USGBC LEED for Communities Certification of the New York State Olympic Region

Clarkson University Adirondack Semester

Last Revised: 17 December 2018

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Executive Summary

Leadership in Energy and Environmental Design (LEED) for Communities is a rating system created by the United States Green Building Council (USGBC) that measures a community's environmental sustainability and quality of life of residents. LEED for Communities (LFC) is currently a pilot program that builds upon the same principles as LEED for Buildings, the world standard in green building certification, but significantly expands the scope of the program. LFC promotes better management of resources and smart city planning and design. The USGBC's LFC program is also compatible with other smart city measuring programs such as CitiStat, Estidama, EcoDistricts, and Climate Smart Communities.

A fundamental aspect of LEED for Communities is the principle of continual data collection and comparison against previous data. The steps for LFC Certification are registration, Precertification, inputting data, Green Business Certification Incorporated (GBCI) review, and Certification. Data collected is input into Arc, a system that then evaluates performance. The program requires data collection for 14 Core Metrics spanning the categories Energy, Water, Waste, Transportation, and the Human Experience. Additional Community Metrics may also be created to measure data more specific to the region. In addition to data collection, LFC Certified communities must submit goals and plans to achieve their goals each year. These are plans to improve the community's baseline data measurements. The first set of data collected is baseline data from which the region can work on and improve over the coming years as the program develops.

The initial LFC Certification in the New York Olympic Region was undertaken by 14 students from the Clarkson University Adirondack Semester (CASS) for the duration of the 2018 fall semester. This was done to help the community reach environmental sustainability goals, lessen the region's environmental impacts, and improve the quality of life for residents of the community. The Certification and ongoing measurement processes educate members of the community on environmental impact and engage community response and action to lower environmental impact in the region.

Through LFC, the New York Olympic Region will be able to track progress in efforts in resource management as well as the human experience of the community. The stakeholders and jurisdictions involved in the New York Olympic Area LFC Certification are the Town of North Elba, the Village of Lake Placid, the Lake Placid Central School District, and the Olympic Regional Development Authority (ORDA). The physical boundary for Certification will be the Town of North Elba and Lake Placid Central School District combined, with the ORDA venues of Whiteface and Gore acting as satellite facilities.

This region is the first of its kind to be LFC Certified; it is a multi-jurisdictional community in a rural area with a sizable tourist population. To find baseline data for the 14 Core Metrics, the Clarkson Adirondack Semester Students searched in public databases and contacted local organizations for available information. A common roadblock was that data was only available at the county level, not at the boundary level specifically. In this case, students

contacted local offices and created data estimates. The data collected for the 14 Core Metrics will serve as a baseline from which the community should strive to improve.

Data for the additional Community Metrics has not yet been gathered. The Community Metrics were chosen in concurrence with the goals and plans of the individual stakeholders. The Clarkson Adirondack Semester Students compiled a list of Community Metrics with the stakeholders that incorporated their interests and goals. For each metric, a stakeholder was assigned as a lead on data collection. The community also has a comprehensive plan that highlights projects and sustainability goals that they want to accomplish.

As mentioned earlier, LFC Certification is about the ongoing journey and commitment to sustainability. Data is measured annually, in addition to new plans being proposed.
LEED for Communities is currently a pilot program, so the metrics and other Certification requirements are not necessarily the most compatible with our jurisdiction. To ameliorate this issue, we have compiled recommendations for both the USGBC and the individual stakeholders. Most LFC Certifications have been conducted in urban areas where information is easily accessible and the metrics are more relevant. Something to consider regarding LFC Certification is to create a more flexible and relevant set of the 14 Core Metrics that are more specific to different geographic regions. For instance, development of green infrastructure, connectivity, and data tracking are much easier to do in cities than in rural areas.

Going forward, data collection could be administered by local organizations such as ROOST and ANCA. The creation of a website where stakeholders and those responsible for data collection can collectively share and input data publicly will likely be important for future work. This way the data is stored in one location and is easily accessible to the community and to input the most current measurements into Arc. We recommend that the LFC initiative be highly publicized to educate the public on why it's happening and who the stakeholders are, so that the community can begin working towards improving the baseline measurements.

