within county boundaries. There must be a report each year detailing the amount/volume of waste recycled and disposed of in the county in the previous year. Carlisle specifically dumps waste in the Cumberland County landfill, located in Newburg PA, a nearby town. A company called advanced Disposal is currently contracted to head solid

waste/recycling waste collection. They are licensed under a three year deal which is set to expire in 2017. Although there are no apparent plans to shift from Advanced Disposal to a differing solid waste collection agency, it would be ideal for the Borough to have a longer-lasting plan. The Borough's plan to collect the municipal waste operates under a pay-as-you-throw system, with each bag for municipal solid waste costing the consumer \$3.50. Every household in the Borough receives curbside pickup using only these bags and free recycling bins.

The Cumberland County Landfill accepts many types of municipal solid waste, but can not accept: materials from renovations, human body waste, lead pipes, medical or other hazardous wastes, and recyclables. The landfill receives waste from all Cumberland County, and also areas in New York and New Jersey. They operate under strict regulations guided by the EPA to assure that the landfill does not pose a risk to the environment. Currently, the landfill is authorized to accept an average of 2500 tons of municipal solid waste per day, but accepts an average of around 2300 tons to maximize revenue without the chance of exceeding the limit. The landfill applies for permits to increase the total area that they are able to dump on when necessary - the most recent event of this happening in 2007.

There is only one solid waste treatment or disposal plant processing all of the solid waste generated within the city (Carlisle, PA Website. "Solid Waste Collection Info.") leading to a ranking of 3. This single wastewater treatment facility for the Borough is served by individual pipes. These individual pipes do have occasional blockages, but response teams react immediately and resources are always available for such situations. Carlisle has not had any experiences with past extended period of blockages in this distribution system in the past. An average of about 6 blockages occur each year. There are backup generators dedicated to keeping this system operational in case of an extended power outage. Advanced Disposal is currently the only collector agency that is permitted to collect the Borough's municipal solid waste and recycling. A Borough-specific document was published in 2014 detailing how collection of different wastes generated works, including: municipal solid waste, recycling, bulk item collection, and brush collection. The Borough has adequate means of collecting each of these item types.

However, there does not seem to be much diversity in either of the systems. There is only one entity in charge of each sector of waste disposal and treatment. There is no evidence for backup plans in place to address waste collection/treatment if something catastrophic were to happen that would render the current systems insufficient. Carlisle has not have a history of issues relating to this, but it would be ideal to have some sort of redundancy or diversity to provide a backup option. The solid waste is operational practically every day of the year, excluding 6 major holidays, which pushes waste collection back one day. All waste in the Borough is collected and distributed in a timely manner.

Regarding energy generation, transmission, and distribution, the systems operate within capacity the majority of the time, leading to a score of 4. There is sufficient redundancy to accommodate temporary demand surges in the short term. Emergency facilities such as hospitals and security offices have backup power supplies to ensure continued functionality in case borough-wide power were to fail. There is not sufficient redundant capacity to accommodate predicted growth of warehouses and other industrial facilities without expanding infrastructure. These expansions are completed as new developments are planned and constructed. The power company has thorough and effective strategies to grow as the market grows, however, expanding gradually as needs present themselves.

Currently, PPL's electricity supply is above peak demands, causing power outages due to surplus load on the electricity distribution system to occur very rarely. Expanding capacity of current energy distribution and generation systems by upgrading old infrastructure to modern technology also helps assure that infrastructure is replaced on an as-needed base. This causes fewer repairs to vital



infrastructure because it is being regularly maintained. However, energy utilities still need to be repaired when they break, which happens infrequently. Specifically, these instances occur largely due to car crashes, tree falls and intense weather events.

As a state, Pennsylvania is looking to decrease non-renewable electricity usage. This will be accomplished by providing alternative renewable energy providers incentives that offer competing prices to outdated, polluting, and more costly fossil based sources. Carlisle takes advantage of this new shift, specifically in terms of solar power. Dickinson College, one of Carlisle's main power consumers, has plans on reducing overall power consumption, with the ultimate goal of going climate neutral in the coming years. Their soonest approaching deadline is in 2020 for meeting a 25% reduction of their environmental footprint; electricity consumption makes up a large percentage of this footprint. These initiatives also help address the issue of reducing electricity bills for everyone. Specifically these target reducing the bills of the lower class. Pennsylvania's Low Income Usage Reduction Program, which originally intended to reduce bills, has also reduced power consumption up to 16.5% on average in 70% of households. Although this is a statewide program, results can be applied specifically to Carlisle Borough. Despite these efforts, there is still much to be done to reduce demand and improve methods of maintaining spare capacity. This room for improvement led to a score of 2.5.

There are superior amounts of excess capacity built into Carlisle's water distribution system. The Borough's water supply demand on any given day is 43% of the total system capacity (Carlisle's 2015 Annual Water Quality Report), supporting a score of 5 for this section. Although Carlisle's water treatment plant has the capacity to withdraw 9 million gallons per day of water from the Conodoguinet, the Borough is regulated to only withdraw 7 million gallons per day. The Borough uses only 3 million gallons a day of water, leaving there to be around 4 million gallons per day of spare capacity in the water treatment and distribution systems. This is very great for the Borough, as the current water infrastructure can easily handle new developments that require large amount of water inputs. It also allows for excess water to be used in case of emergencies (for instance a large fire) without putting other areas of the community at risk due to a water shortage. It also helps make the Borough more drought-resistant, as the total water level in the Conodoguinet can drop significantly without impairing water withdrawals, as there is a large amount of excess capacity. Additionally, emergency interconnects with South Middleton and North Middleton Townships can supply the Borough with up to 1,500,000 gallons of purified water per day in the event of an emergency. This is insufficient to meet typical Borough demands, but is adequate to ensure that vital community assets, such as hospitals, remain functional.

There are no apparent plans to reduce borough-wide water consumption in non-essential periods. During periods of drought when the Conodoguinet Creek's capacity is lower than usual, there are conservation effects and requirements in place on a Borough wide scale. These inefficiencies, and lack of thought when the Borough has shown clear insight to elements of its infrastructure leads to a score of 3. These efforts include reducing the amount of times per week water is used to water lawns and gardens. Other measures are put into place but are more voluntary. Dickinson College's ALLARM researches water conservation techniques and educates the public on how to implement these in a way that benefits the community's environment. There are numerous regulations in place that address consumer's effects on the water supply, including improper treatment due to exposure to excess nutrients, fertilizers, or pollutants. While these don't necessarily address the issue of reducing demand in the Borough's water supply, these regulations help inform how water is viewed as a precious asset to the community and how it is important that this resource is conserved by not rendering it useless to human consumption via contamination.

There is not much evidence for a lot of attention being paid to improving efficiency of the system or increasing spare capacity as the Borough has not identified either of these issues as major threats to the community. Cumberland County's 2014 Hazard Mitigation plan talks about how the Borough should respond to droughts, with different stages and plans corresponding to different severities. This details specifically which community assets should receive water supplies and which should have their supplies reduced, as well as what risks the drought poses to the community.

There is excess capacity in Carlisle's sewage treatment and other sanitation systems. No sewage is left untreated on a daily basis. Similar to the excess capacity experienced with the water distribution services, Carlisle currently has twice as much capacity for sanitation services than Borough residents normally consume. On a daily basis, Carlisle's wastewater treatment facility treats 3.5 million gallons of wastewater per day, while it has the total capacity to fully treat and transport 7 million gallons per day. This spare capacity is superior to the point where there would be no problems related to accommodating the added amounts of sewage and wastewater produced by new developments within reason. However, Carlisle's sewage infrastructure is aging and as a result needs to be replaced. This is a costly project, but could also increase total capacity for sewage and wastewater treatment infrastructure if desired by the Borough. There are planned projects to lengthen the life of current Borough wastewater transportation systems without having to fully replace the infrastructure. This section relating to sewer system capacity earns a rating of 5.

100% of the population has access to regular solid waste collection, and the Borough has put in superior thought into its waste collection and minimization system, and rated as a 5. Currently, the Cumberland County Landfill accepts an average of 2,300 tons of municipal waste per day, which is 200 tons of municipal solid waste per day under the upper limit of an average of 2,500 tons per day. This operation also has a daily maximum of 2,900 tons of waste per day. The landfill operates within these guidelines at all times. There is significant capacity built into this system to accommodate for fluctuations in total waste volumes, and also developments to a certain extent. Even on days where collection is doubled due to no municipal solid waste being collected the prior day, boundaries related to total volume of municipal solid waste collection are not reached or passed. If needed, the landfill could accept less municipal solid waste from out-of state deliveries and instead focus on first collecting all solid waste in the Borough, then outsourcing to fill the rest of the average daily maximum loads from out of state consumers. This is an ideal system, as Carlisle Borough's municipal solid waste collection is addressed, while the landfill maximizes profits in both scenarios.

There are limited programs in place to promote recycling as an alternative to disposing of items in Carlisle Borough. Because of this lack of alternative strategies in place to reduce demand on treatment and landfill facilities, this section was scored at a 2. Currently, a lot of items that are disposed of have recycling potential, but have instead been thrown out. The Borough has published a Residential Recycling and Disposal Guide which hopes to educate residents on specifically what and how to recycle. The Borough offers services to dispose of all recycling types, including paper, glass, metal, and electronics. There is also a brochure on Solid Waste and Recycling in Carlisle that addresses specifically which items can and cannot be recycled and also how the Borough's compost facility works. All of these initiatives together attempt to slow the amount of waste being generated and dumped into landfills, while simultaneously generating benefits in other sectors of the community.

Recycling and composting both have large benefits for Carlisle, which is why it is beneficial that Carlisle is engaging in these methods. Composting in Carlisle is largely in relation to Dickinson College. There have been issues with residents in Carlisle disposing of waste on streets, specifically in the form of large bulk items. This goes against Borough policy for two reasons: firstly, residents are allowed only one bulk item to be disposed per week, and secondly, all waste must be in regulated bags.

Carlisle has imposed a fine for residents caught violating this rule in an attempt to slow the total amount of municipal solid waste produced.

Regarding electricity and power in the Borough, upgrades to electricity infrastructure happen frequently. When upgrading old infrastructure to accommodate new developments that require a larger amount of energy, the infrastructure is replaced. This prolongs the system's lifespan without waiting for it to fail before replacing it; this is evidence of successful proactive management. If infrastructure were to fail, it would be addressed in a very timely manner, in a period of an hour to a day. These areas are addressed on an importance basis: areas that are more vital and critical to the Borough's functionality are addressed first. Most issues are addressed ahead of time as teams identify issues with infrastructure such as rotting poles or fraying wires. However, some events such as squirrels or other rodents getting into infrastructure, cars crashing into poles, or trees falling and breaking wires, damages infrastructure to the point of necessary repair. PPL is well prepared to address these issues as they are detected. This active monitoring and maintenance of electrical infrastructure earns a score of 4.5. The average length of electrical interruptions is 8.5 hours/year/customer with PPL (PPL Electric Utilities Website. "Maintaining Reliable Services").

Carlisle has a hazard mitigation plan, most recently published in 2014, that talks greatly about hazard risk assessments for the Borough specifically. There are sections in the plan that talk about: local hazard mitigations, risks from natural hazards (floods, fires, storms, drought, earthquakes, sinkholes, and more), risks from anthropogenic sources (dam bursts, nuclear meltdown, transportation accidents, and more), and ways to respond to these hazards. This plan is discussed every year during meetings of the plan committee, and is updated at least once every two years. This plan talks about the effects of severe winter storms on electricity, but does not have input on how the Borough should address these issues on a specific basis. While no direct hazard risk assessment tests are done, these issues are thought about and the Borough determines the most accurate way to respond to these threats.

For example, in the past, the Borough has attempted to solve some issues by utilizing underground electricity infrastructure, but in the long run this was less effective than the prior method as it was more invasive, more costly, and not as helpful as it was planned on being when planned and implemented. This caused the Borough to respond to this issue and revert to the old technology. There are plans in place on how PPL will respond to emergency recovery and maintenance of systems on a local level, specifically related to distribution services. This does not cover generation sources, such as the substation or any of the solar panel arrays in the Borough.

As discussed above, water monitoring is an important initiative in Carlisle. This section was scored at a 4 for the reasons discussed below. A lot of attention is paid to maintaining the quality of the Borough's water supply. The Borough has identified and acted upon certain protective measures necessary to assure that the watershed remains in high quality via the Annual Water Quality Report's findings. These measures include: addressing problems with nonpoint (general) source pollution, continuing to regulate industrial and municipal pollution and discharges into the river, and reducing agricultural runoff into the Conodoguinet. ALLARM monitors local water sources and helps plan and implement restoration projects to benefit these sectors. Education of community members is a large part of this operation as well. Carlisle's water distribution infrastructure has all been constructed and operated under the regulations put forth by the PADEP. Emergency response programs in response to hazards that might affect the water distribution system in Carlisle are relatively lacking, however.

There is a one day backup supply of water in the water tower, located by the Borough's high school. The Borough can also receive some water from neighboring boroughs who siphon water from different sources, but this reserve would not meet Borough demands without curtailing consumer's water use. Carlisle has a hazard mitigation plan, most recently published in 2014, that talks greatly

about hazard risk assessments for the Borough specifically. There are sections in the plan that talk about: local hazard mitigations, risks from natural hazards (floods, fires, storms, drought, earthquakes, sinkholes, and more), risks from anthropogenic sources (dam bursts, nuclear meltdown, transportation accidents, and more), and ways to respond to these hazards. This plan is discussed every year during meetings of the plan committee, and is updated at least once every two years. This plan talks greatly about how the Borough should protect its valuable water resources from possible disasters. It also talks about the Borough should protect itself from various water-based hazards such as floods.

Following the discussion of water is the topic of sanitation, which was scored at a 3.5 due to the extent to which there are effective monitoring, maintenance, and emergency response plans. Carlisle's sanitation services for solid waste are evaluated on a three year basis. Carlisle's provider, Advanced Disposal, was chosen in 2014 so there will be another evaluation of deciding the Borough's service provider in 2017. This provider is chosen on the basis of the lowest bidder whose practices are deemed safe, responsible and reliable. The Borough's wastewater treatment facility operates under strict guidelines and the water is monitored and tested on a yearly basis. These companies that oversee operations currently produce a yearly report. Carlisle's report shows no signs of infractions of regulations. The Borough has a backup plan to treat and transport wastewater if power is out. This plan relies on the use of emergency generators. The distribution of wastewater does not need electricity inputs, as gravity is the driving force behind the flow of the water.

There seem to be no backup plans in place to address issues of permanent blockages or disruptions in the wastewater transportation system. The main way that the Borough responds to these issues is by physically replacing the infrastructure sections or clearing the blockages. This process is effective but invasive, and does not allow for wastewater to flow through the system while the repairs are being addressed. Carlisle has a hazard mitigation plan, most recently published in 2014, that talks greatly about hazard risk assessments for the Borough specifically. There are sections in the plan that talk about: local hazard mitigations, risks from natural hazards (floods, fires, storms, drought, earthquakes, sinkholes, and more), risks from anthropogenic sources (dam bursts, nuclear meltdown, transportation accidents, and more), and ways to respond to these hazards. This plan is discussed every year during meetings of the plan committee, and is updated at least once every two years. Sanitation sources are briefly discussed as possible terrorism targets, which has caused strict regulations about access to the plant and technologies to ensure function. Otherwise, sanitation services are not a huge topic of discussion in the plan.

Regarding solid waste within the city, a company called Advanced Disposal is in charge of collecting and dumping all of Carlisle Borough's municipal solid waste. They adhere to strict guidelines in terms of when and where to pick up waste, what kinds of waste to pick up, how much they can pick up at a time and in a day. The 1988 Municipal Waste Planning, Recycling and Waste Reduction Act requires counties to: prepare, adopt, and implement a Municipal Waste Management Plan within county boundaries, acquire permits to dump and have capacity to dump all of the county's waste within county boundaries, and publish report each year detailing the amount/volume of waste recycled and disposed of in the county in the previous year. The collection company, Advanced Disposal, has published waste collection and recycling guidelines for Carlisle PA. Largely, these focus more on the measures Carlisle residents must take to dispose of materials responsibly, however. This education is important, and ensures that hazardous materials that the landfill cannot accept do not end up in this area.

Advanced disposal is legally bound to monitor the state of the landfill via regulation by the Environmental Protection Agency, to assure minimal risks are impacted on the environment. They also offer many services that that help improve the environment: the main one by burning methane

produced from the landfill to generate electricity. Workers at the facility are all skilled in relevant areas. There is no evidence that Hazard risk assessments occur on regular intervals to specifically address hazards and long-term risk scenarios related to the landfill. The Hazard Mitigation Plan, which is updated every two years and is discussed, provides the Borough some degree of hazard risk assessment. However, solid waste systems are not mentioned in this plan. Also, there is very little redundancy or diversity in the system, which could pose a risk in case a catastrophic event caused the municipal waste system currently in place to be rendered incapable of responding to Borough demands. Because of this, the solid waste system's resilience received a score of 3.5.

All of the aforementioned utility services contribute to Carlisle's critical assets, which were last assessed three years ago (Carlisle Borough. "The Borough of Carlisle Brownfields Area-Wide Plan"). The Borough's assessment of critical assets received a score of 4.5 for the following reasons. There is a very comprehensive list of the county's critical facilities that deserve extra attention in events of extreme circumstances in the Carlisle Hazard Mitigation Plan. These assets include municipal office buildings, medical centers, schools, firehouses, sara facilities and more. There is also a section of this plan that identifies each asset's vulnerability to the hazards that Cumberland County is at risk of experiencing. This plan is updated every 2 years at the most and is reviewed by the committee that published it on a yearly basis. There is a list of ways to mitigate these risks in the plan under the Mitigation Action Plan section. These action plans range from developing flood intensity indicators to identifying areas in the community that are at high risks of flooding to beginning to identify future sinkhole events. These mitigation strategies are arranged by the type of hazard that the boroughs are at risk of. Carlisle is hopeful that they can address all of the 31 identified mitigation actions within a five-year cycle from conception of the plan, which would be by 2019. This document is public, but there is no evidence that it has been communicated to the Borough's emergency responders directly.