1.0 *Introduction*

With the recent increase of environmental awareness among the general public, there have been calls to improve sustainability practices worldwide. As a result of this, several organizations, including the United States Green Building Council (USGBC), have begun to pioneer smart city programs that aim to promote green and sustainable design in cities and communities[1].

This whitepaper will examine the approach of the USGBC's Leadership in Energy and Environmental Design (LEED) for Cities & Communities pilot program (LFC) in the New York Olympic Region (NYOR), which includes the Village of Lake Placid, the Town of North Elba, the Lake Placid Central School District (LPCSD), and the Olympic Regional Development Authority (ORDA).

2.0 *Background*

2.1 *Creation of Leadership in Energy and Environmental Design (LEED) Program*

Founded in 1993, the USGBC was created with the purpose of promoting sustainability in building design, construction, and operation with the goal of improving human wellbeing. From this, the USGBC has expanded their operations to include new initiatives. Leadership in Energy and Environmental Design (LEED), the USGBC's green building certification program, is used worldwide. As of April 2016, there are 93,800 active LEED programs operating in 167 countries[2].

LEED programs have been developed for use in homes, building design and construction, building operation and maintenance, interior design, and neighborhood development[3]. The USGBC's newest sustainability initiative is an expansion of the LEED platform. LEED for Cities and Communities aims to adapt the rating system previously used in LEED for buildings to encompass entire communities[3].

2.2 *Creation of LEED For Cities and Communities (LFC) Program*

2.2.1 Smart Cities

Trends in urbanization, the recent wave of environmental awareness among the general public, and the need for sophisticated frameworks to monitor and regulate city data has led to the creation of "smart cities[4]." Because the concept of a "smart city" is fairly new, there can be numerous ways to define this phrase. The term "smart city" can refer to a community that approaches development using a technical and economic mindset with oversight from a strong central governance structure[4]. Smart cities can also include strong community input and the adoption of sustainable technologies. However, smart city programs do not conform to a specific ideal of a smart community and smart city projects are unique in their individual approaches[4, 5].

Smart city programs address areas of sustainability which traditional building-centric programs do not. These programs deal with large scale, multifaceted issues that affect the community. Furthermore, the numerous stakeholders within the community may bring conflicting agendas. Thus, smart city programs are designed with a flexibility that accommodates these elements[4]

Each community that adopts a smart city program will likely face unique difficulties and obstacles, and each program chooses to address these challenges in different ways. However, despite their different methods of operation most of these projects operate with the overall goal of increasing a community's livability and mitigating the adverse effects of community development on the natural environment[5].

2.3 *LFC Certification Process*

2.3.1 Summary

Since LFC's formation in 2016, the goal has been to improve the sustainability of communities by providing a framework to monitor community performance, define goals, and track data[3]. The result has been a system where communities establish a benchmark, continuously improve their performance, and compare their progress to similar communities. As of September, five communities have achieved LFC Certification, two have been Precertified, and 13 have begun the process to be Certified[6].

To begin the process of LFC Certification, a community must first register with the USGBC on the Green Business Certification Inc.'s (GBCI) online data tracking software, Arc Skuru or Arc. Next, the boundaries, governance, and stakeholders of the community must be identified. Once this is accomplished the community may begin the data monitoring necessary for Certification. LFC has established fourteen Core Metrics used for the Certification process, which are divided into five themes: Energy, Water, Waste, Transportation, and Human Experience[1]. To further improve their scores, communities can also choose or create additional metrics, or submit plans to meet specific goals set forth by the USGBC; these options will be explained further in Section 2.3.3. Once communities have entered data for the fourteen Core Metrics and either chosen additional metrics or submitted plans, the community's benchmark is established and a Performance Score is given.