Emergency standby power is another element of community resilience, and received a score of 5. There are backup power supplies for the Borough's critical assets. These assets include wastewater and water treatment and distribution facilities, hospitals, and critical data centers. 100% of Carlisle's hospitals have back-up electricity generators (Tom Grosz). Most of the time (at least in regards to data centers) the generators are always running and can be switched to immediately when necessary, causing the data systems to experience no downtime. In areas that require constant running, these backup generators are vital to functionality. There is nothing indicating that these backup power generators are insufficient to provide adequate power for the assets that rely on them in times of need. Some of these facilities, including medical centers, would not be able to regulate temperatures without power from the grid, would could cause certain populations such as the young or elderly to be at a higher vulnerability of developing certain diseases. Emergency shelters have been identified that these populations can go to in times of need. Certain facilities have capacity for alternative power sources too, including oil and wood. However, the individual consumers are responsible for purchasing and operating these sources, not the Borough.

The Borough's back-up water supplies are less extensive, receiving a score of 4. There are, however, a wide array of mechanisms in place to provide backup water supplies to the Borough in case of an emergency. The Borough has a water tower that holds a one day supply of water at all times and can restrict access to all non-vital places if water conservation is necessary. The current infrastructure is connected to other borough's water systems too, which allows Carlisle to receive water from these boroughs to distribute to vital assets, such as schools and hospitals, if necessary. The Borough prioritizes supplying these vital community areas with water over other sectors, and addresses issues with the physical infrastructure first in an emergency. The Borough has experienced no issues in the past five (plus) years in providing Carlisle with adequate amounts of water services, even after major

events. Ideally, there would be more redundancy in this water distribution system, as the current system relies on a relatively non-diverse network of plans and systems.

Limitations: The only large limiting factor that stands out as an issue is the Borough's contracted PPL power provider. The Borough seems to have little control over the planning aspects of PPL's business plan. Where Carlisle has painstakingly and comprehensively planned the future goals of their infrastructure, PPL seems to be less compatible with their "as needed" expansion. The percentage of defined medium- to long-term waste management service contracts is not known. The average annual hours of water service interruptions per household is not known. The waste generation rate per capita is not known. The average annual residential electrical use in kw hours per year per capita is not known.

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## **ENVIRONMENT**

The relationship between Carlisle and its environmental surroundings is adequate. There are numerous environmental draws for people in the community, including hiking and fishing. These also help draw tourists into the Borough. The Borough also has very fertile farmland soil, causing agriculture to be a major industry in the Borough and also overall in the valley. There have been many efforts taken to protect the natural environment, including the water and the soil, from degradation. These efforts can be seen in the Urban Redevelopment Plan sections pertaining to redevelopment of the brownfield field and in the work completed on the LeTort Spring Run, which it runs through the downtown area of the Borough.

There are also many regulations in place to ensure that Carlisle does not adversely affect its environment. Stringent regulations monitoring pollution of sewage treatment plant emissions and farmland practices are imposed on relevant entities in the Borough. These regulations are monitored by the Environmental Protection Agency, The Chesapeake Bay Initiative, and the Pennsylvania Department of Environmental Protection. Carlisle has done a great job in listening to the public and implementing projects that the public desires, including more parks. There is also talk of increasing the extent of the downtown trail system to ease connections to other plan in the Borough and also townships by alternative modes of transportation.

Ecosystems within and surrounding the Borough have been identified and evaluated to various extents, earning this section a score of 4. Statistically, only 18.05% of natural areas within the city have undergone ecological evaluation for their protective services (Carlisle Borough. “Carlisle Maps and Analysis”). For instance, many of Carlisle’s features have been noted for their scenic beauty, including nearby mountains, waterways, and parks. This is very beneficial for the outdoor recreation-seeking residents as well as tourists who seek out Carlisle and the rest of the Cumberland Valley as a place to fish, kayak, and hike on the Appalachian Trail. The three close by state parks (Michaux, Tuscarora, and Gifford Pinchot) have also been identified as valuable outdoor resources, and are destinations for locals as well as visitors to the region. In terms of Carlisle’s appeal to agricultural practice, the region surrounding Carlisle has incredibly nutrient-rich soil, making it very desirable for farming (from small to large scale). The region’s nutrient-rich soil is due to the rock composition in the overall Cumberland Valley. The relatively flat landscapes and easy access to a number of small streams complement the practice of agricultural and help make Carlisle a prime location for farming. As a result, Carlisle’s residents have access to an abundant supply of local food. This benefits the community and local economy by supporting local farmers and keeping money in the region. Every Wednesday during the harvest season in downtown Carlisle, there is a farmer’s market (Farmers on the Square) where local vendors sell a variety of produce, including fruits, vegetables, breads, and more to local residents.

Carlisle has invested in its environment through many programs and initiatives over the years, including pursuing green infrastructure developments, expanding and restoring parks, improving stormwater management programs, and restoring stream habitats. Unfortunately, the Borough has a relatively small footprint, and has little to no new green space that can be developed or preserved. This means that all environmental-based projects have a space confinement, and innovation is critical in developing environmental infrastructure and assets. This is one reason why the Borough’s brownfield site development is critical - Carlisle has space to implement projects that have potential to improve the environment.

Water, however, can be found in abundance within the Borough. There are many efforts in place to protect and improve this important resource’s quality long into the future. The value placed on local water systems such as the LeTort Stream and Conodoguinet Creek (both of which run through Carlisle), manifests itself in the form of water ecosystem maintenance in multiple spheres of life in the Borough. The Alliance for Aquatic Resource Management (ALLARM) is an important asset, organized and run through Dickinson College. ALLARM has monitored the LeTort since 1996, providing water quality data for the stream over a significant period of growth and change in the region. This data has sparked efforts to improve water quality through a number of initiatives, which include reducing stormwater pollution, working to educate youth, and designating official stream restoration sites. Stormwater pollution is one of the leading sources of non-point pollution in the state of Pennsylvania, causing stream health degradation and in turn affecting other aspects of the ecosystem. Stormwater in Carlisle comes from storm drains across town, concentrating untreated discharge into two small and vulnerable streams, one of which being the LeTort. The Borough of Carlisle recognized this as a threat to community health, and partnered with ALLARM to develop public education and participation initiatives and to ensure compliance with the Borough’s Municipal Separate Storm Sewer System permit. Now the partnership also includes Cumberland Valley Trout Unlimited and LeTort Regional Authority. There are now “Adopt a storm drain” programs and rain barrel workshops on a regular basis to help involve community members in the process of preserving environmental assets within the region.

Carlisle’s 2015 annual water report formally addressed the protective measures the Borough is currently taking to protect its watershed, specifically including issues of non-point source pollution of

water. It also recommends future actions Carlisle can take to protect this resource. At King's Gap, a nearby state park, local residents can learn important environmental lessons while experiencing a pristine environment close to home. King's Gap and its education program are not located directly in the Borough, but the services they provide are utilized by Borough citizens and tourists who spend time in the Borough. It should be noted, however, that despite many flourishing environmental protection programs in and surrounding Carlisle, there is little information or analysis of how individual ecosystems and resources provide specific protective measures to the region.

Ecosystems have also been considered alongside man-made infrastructure in some cases in order to develop strategies to physically protect the city, earning a score of 4. Carlisle has attempted to implement the best management practices possible in order to decrease the amount of flooding that the town experiences. Preventative projects have been completed that protect the LeTort Spring Run from flooding into the downtown area where the stream runs directly through. This preventative measure has been approached from a government-initiated standpoint. Officials encouraged residents to facilitate rainwater infiltration by constructing rain gardens using native plant species. Infiltration is the ideal approach to return rainwater to the groundwater table, as it reduces the amount of overland flow into small streams and rivers, altering river systems by introducing excess nutrients and chemicals. Rainwater infiltration lowers the impact of major rain events on natural systems within the Borough. In areas with high surface runoff or stormwater drain usage, water is input directly into streams, where it impacts stream or river currents intensely, but for a shorter amount of time. Finding a way to develop without creating stormwater runoff is a major challenge, especially due to the fact that Pennsylvania is the most flood-prone state. For these reasons, Carlisle has put a lot of effort and focus towards stormwater management. In future developments such as the brownfield site projects, the Borough plans to implement added stormwater infrastructure.

Pennsylvania has had to adjust to more frequent major flooding incidents. A change in development patterns to account for the total increase in stormwater runoff is taking place, partly because stormwater management is an important issue that developers must account for. In Carlisle, such processes are taking place in the form of tree planting in the local LeTort park to facilitate infiltration, valley meadows, and riparian buffer projects. The Municipal Separate Storm Sewer System (MS4) also helps address this issue. The MS4 goals largely refer to regulating the amounts of pollutants that are expelled by a system, an effective means of targeting point source pollution. The Borough also encourages Audubon certified wildlife habitats in residential backyards. This initiative largely looks to increase the amount of native species in an area in order to conserve and restore appropriate ecosystems. All of these programs and initiatives function to ensure that valuable areas of Carlisle's environment, focusing primarily on the Borough's soil and water, are protected by municipal development projects. That said, there is an apparent lack of documentation or analysis of how other elements of Carlisle's physical environment benefit the Borough.

The extent to which these protective ecosystems are protected is satisfactory but not optimal, earning a score of 4. Warehouses in Carlisle must abide by the Department of Environmental Protection MPDS permits, which seek to minimize industrial effects on surrounding environments. Largely this focuses on their emissions in regards to pollution and also on physical waste products. The emissions from Carlisle's wastewater treatment facility are also heavily regulated in regards to pollutants. This is in order to ensure that the aquatic ecosystems are not affected by the possibly harmful byproducts of the system. Biosolid sludge is also produced following these strict guidelines. A "fee in lieu of" program is also in place, which requires mandatory dedication of parkland or funding to use for development of recreation assets as mandated by ordinance. As the Borough develops the brownfields sites, there will be more green spaces built into the Borough. This serves many services, but the main



ones are: getting people active in order to increase their health levels and bettering the physical environment.

Carlisle's federally designated wetlands are protected through the Army corps of engineers' services. There is also an extensive bike and pedestrian network through downtown Carlisle, right along the LeTort Spring Run. This provides people access to popular fishing spots. There are plans to connect this trail to the rail-trail that stretches from Newville PA to Shippensburg PA, adding an extra 13 miles of trail for pedestrians and cyclists in Carlisle. There has been no major destruction of Carlisle's environmental assets (streams, soil, etc.) recorded. There are plans in place to better certain areas of Carlisle's environment, including stream buffers and the LeTort Spring Run trail, as well as expand current trail systems to connect to other townships. These plans are spelled out in the Carlisle Urban Redevelopment Plan.

There seem to be no official documents in place that discuss Carlisle's efforts to protect whole ecosystems from natural threats, and only 4.22% of the city area is officially recognized for environmental protection (Carlisle, PA Website. "Facilities/Parks"). Most of the ecosystem protective services are in regards to human caused pollution and possible environmental degradation. There also is no evidence or documentation of any important protective ecosystems that have been disrupted or altered over the past 15 years. Carlisle is definitely looking towards protecting its current environmental services in future developments.

There seems to be a lack of general awareness of bigger ecosystem services present in Carlisle, and it has been 3 years since a thorough assessment of the Borough's ecosystem assets/services, leading to a score of 3. There is a general understanding of the importance of the impact environmental features can have on the community. These services include how Carlisle is spending larger portions of municipal money on water management, specifically by removing harmful nutrients from waterways. However, there are no comprehensive plans to document and bolster this list. The use of more native plants in household gardens to strengthen the native ecosystem has become a more common practice among Carlisle residents. The Audubon certified wildlife habitats project, encouraged by the Borough, has similar motivations.

Carlisle's comprehensive plan is the most recent publication that talks generally about how the environment should be taken into account in considering the future of the Borough. Broadly, this document hits on points relating to how road and neighborhood development affects the environment, and also how attractive areas of the environment (for scenic/recreational reasons such as hiking or fishing) should be preserved. Carlisle does want desire to alter the environment when planning and implementing future developments.. Thus, Carlisle has identified the importance of connecting residents and tourists with the environment.

There is a good level of ecosystem protection via regulation, earning this section a score of 4.5. An example of this regulation is the Department of Environmental Protection MPDS's permits on warehouses. There are also harsh regulations imposed on the wastewater treatment facility that relate to the attributes of the plant's byproducts. They operate in cooperation with guidelines from the Chesapeake Bay Initiative, Pennsylvania's Department of Environmental Protection, and the Environmental Protection Agency. These guidelines are very actively enforced with aquatic pollution levels being analyzed on a yearly basis. There have been no issues with water pollution stemming from the wastewater treatment plant's practices in the past 200+ months. Carlisle has relatively high levels of air pollution due to the amount of car travel that passes through the Borough to warehouses and also that bypasses the Borough on I-81 and I-76. The Borough has attempted to decrease these levels by preventing trucks from idling in the downtown areas for extended periods of time. Decreasing congestion in the downtown area by detouring trucks around the dense downtown area and by planning

to improve transportation infrastructure to decrease travel times are projects the Borough has embarked on that also help with this goal. In conjunction with the various restoration projects occurring around the Borough, it is apparent that Carlisle is definitely focusing on bettering its environment.

Compared to neighboring towns, Carlisle is superior in policy implementation. Carlisle implements many policies, especially ones relating to strengthening connections between the Borough and the environment. For example, both the bike and pedestrian plan and the road diet have been completed in full. There are also plans in place to bring back native species to the Carlisle area - specifically through the lens of incorporating native plants to combat invasive ones that have taken over the area. This is practiced in gardens and on the ecosystem level. One specific example of this is in riparian buffers ALLARM oversees. There has been no apparent recognition of how biodiversity might be strengthened by connecting the Borough to surrounding green spaces.

Community members are highly involved in giving feedback for environmental projects. Programs for active management and restoration of important resources received a score of 4.5. Small community organizations are critical to getting things done. This was vital in the creation of Heberlig-Palmer park, which expanded green space in the Borough. Carlisle receives great amounts of funding to better the environment and to assure that quality of life of residents is not compromised by any of these projects. The Cumberland County planning department provides funding to Carlisle Borough, and Carlisle also receives state funding through Department of Conservation and Natural Resources, and the Department of Community and Economic Development. Carlisle also receives funding from various sources for specific projects, including PennDOT (for trail restoration and expansion projects) and the Environmental Protection Agency (for brownfields site development).

Limitations: The percentage change in the number of native species was not known. Specific programs and plans in place that describe the measures taken to protect the environment, especially after a shock are unknown.

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## **PROTECTIVE INFRASTRUCTURE**

Carlisle's Protective Infrastructure largely revolves around stormwater management, due to the Borough's vulnerability to floods in the LeTort Spring Run, the Conodoguinet Creek, and various

stormwater sewers overflowing after large storm events. Carlisle has experienced extensive flooding in the past, but the most severe flooding event occurred over 30 years ago. Many plans that the Borough has published, including the Hazard Mitigation Plan and the Stormwater Management Plan identify how specifically the Borough is at risk from any of these flooding related events. These plans list important assets to the community and how they are at risk of certain hazards. They also talk about how Carlisle should go about addressing these issues to assure Borough vitality is not compromised.

Carlisle has been granted large amounts of funding over the past few years to tackle issues relating to stormwater management. The Borough has used this money to finance helpful and impactful projects. Carlisle has not done much to identify projects related to protective infrastructure outside of the stormwater management umbrella. However, these other issues do not pose as large threats to the Borough as stormwater-related incidences do, which explains the difference in attention the sectors have been given. The Borough has identified the importance of protecting critical utilities and assets, such as the farmland environment and water resources, and has set forward protection strategies to ensure that these benefits are not adversely affected by Borough functioning.

The Borough's current protective infrastructure was ranked at a 3.5. It has been 3 years since the last city-wide review of the adequacy of the Borough's protective infrastructure assets. Carlisle is located in Pennsylvania, which is the most flood-prone state in the country. Thus, having adequate stormwater drainage infrastructure that is implemented and managed accurately and completely is very important to the Borough's functionality. Otherwise, stormwater drains are at risk of overflowing due to volume or becoming blocked due to debris. This has potential to cause rampant flooding, impeding daily lives.

There is a complete Emergency Operations Plan that is kept up to date, but it is not made available for the public. In this plan, there are details about the specific actions the Borough would take to respond to a catastrophic flood, in either the downtown area due to flooding in the LeTort or Conodoguinet or stormwater drains becoming non-functional. There is a county-wide Hazard Mitigation Plan, last updated in 2014, that identifies numerous possible risks that Carlisle could face as well as how the Borough can respond to them. The mitigation section of this document talks at great lengths about how these risks will be tackled, discussing greatly the protective infrastructures present in the Borough. This plan is reviewed every year and updated within a two year time span of when it was last updated. The main protective infrastructure system in Carlisle is the stormwater management system. There is a county-wide Stormwater Management Plan, published in 2010 that greatly conveys the specifics of Carlisle's extensive stormwater infrastructure. This includes the funding received for projects and specific goals and objectives of operations. The Borough currently maintains an extensive network of 27.6 miles of stormwater sewer.

However, there seems to be no documentation providing a complete overview of the Borough's protective infrastructure in addition to stormwater. This means that there are no regular assessments of these resources undertaken. There are also no explicit plans to develop a complete document that would attempt to specifically identify and protect all protective infrastructure components in Carlisle. Certain aspects of Carlisle's protective infrastructures are known, however, but not explicitly documented. For instance, Carlisle has very fertile farmland and is located in a valley which helps with rain water retention. There are other forms of action needed to be taken to assure Carlisle's natural resources are protected. This also falls under the broad category of protective infrastructure. There are numerous agricultural operations in the Borough, including vegetable and animal farms. These farms are poised to negatively impact surrounding ecosystems. One example of this is if there was excess nutrient runoff after a large storm event. There are numerous regulations in place to prevent mistreatment of animals and ensure proper farming practices, but fewer apparent regulations over nutrient runoff protecting

groundwater resources. Sections of the Carlisle's 2015 Water Quality Report, updated annually, talk about the dangers that these areas pose to water resources, as well as what protection activities the Borough is currently undergoing and should be implementing to assure watershed vitality. These measures are important to the Borough, because potable water is such a valuable resource.