2.3.2 Core Metrics & Scoring in Arc

LFC uses the software tool Arc as the platform for data monitoring. Arc acts as the forum in which all the data gathered is uploaded for review by the GBCI and made available to other communities. As such it is equipped to receive data regarding the 14 Core Metrics and any additional documents necessary for Certification[1].

The LFC approach uses a set of 14 Core Metrics to monitor community performance. Monitoring the 14 Core Metrics is integral to LFC, as the project emphasizes the use of quantitative data that can be easily understood and compared. To retain Certification, data for the 14 Core Metrics must be updated annually; this allows the USGBC and the community to gauge the success of the strategies the community has implemented to improve their Performance Score[1].

A community's Performance Score can range from 1 to 100 based on the 14 Core Metrics. The metrics are scored in the Arc platform, and each category of Energy, Water, Waste, Transportation, and Human Experience is given an individual score out of 100. These scores are then weighted so that Energy can contribute up to 33 points, Water can contribute up to 15 points, Waste can contribute up to 8 points, Transportation can contribute up to 14 points, and Human Experience can contribute up to 20 points to the Performance Score. The remaining ten points come from the Base Score, which can be improved by either tracking additional metrics or

submitting specific plans for community improvement to the USGBC (see Section 2.3.3 for more detail about the Base Score)[1].

The final Performance Score translates into the community's Certification Level. Communities are Certified with a minimum of 40 points, but can achieve Silver Certification (minimum 50 points), Gold Certification (minimum 60 points), or Platinum Certification (minimum 80 points). Scores are evaluated annually when the community submits new data, and as such a community's Certification Level may vary from year to year[1].

2.3.3 Options for Improving Base Score

In recognition of the fact that not all of the plans a community has will immediately affect the community's Performance Score, the USGBC requires communities to choose from one of two options that will improve the Base Score up to ten points. In Option A, the community submits plans for achieving goals set forth by the USGBC, such as a carbon reduction or disaster preparedness plans. Each plan submitted to the USGBC will earn up to two points. For Option B, communities commit to tracking a minimum of two additional metrics, with each additional metric earning half a point, up to ten total points. These additional metrics can come from the list of over 200 suggestions provided by the USGBC or can be created by the community to tailor to specific needs; communities must provide information about the data sources, methods of collection, and accuracy, in addition to identifying who specifically will be in charge of data measuring and tracking[1].

2.3.4 Community Roadmap

An integral part of LFC Certification is ongoing commitment and planning, therefore the creation of a comprehensive Roadmap is a further requirement for LFC Precertification. The Roadmap is a document that consolidates all existing and planned sustainability projects, the methods through which these projects are enacted, and the metrics associated with these projects. In addition, the Roadmap contains information regarding the state of data monitoring in the community including the roles that the various stakeholders play in the data gathering process[1].

2.4 *Benefits of LFC*

LFC is a versatile system which utilizes a data-driven approach. Performance is presented in an easily understood score intended to highlight community achievements. Furthermore, the score is updated every year, giving an idea of continued progress made by the community[2].

The Core 14 Metrics are designed to be applicable to any community in order to allow communities to compare against one another. This proves useful when searching for new strategies to implement, as newly registered communities can learn from prior successes and already Certified communities can observe the effects of new strategies[2]. Additionally, LFC is designed to work with, not against, other data-centric sustainability programs.

LFC Certified communities also gain an economic advantage. By implementing LFC and gaining higher Certification Level, communities improve their attractiveness towards potential investors. Through this, an influx of financial capital can be gained used to fund ongoing improvement in the community[1].

LFC can also be used as an educational tool for residents and visitors. By studying the goals and techniques of LFC, individuals are educated on the importance of sustainable design in modern communities and the role of Human Experience Metrics in sustainability programs[1].

2.5 *Comparison to Other Smart City Programs*

As mentioned previously, a key aspect of the LFC program is its compatibility with other sustainability frameworks. Other community-based sustainability programs discussed below include CitiStat, Estidama, EcoDistricts, and Climate Smart Communities.