On a county level, there are studies that have been conducted that have discussed natural resource access and protection. There are already measures in place to protect valuable natural resources to Carlisle, including preventing gas companies from implementing tanks too close to water sources and using land regulations to assure that resources are respected. The clean air board also passed an anti-idling ordinance recently, allowing a vehicle a maximum of 5 minutes of idling at a time. This allows the air to be cleaner, as less pollutants are entering it. By taking these measures, the Borough shows how they are attempting to protect valuable resources.

There are semi-thorough operation and maintenance regimes in place for protective infrastructure assets, leading to a score of 4, but it has been 14 years since the city's stormwater (or other protective) infrastructure has been inspected (Carlisle Urban Redevelopment Plan). There are a series of potential risks that require protective infrastructure in the Borough. The LeTort stream, which flows through downtown Carlisle, has the potential to flood, endangering the downtown community. The Borough has responded to this risk by encasing the river's banks in cement barriers. Dickinson College's Alliance for Aquatic Resource Monitoring (ALLARM) has done work to create and maintain natural riparian buffers that prevent major flooding from stormwater, while helping to maintain the stream environment as erosions decrease and biodiversity increases. The Emergency Operations Plan addresses these issues, and puts in place a protocol for dealing with such disturbances. Pennsylvania's Emergency Management Agency (PEMA) is in charge of overseeing hazard mitigation efforts. The specific branch of PEMA that oversees this is the Bureau of Recovery and Mitigation. PEMA's work is guided by many different acts, including the Federal Critical Infrastructure Protection Act, the Patriot Act, and Department of Homeland Security Directive, meaning many standards are operated and regulated to federal guidelines.

Cumberland County's Hazard Mitigation Plan talks about vital community assets and documents how at risk they are to various hazards, including flooding, earthquakes, and more. In Carlisle's risk assessment process, the final step taken by the Borough was identifying the impacts of natural or human caused hazard events on residents, buildings, infrastructure, and the Borough as a whole. The Borough was able to pinpoint specific areas that would be affected by hazards and plan the most acute, accurate, and cost effective ways of responding to the problems by doing an additional vulnerability analysis. Carlisle has identified critical assets of society (economic, social, and physical) through this process. The mitigation strategy section of the Hazard Mitigation Plan talks at length about how specifically important infrastructure assets in Carlisle are protected from hazards, clearly defining who takes actions and to what standards these actions should be performed for each identified goal/objective. While this information doesn't necessarily inform about the city's protective infrastructure, it still informs on how Carlisle responds and protects key assets that are vital to the community's resilience.

In the past few years, Carlisle has been granted large amounts of funding for infrastructure related projects. This has included a \$5 million grant from the U.S. Department of Transportation's Transportation Investment Generating Economic Recovery Grant program for development of the Borough's two brownfield sites. The funding is specifically geared towards transportation projects, but there will be increased stormwater parks in these areas, helping the Borough respond to issues of storm-related flooding. In Carlisle's 2015 budget, the Borough was granted an additional \$5 million to work on infrastructure that was depreciating in value. Overall, the Borough has had adequate funding for

stormwater-related protective infrastructure projects. However, funding for other types of protective infrastructure not relating to stormwater is not as abundant as it should be.

A robust stormwater management plan updated in 2010 provides specific language on how Carlisle should respond to issues of stormwater drainage on the street level. Because of this and other upgrades to protective infrastructure, this section received a score of 5. This management plan includes many facets of the issue, including keeping inlets/gutters and streets clean, keeping sediments from entering the waterway, and preventing nutrients and pollutants from entering the water system. If these issues are not dealt with, they all have proven negative effects on local ecosystems. These take the forms of human health hazards (flooding caused by poor drainage into sewers causes sanitation issues) and ecosystem functionality hazards (nutrients entering water can cause undesired algal colonies). To Carlisle, a functional stormwater management plan is fundamental to the public health, safety, welfare, and protection of the Borough's residents, their resources, and the environment.

Carlisle also reuses the captured stormwater as a resource to supply streams with a base level of water and also protect and maintain surface water quality. Initially, the stormwater management plan had trouble getting passed, but it was eventually passed and implemented. The plan is enforced, and anyone that violates provisions set forth must pay a fine. A significant portion of the Borough's general fund went towards public works funding, which includes stormwater plan management and implementation. Specifically, in 2015, \$136,000 was spent on stormwater management. An additional \$250,000 stormwater project was given money through governmental funding. Carlisle has also planned for an additional \$500,000 stormwater project and a \$75,000 LeTort stormwater improvement project to be implemented beginning in 2016.

Of the funding Carlisle received for work on stormwater in 2015, the Borough used a majority (over 50%) on stormwater-related projects, showing how invested the Borough is in managing and protecting this important community asset. Stormwater is the only published public plan regarding infrastructure in Carlisle, but many aspects of the Hazard Mitigation Plan discuss how the Borough should react to stresses, and sets out goals and objectives on how to proceed in the future. As a whole, this plan helps improve the resilience of the Borough.

Limitations: There was not a complete list of borough-wide protective infrastructure, meaning these sources had to be inferred from language in other reports and plans. There was also a lack of documentation on how these assets would be protected in the future, especially after a catastrophe occurs. Definitions of protective infrastructure were also inferred, both on the part of the researchers and informants, because the term was vague.

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## **TRANSPORT**

Transportation infrastructure and functionality adequately suits Carlisle’s overall needs. The road diet, the most recent large project to address issues of safety and congestion in the downtown area, was completed in 2011. Studies are currently being conducted to determine the effectiveness of this project. There have been initiatives in place, largely through the road diet, to increase alternative means of transportation, including walking and cycling. Although definitive results judging the effectiveness of the road diet have not been published yet, the apparent results do not follow what was intended to happen. Although the downtown area is largely tractor-trailer free, it still experiences high levels of congestion. These are amplified at peak travel times. Residents do not use alternative means of transportation as much as the borough hoped they would resort to. The borough is still waiting to determine how safety of residents has changed due to the road diet’s slower speeds and altered traffic patterns.

An area of transportation in Carlisle that could use improve is the public transportation sector. The current Capital Area Transit (CAT) Carlisle Circulator bus is not being renewed after its three year pilot trial due to low ridership. In order to appeal to a larger demographic, the Carlisle Circulator must have more direct routes. Carlisle is well connected to surrounding boroughs and nearby cities such as Harrisburg through CAT buses. Residents of Carlisle can easily access transportation hubs in Harrisburg including a train station and an international airport. These provide options to travel throughout the country. However the transportation system falls short in Carlisle. The Circulator’s schedule is inefficient, and difficult to understand. It often takes over an hour for the bus to return to the same pick-up location. The user unfriendly nature of the system has kept commuters and shoppers alike in their personal vehicles.

Safety in Carlisle is adequate, as is law enforcement. The borough is able to spend large amounts of money on transportation projects to improve the physical capital. The main project the Borough has embarked on recently has been the road diet, which cost up to 20% of the overall borough’s annual budget during construction. Carlisle’s evacuation plan is relatively lacking. However, as Carlisle is located between two major highways that allow easy access to the rest of the country, residents have easy and direct access to most major cities on the East Coast as long as they have a car with which to transport themselves.

Carlisle's road network was scored at a 4.5, and the average speed of road journeys from Borough center to the Borough boundary is 29km/hr (Google Maps). There are currently no plans for changing the current road system throughout downtown Carlisle. The road diet project in 2011 was the last major project implemented to regulate transportation through Carlisle. This project included downsizing High St. and Hanover St., the two major highways that intersect at the square in the center of town. This project had the goal of making the area safer and more navigable for pedestrians and cyclists alike. This project attempted to increase safety. The borough set up detours for large trucks to bypass Carlisle outside of the downtown area. This had the goal of reducing total traffic flow through the downtown area as the larger tractor-trailers had different ways of reaching the warehouses on the edge of town from the interstates. The project also added dedicated turning lanes and bike lanes, and increased the number of pedestrian crosswalks as well as the modernized the technology coupled with them. In doing so, the total amount of travel lanes decreased from four to two. The road diet allows for emergency vehicles to easily navigate downtown Carlisle during high-traffic times as they can travel on the dedicated turning lane which has a lesser volume of total traffic. This allows for immediate, unimpeded responses to emergencies.

A major reason in changing the road system was increasing safety of the borough's residents. By removing two total lanes of vehicle travel from High Street/Hanover Street drivers of cars have more chances to be engaged with the community by viewing appealing elements of the downtown. This was implemented in an attempt to increase economic appeal of the area to passers by. Tests are still being conducted to determine the lasting effects of this project: how traffic patterns and safety have changed due to the overhaul of the road system. The community seems split on the road diet implementation, not appreciating how cars have not been given as much priority in the new road system. There are numerous complaints about the amount of traffic, especially during peak travel times, through the downtown area. This was largely a result of halving the total number of travel lanes.

In 2014, the borough began talks of redesigning the road diet's lasting effects compared to how they were intended. There is a 2 year inspection period happening currently that is ending in 2016, after which the results on traffic flow and human health will be reevaluated and compared to desired results. After this, conclusions on how to proceed with the project (whether or not it is worth altering any road patterns further) will be reached. The current large transportation project in effect is updating the traffic patterns in the brownfield sites located north of the downtown area. This would include continuing roads through the un-utilized brownfield sites and connecting them via roundabouts to the downtown's grid system. Roundabouts are desired as they can allow for more total traffic to flow through the Borough at peak traffic times. This is an optimal travel pattern and can provide more means for traffic to bypass the center of the downtown area, further helping address the issues of increased traffic on specific stretches of road.

There is an official map that sets location of future transportation-related improvements. There is also currently no plan to change the pace of traffic through downtown Carlisle, as it is part of the plan to slow down riders so they are more engaged with the community by witnessing all the economic opportunities the downtown sector has to offer. This has promise for increasing the economic sector, as travelers will be privy to businesses in the downtown area at which they can interact. There is currently no system in place to alert drivers in the area if traffic patterns are greatly disrupted due to construction sites, accidents, floods, or other disturbances. Under ideal circumstances this would not be the case, as it is better to have informed drivers. Third party providers have begun incorporating messages informing drivers of real-time traffic conditions which can help navigate roads in Carlisle. However, this service is not provided by the Borough for the general public.

The borough's road networks allow for easy and direct travel through the downtown area, and also across town. The speed of these journeys depends on the time of day, but for the most part these journeys are not unnecessarily long. All important assets of the community are easily reached by a variety of roads to allow a high level of diversity in ways to access them. This causes direct journeys to these critical areas from all areas of the Borough to be feasible.

However, the Borough's public transportation systems are much less diverse, earning a ranking of 2. Only 27.9% of commuters (as a percentage of total commuters) use a travel mode other than a personal vehicle (Data USA. "Carlisle, PA: Housing"). The current public transportation system in Carlisle, called the Carlisle Circulator, is on its last year of the three year trial period. This system will most likely not be renewed in the future once the current trial period concludes. This bus system travels around the Borough, making stops in major residential areas and employment areas in an attempt to shuttle people to and from work. This system largely helps portions of the population that can't drive or don't have cars, which generally includes the elderly and the lower class. As this program targets improving the quality of life for the underrepresented minorities and elderly, it greatly helps improve Carlisle's overall resilience.

Usage of the system started out high but has decreased over time. Ridership only temporarily increases when incentives such as decreasing the costs of travel on these buses are put in place before returning to old travel patterns. Currently, the circulator struggles with ridership issues, as not enough residents are utilizing the system to make it worthwhile to keep operational. The major complaint with the system is that the circulator is very indirect, so normal trips to and from work are derailed as the circulator must make many extra stops at various locations. The lack of riders is most likely due to this complaint. Studies have been conducted on this transportation system to see how to improve it. These have focused on how to make journeys more direct in future iterations of Carlisle-wide public transportation systems. If revamped in the future, a public transportation system would allow more direct journeys within Carlisle and also to the surrounding boroughs and townships.

In the future, the implemented system will rely on Carlisle residents using the bus. However, the system will be open to residents of other boroughs and will also integrate travel routes into other towns, opening up services to other communities and hopefully strengthening connections with neighboring townships. This service may not be as consistent as it is currently, but it will reach a larger area and have more specific trips which will hopefully pander to a more general audience of ridership. Public transportation currently brings people from close by areas (mainly Harrisburg) to employment places in Carlisle, such as the factories lying on the outskirts of the Borough. Carlisle is connecting via bus system (Capital Area Transit) to Harrisburg, which has an international airport, bus, and train transportation networks, allowing residents of the Borough to have access to traveling to many different areas of the country without much trouble.

Alternative personal transportation options are promoted to a certain extent within the Borough, and were given a score of 4 according to the following information. When the "Road Diet" was implemented, a lot of thought was given to the safety and ease of transportation of residents seeking alternative personal transport options. This largely includes the needs of pedestrians and cyclists. As outlined in the road diet, implementation of dedicated bike lanes and increased crosswalk technology was planned to increase the quality of lives of both of these community sectors. This has not yet been proven, but the community should hopefully have definitive results in 2016 when the road diet study will conclude. These results will inform the borough on the actual safety and changed traffic pattern of the implemented development. The amount of bike racks downtown is lacking.

However, the amount of the population that uses alternative transportation methods has been significantly less than expected, with only 15.8% of journeys undertaken by walking or cycling (Data



USA. “Carlisle, PA: “Commuter Transportation Graphs”). In order to address this, there have been talks about expanding the system of bike lanes out of the downtown area and into the surrounding communities, allowing people traveling via bicycle to access warehouses, parks, and other townships more easily. The LeTort trail extending South of town is one example of this, as it allows for people to access areas on this part of the Borough without having to worry about road traffic. There have been serious talks to extend a walkable/bikeable rail trail, currently connecting Newville and Shippensburg to Carlisle, which would encourage usage of more alternative transportation methods. Expanding uses of alternative sources of transportation has many benefits for the Borough. These include health benefits and social benefits. By walking or cycling instead of driving by car, people are being more active and socializing with more people. This increases their overall mental and physical health. This is very important to a society, which is why it is beneficial to Carlisle’s resilience that the Borough is focusing heavily on how it can better this sector of transportation.

Diverse and effective transportation links to other cities and regions are not as prevalent as they could be, and were therefore assigned a score of 3.5. Through the Capital Area Transit network, Carlisle is connected to four surrounding towns on a daily basis. The Capital Area Transit network is a system of buses that originate in Harrisburg and transport people within the city and also to surrounding towns. These townships/boroughs include Carlisle, Shippensburg, Newville, Mechanicsburg, Lemoyne, Camp Hill, Hogestown, New Kingstown and Middlesex. The Capital Area Transit network also services specific areas within these towns, including food distribution centers, entertainment options, and other public transit networks. Together, these assist the lower class, young, and elderly sectors of the population who can’t drive or don’t have cars. It is also a cheaper alternative to owning your own car, causing it to be a desirable alternative for a lot of residents.

Carlisle Borough has not undergone a strategic assessment of transport links with other cities and regions. The Borough does not have contingency plans in place to enable movement of people and goods into or out of the city should one or more major external transportation links fail. However, the transportation network (especially in the downtown area) has been reviewed in case of an emergency as part of the road diet. This has largely focused on the ease of travel by emergency vehicles, such as ambulances and fire engines. In addition, Carlisle is located in the crux of two major interstates (76 and 81), which allow direct transportation routes to major close by cities including Washington DC, Baltimore, Philadelphia, and Pittsburgh, and in a grand scheme the rest of the country. This helps with the transportation and shipping industries, allowing Carlisle to be able to receive goods from around the country in a timely and direct manner.

Carlisle’s Comprehensive plan budget includes specific funding for transportation infrastructure, including maintaining traffic lights, road marking, detour signs, and traffic delineation devices, earning this section a score of 4. Funding for this sector has increased over the past few years, resulting from the road diet. This was an extensive project to implement. The road system throughout downtown Carlisle has been maintained well, with critical areas being replaced when necessary. Most of Carlisle’s transportation funding is proprietary, and is under the public works funding. Governmental funding takes care of the highway roads that pass through the Borough. There is no reinvestment plan that deals with cycling funding back into transportation infrastructure.

In 2015, \$600,000 worth of funding was committed to conducting a transportation study. This study was conducted in conjunction with the Carlisle Urban Redevelopment Plan and was aimed at studying areas for which road improvements (both infrastructure-wise and navigation-wise) are necessary in the near future. This study is different from the road diet study that is also currently being conducted. When it was being implemented, between 5% and 20% of Carlisle’s annual budget was spent on the road diet implementation, showing Carlisle had a serious stake in improve transportation

infrastructure in order to better the community in terms of health, safety, and the economy. In July 2016, Carlisle was granted a \$5 million grant for completing transportation projects planned through the brownfield sites north of the downtown area. This project will help reduce traffic and congestion through downtown once completed as more streets and roundabouts will be constructed.

Safety within the Borough is largely in line with federal regulations in regards to road markings, speed limits, and traffic patterns/vehicle behaviors, and was therefore scored as a 4. These specifics are all determined on a country-wide level whenever roads are initially planned on being constructed. These regulations also includes police behavior and how they regulate the prescribed laws within the Borough's jurisdiction. There are both Pennsylvania State Troopers and local Carlisle Police Officers that are in charge of enforcing laws. All drivers must legally pass a proficiency examination prior to operating vehicles on public roadways. This takes the form of drivers passing a permit or a license test. Once the test has been taken, drivers must get recertified multiple times after a certain period of time has passed in order to be able to drive.

Transportation safety is a large issue that is being addressed by the Borough. The road diet was a specific instance of the Borough altering traffic patterns to improve safety of pedestrians, cyclists, and vehicle drivers alike. This was planned to have happen by reducing the total amount of travel lanes and by providing adequate infrastructure for large trucks to bypass downtown Carlisle in journeys from the interstates to various factories lying on the edge of town. The Borough is still waiting for results of this project to be completed and publicized. In addition, Carlisle police have undergone several initiatives to improve Borough safety. As of 2014, there was a safety campaign put in place on South Hanover street to target aggressive drivers that pose safety hazards to residents. There are no available results to see how this initiative has helped the Borough's overall safety, but according to recent data, there are five transportation fatalities per 100,000 population in Carlisle (Penndot "Carlisle Borough Crash Data").

Many intersection in Cumberland County have been identified by a Harrisburg Area Transportation Study as posing possible threats to the Borough. A lot of these relate with the way the intersections are laid out in conjunction with the increase of overall traffic due to population growth in the Borough. Many of these intersections lie within Carlisle's boundaries. Unfortunately, due to the population growth in the area, the risk factor methodology in this study has identified that future transportation accidents will most likely increase due to the trend of an increasing population. Carlisle is particularly vulnerable due to the high amount of its roads lying within a quarter mile of a major highway, which is where a majority of accidents occur. This is also where a lot of critical assets are located.

Planning and programs for emergency response and recovery across the transport network are thorough and up to date, with the evacuation plan being update one year ago. This section received a score of 4.5. The Borough evacuation plan was updated one year ago. Carlisle's Department of Public Safety is in charge of providing comprehensive planning and operational readiness to municipalities, groups, businesses and individuals in preparing for, supporting and recovering from the impact of natural or man-made disasters. They coordinate and mitigate hazardous risks and other incidents that might affect the community. They are also in charge of propagating the messages after a disaster occurs. Residents can sign up on a list to be notified of emergencies as they happen on the Department of Public Safety's website. If people can not sign up for the emergency notification list for one reason or another, the public safety department relies on news of emergencies and measures that should be taken reaching these people via word of mouth.

The website has a small description on what to do in case of an emergency, which includes: contacting family members, taking medical/disaster supplies, following alternative transportation routes set in place by the department of public safety, and following all normal laws. There is no evidence that this list is spread to people - rather, people have to research how to react to a disaster requiring evacuation on their own. There is no apparent information on how the public transportation systems, including the Carlisle Circulator and the Capital Area Transit buses will function after a large event. The severity of the event will most likely dictate the effect on public transportation systems.

The 2014 Cumberland County Hazard Mitigation plan identifies how a lot of hazards, such as winter storms and flooding, can affect transportation in Carlisle. This plan also talks about how transportation accidents pose hazards to the Borough, including destruction of power distribution infrastructure and bridges. A large focus of this plan relates to flooding, and how many major travel roads, including interstates, cross through the county's watershed. This poses an extra risk, as transportation accidents occurring in this area have the ability to pollute water resources. The plan states how transportation carriers must have response plans to address accidents. If they don't, the Borough will step in and make executive decisions. Pennsylvania's Department of Transportation is responsible for addressing and mitigating issues of flooding in the Borough. There is an extensive network of detours in place in the Borough to bypass accidents or closures on certain road stretches. This allows traffic to flow through the Borough instead of being stopped completely. However, this is not always desirable as it increases traffic and congestion levels in downtown areas.

When accidents occur outside of the Borough on nearby Route 81, traffic most often times flows through downtown Carlisle. In these situations, the streets are prone to becoming gridlock, increasing vehicular travel times and also pollution for the area. This poses a risk to human health. The added vehicular travel time is likely to cause more accidents and also release more pollution, which can affect those with respiratory diseases. These types of events require a manual response and traffic management on behalf of the police department to completely address. Carlisle has attempted to avoid this situation by providing an extensive network of roads that bypass the downtown and allow vehicles to travel from one side of town to the other, but this is not always effective. Largely, this has just helped prevent tractor trailer travel from clogging up downtown streets.

Limitations: The extent that adequate resources available for safe operation and essential maintenance and upgrade programs for Borough functioning are not known. Specific details about how public transportation systems connect to other boroughs were not researched. Specific evacuation plans were not known so information to fill out these sections had to be pieced together from interviews and other plans. There was a lack of information on how public transportation systems would operate during catastrophic events.

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## **INFORMATION AND COMMUNICATION TECHNOLOGY**

In Carlisle, Information and Communications Technology (ICT) is modern and top of the line. Technologies are tested regularly for functionality. There is a wide array of technologies in use that function together to provide many degrees of redundancy. This is helpful alike for Borough residents and emergency responders during shock events as to avoid an overload of any one of the communication systems. The Borough is also looking to improve technology when necessary, in an attempt to better the quality of the emergency responders’ and dispatchers’ jobs.

There is a high degree of reliability in the system. This largely takes the form of always-running generators being able to be relied upon to provide power to the Borough in a seconds notice. This is helpful in case the Borough’s power system unexpectedly fails. Generators are tested weekly for functionality and reliability. However, in an event that they fail, there are numerous hard-copy paper backups of all important governing documents and emergency protocols. The Borough can operate off of these if the need arises. Frequent tests are done to ensure this is manageable and feasible.

Safety of the Borough’s critical documents has never been an issue. The safety measures the Borough takes in uploading and keeping all governmental and other classified documents is very good. The Borough has pinpointed user errors on the part of employees being the largest risk to the Borough’s safety. As a result, they have done their best to educate employees about possible risks they take when working and how they could undermine Borough security. All of the technology, both informational and operational, is tested regularly, modern, and top notch.

Households and businesses have access to a range of communication technologies, reflected in a CRI score of 4. These include mobile phones, radio, internet, and landline services. Wireless technology is offered in some, but not all areas. Social media access is available in all locations. Most of the social media usage is reliant on the consumer, however. All Borough radio communications run through the county’s office. The communication’s system is very modern and allows Carlisle residents to communicate with the police, PennDOT and other important contacts whenever necessary. The Borough is trending towards using more advanced, longer-lived technology in emergency services. For example, emergency services will begin utilizing tablets to ease communication during large emergency events in the coming months. This service will allow more residents to be contacted in a shorter amount of time.

Redundancy is also a very important aspect of the system. Carlisle does a good job overall of providing many technology options to allow residents get in touch with emergency responder services. Carlisle’s systems have many backups in place, allowing many alternate ways of accomplishing a goal in case something prevents one way from functioning as planned. Carlisle diversifies the ways they inform the public of emergency notifications and events, utilizing: publications, websites, phones and social media. Social media specifically is heavily relied upon to reach out to the public. Carlisle utilizes a program called South Central Alert to easily contact any residents listed in the white pages by up to ten different communication technologies. Residents are encouraged to sign up for this service with

their cell phones/email addresses to provide another way of being contacted in case of an emergency. Using this service, the Borough is able to isolate specific areas (such as streets) and communicate with a specific location very accurately. The Borough also utilizes the Emergency Alert System, which notifies people of emergencies on televisions and radio networks. This is an older but still effective method of notifying the public about a catastrophe. The communications infrastructure is all up to date.

In wake of an emergency, warning messages are spread through the Borough immediately. There are mechanisms in place to alert a large number of residents via phone calls, emails, online messages, and television and radio alerts, which led to a score of 5. This happens through both the South Central Alert and Emergency Alert Systems. Carlisle acknowledges that not everyone will be reached out to via these communication networks, so they rely on word of mouth to spread messages to people that do not have access to phones, radios, television, or the internet. Borough residents can also sign up for a paging program called Code Red. This program is very useful in notifying residents and businesses of events via phone calls by use of a dialer. In extreme circumstances, such as three mile island evacuation protocols, there are protocols in place for route altering operations, allowing for emergency responders to be stationed around neighborhoods with megaphones informing residents of the emergency and how to respond to it by verbal communications. These responders alert all present residents of the emergency as well as how to respond to it. Carlisle has never had to resort to route alerting to respond to an emergency since its implementation. Still, route alerting remains a very fast and accurate way of responding to catastrophic events from explosions in gas lines to Nuclear hazards.

The communications technology in place allows for extensive communications to occur between the Borough officers and the emergency responders during shocks. Ideally this makes the process of notifying residents about how to respond to emergencies as straightforward and concise as possible. Officers are better able to communicate messages and make sure that all residents are alerted without redundantly alerting the same group of people multiple times. It also allows the municipality to communicate to specific offices (for instance the fire department) if necessary. The infrastructure in place allows for many forms of communication to occur simultaneously during emergencies that Carlisle might face. Taken together, the services provide a platform to warn people about impending shocks and inform them about the best ways to safely respond. Nearly all of the Borough's residents are warned through this network, hearing about the shock from one of the many utilized warning technologies. However, the specific amount of people that are identified by these techniques are not known. These systems are able to communicate messages around the entire Borough.

Sometimes, during shocks the systems can get overwhelmed by the sheer amount of people calling various official offices around Carlisle (including the Borough police and fire stations) and family members. At these times, residents will not be able to communicate via phone calls. In the near future, Carlisle has plans on addressing this issue by implementing a next generation 911 system, which would allow residents to communicate with 911 by text. This would allow residents to send pictures to 911, allowing the dispatchers to be able to provide a more direct response. It is usually easier to gauge the full extent of a shock from a picture than from someone's verbal description. This would also decrease phone call traffic as texts do not have a large load on the system as phone calls do. This would make the infrastructure more resilient, allowing it to stay up for longer as emergency responders are attempting to propagate messages about the extent of a shock and residents are attempting to call official offices or family members.

The current infrastructure in place allows for high levels of communication between emergency responders during and after a shock, reflected in a score of 4.5. Tasks are delegated from central offices to emergency responders via radio primarily, but there are backup communication technologies in place to allow responders to communicate in case the main technology does not work. The borough is

planning on providing all emergency responders with tablets in the near future. This addition will give them another possible communication device to help spread messages easier, providing another degree of redundancy. Thus, information can still be effectively communicated during demand surges following an emergency event. The technology used is appropriate in regards to the shocks facing the city. There are clear procedures governing emergency responder's roles during propagation of an emergency signal. These include: who distributes the message, who acts on it and alerts the public, and who is in charge of mitigating the response, if applicable to the given situation.

This technology is understood and tested frequently. The emergency response plan is checked every two years, and important personnel in regards to disaster response receive training every year. The training is facilitated by the Cumberland County's emergency public safety center. Every two years the plan has to be reviewed and a resolution is passed by the Borough council, which is eventually submitted to the Pennsylvania Emergency Management Agency (PEMA). The training is a tabletop exercise, so while the technology is not tested in the process, the protocols are reviewed. Technology is reviewed and tested separately. The training involves a disaster simulation that affects Carlisle, such as a tornado. The team looked at the steps to implement the plan, worked through the operational period and then discussed the recovery process.

Effectively, to start this process the team has to get the Borough center open and declare a local disaster. Then, the Borough manager, the mayor, or the council president signs off on the sheet declaring the state of emergency. They send that to the county, detailing that they have declared a local disaster and that will allow them to supersede any purchase requirements that the Borough has in place by ordinance so they don't have to go to a competitive bidding once Carlisle is in a disaster. This allows Carlisle to get a piece of necessary equipment without going through purchasing requirements, expediting the process. The rest of the plan is delegated from here depending on the details of the specific disaster that Carlisle is facing.

On a county level, all important data is backed up. The backups are in accordance with legal regulations. This includes following guidelines of the Pennsylvania Right to Know Law, which focuses on making documents that talk about the public accessible and available to the public. All files and systems must be backed up on stable servers. The physical equipment that powers these backups, including the hardware and emergency generators, are checked for functionality on a regular basis. The generators are checked as frequently as every week..

They are also available as hard copies to reference in case of emergencies when systems are not able to be accessed. This is the third level of redundancy in the back up system. Carlisle has never had to resort to using paper backups during any emergencies since they were introduced. These emergency protocols (operating off of paper documents instead of internet plans) are practiced regularly to assure that operations would be able to proceed as intended in case the network was to crash and backups online were not able to be accessed.

There are robust backup plans in place that focus on providing power to the online databases at all times to assure that systems do not crash. A fast generator is always running and connected to the backup file server. This system is able to be relied upon in a moments notice after an emergency happens that causes power to be disrupted in the grid. Thus, the generator would begin providing power to the system immediately, allowing the files and systems to stay up without allowing time for the system to reboot or crash. This happens automatically. As soon as a small dip is noticed in the power supply, the power draw is shifted from the borough's power grid to the backup generators to make sure power supply remains constant adequate. This generator system also runs the radio software, another important borough asset that should be functional at all times. This level of necessity is amplified during an emergency event. The infrastructure and technology used by these systems are all up to date.

The backups that are present also serve for cyber security as the Borough has copies of all important information and has taken measure to protect the information's safety to assure security. All of this led to a score of 5 in the CRI. Neighboring townships have had issues with cyber security, but Carlisle has not experienced any of these problems.

All information technology hardware used by the Borough is up to date and top of the line, resulting in a score of 4.5. Vendor maintenance agreements result in routine inspections to make sure all technology is up to date and functional. Generators are tested for functionality weekly to assure that in case of emergency they will be able to be relied upon creating a steady power supply. Thus, the systems will not experience any downtime, preventing databases from crashing or otherwise being inaccessible due to power shortages in the Borough's grid.

Carlisle's informational technology department does a great job of informing residents and workers of possible risks that the Borough might face in terms of cyber security. The borough does their best to make sure that any possible threats are identified to the community. This has caused a large focus for the Borough's informational technology apartment to be on employee education. The Borough is focusing on employee education as they have identified that employees clicking on risky links and in doing so allowing outsiders access into governmental documents poses the biggest threat to the Borough's cyber security. The municipality is responsible for funding a lot of the programs revolving around technology infrastructure. In Carlisle, this specifically refers to the Borough funding the implementation (purchase and operation) of tablets for emergency services to ease and benefit the communication of all emergency responders.

The Borough's backup system was determined to receive a score of 4. There is an extensive system of all operational technologies, including radio software and database backups. This allows daily functionality of many systems to occur without risk of disruption. This is done by the use of fast acting, reliable generators. Risk assessments occur frequently, functioning to prevent the Borough's operational technology from becoming compromised. The largest sector of risk in this area is from employees making mistakes and accidentally giving out information via online links that result in third parties being granted access to information that they can encrypt and ransom back to the Borough. This has happened in neighboring communities but not in Carlisle specifically. There does not seem to be much planning in place to address how the Borough would respond to an event in which operational technologies were compromised.

The Borough has future plans to increase handheld device usage, which will help free up radio traffic. This will allow more time and attention to be paid to emergency services. It also allows dispatchers to work more efficiently as they have a smaller volume of radio traffic to communicate to the public. In the near future Carlisle has plans to implement a next generation 911 program which would allow people to text 911, further freeing up radio waves for dispatchers. This also allows for higher safety for residents as you can contact and inform 911 of a situation via text if you can't talk out loud, and you can also send pictures to 911 via text which could help in determining what kind of response to dispatch. Using this technology would allow certain forms of communication to be able to occur during a systems crash. It would also decrease the total load on systems as texts have less of a toll on the hardware than phone calls do, causing crashes due to a large magnitude of calls overwhelming infrastructure capabilities occurring less frequently.

Limitations: One limitation is that there is currently no way to know what percent of the population is subscribed to be notified to receive emergency notifications. Another limitation is that there is no specific way that vulnerable populations, such as the homeless in Carlisle can be notified so it is unclear what percent of vulnerable populations receive warning of potential threats and then safety.

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### **Recommendations for Improving City Resilience**

Overall, Carlisle has established itself as a moderately resilient community. Improvements could be made in specific areas related to infrastructure and the environment. One of these areas is providing emergency housing to the homeless and vulnerable during emergencies. Carlisle could also improve by having more affordable housing, which the Cumberland County Housing and Redevelopment Authorities are working on at the Brownfield Redevelopment Sites, to make waiting lists for such housing shorter. Carlisle is making efforts to address the current shortfalls, but these efforts are insufficient. In order to assure that Carlisle residents are more stable, especially after a large shock, there needs to be a larger stock of affordable housing. Another area of improvement would be in public transportation. The public transportation system in Carlisle should be revamped to make more direct trips. The CAT bus program is being discontinued due to low ridership which will leave Carlisle with no forms of public transportation. While the CAT bus lasts in the borough, bus stops are very spread out and wait times are long. The system has been found to not be sufficiently user friendly. Alternative modes of transportation such as walking and cycling should be utilized and encouraged more by the community. This is challenging, as current measures in place by the Borough attempt to address this issue, but the community is not responding the way the Borough anticipated. The Borough must take more measures to influence the community into using alternative transportation means. The Borough is currently taking adequate measures to prevent pollution-caused environmental degradation. However, there could be stricter measures taken to improve current environmental surroundings.

Carlisle should develop a more accurate and complete register of protective infrastructures that serve to better the Borough. Currently there is not such a list. There should also be more explicit measures taken on protecting these infrastructures during shock events. Additionally, because the wastewater transportation and treatment infrastructure is over 100 years old, there is a 10-year capital improvement plan in place but there does not appear to be plans for dealing with a disruption in the sewage treatment or transportation systems. There is no city electricity plan for electricity infrastructure that would meet the evolving needs of the Borough long term. In terms of sustainable energy usage, Carlisle could benefit from reducing demand of energy and improving methods of maintaining spare capacity and should continue working with the state of Pennsylvania to decrease non-renewable electricity usage. Also, there are no plans in place to reduce water consumption during non-essential times. Similarly, the Borough could benefit from promoting recycling and composting as an alternative to landfill waste. In regards to Carlisle’s energy supply, there should be a better distribution of affordable, alternative energy generation technologies among residents. This allows a higher degree of functionality to remain if the borough’s electricity distribution or generation systems were to fail. There should be more redundancy in the broad scope of the utilities services. Electricity, water treatment and distribution, sanitation, and solid waste are only provided by one company each. This causes there to be significant risk to the community if anything happened to these companies resulting in a stoppage of services.

There are currently not as many measures detailing how different sectors of the borough would function in the event of a catastrophe as are necessary. Creating more thorough



Emergency Protocols for transportation, housing, utilities, and the environment would benefit the community in regards to resilience to shocks greatly. Additionally, we look forward to hearing more from Carlisle community members during our CRI workshop on December 6th about what they believe Carlisle can do to build resiliency.

### **Key Informants**

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*Customer Support Engineer, PPL Corporation*

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