2.5.1 CitiStat

CitiStat is a popular data monitoring framework that, similar to LFC, records community-based data. Originally it was a modification to the New York Police Department's CompStat, a system developed to keep track of New York City's crime rates. But the City of Baltimore has taken the CitiStat program and expanded it to track a variety of Community Metrics. Essentially, the program acts as a common forum in which various city agencies can contribute data. This data is available not only to city agencies but also to the public. This allows neighborhoods to easily track several metrics including but not limited to: recycling rates, permits issued, and crime rates[7].

A crucial difference between CitiStat and LFC is that CitiStat allows separate cities and communities to freely choose what data they want to collect. Data collection in CitiStat is easily adaptable and can be prioritized by metric, depending on the city's unique needs[7]. In contrast, cities using LFC must collect data for all 14 Core Metrics to achieve Certification. However, because CitiStat cities select different metrics for measurement, CitiStat is less ideal for comparing performances across different communities[7].

2.5.2 Estidama

Estidama was developed by the United Arab Emirates (UAE) Department of Urban Planning and Municipalities. The goal of Estidama is to promote environmental, economic, cultural, and social sustainability across the UAE. To address some of the unique issues faced by the UAE, such as water shortages caused by the arid climate and high energy use for air conditioning, Estidama aims to provide incentives for reducing consumption of resources[8].

Similar to LFC, this program tracks specific data metrics and awards a score. There are currently 3 rating systems in the Estidama program: Pearl Villas (scored out of 90 points), Pearl Buildings (scored out of 177 points), and Pearl Communities (scored out of 159 points). Points

are given based on the performance of the villa, building, or community, with an emphasis placed on the reduction of water and energy consumption. Uniquely, Estidama aims to sustain the culture of the Arab people. It does this by applying the Estidama values to traditional Arab architecture and engineering. Thus, modern housing projects operating under Estidama feature unique Arab designs[9].

2.5.3 EcoDistricts

A third framework that has been developed and used in Portland, Oregon, is the EcoDistricts project. Headed by the Portland Sustainability Institute (PoSI), EcoDistricts prioritizes infrastructure implementation and active monitoring. Another component of EcoDistricts is how it integrates residents. By employing Civic Ecology, a model that describes human, social, and cultural interactions with nature, EcoDistricts plans to empower residents to take on values of sustainability by operating on the policy of community-led sustainability[10, 11].

This emphasis on community led operation is similar to LFC. Both programs intend to act as a medium through which the values of residents promote sustainability. Furthermore, both programs have the community engaging with regional institutions through encouraging meetings between the two groups. However, a key difference between the two projects is the scale at which they are implemented. While LFC is designed to scale its operations to the level of the community, EcoDistricts instead focuses on a smaller scale, with multiple neighborhood level projects that work in conjunction with each other. Because of this, a single municipality can have several EcoDistricts operating within it[11].

2.5.4 Climate Smart Communities

Climate Smart Communities (CSC) is a New York State-based sustainability framework that places a high priority on mitigating the adverse effects of climate change. This is primarily done through reducing greenhouse gas (GHG) emissions across New York State. CSC uses a series of 10 pledges that communities must follow in order to maintain their certification as a CSC. These pledges are functionally similar to the LFC's 14 Core Metrics, in that community performance is judged and scored based on their adherence to the 10 pledges. However, because the focus is on reducing GHG emissions, every pledge is in some way contributing to this overarching goal. Furthermore, CSC also utilizes an online data portal for communities and community agencies to contribute to[12].

A further similarity between LFC and CSC is how they reward ongoing commitment. CSCs are awarded points for a variety of actions including but not limited to: planning, policy implementation, and community outreach. These points are then tallied, and a CSC Certification tier is granted. Similar to LFC, the certification tiers are meant to represent a community's performance and provide an incentive for improvement[12].

2.6 *Community Background*

The New York Olympic Region (NYOR) has a variety of unique characteristics that make it fundamentally different from other LFC projects. NYOR is the first multi-jurisdictional project, as well as being one of the few rural communities in LFC, and has a unique tourist-based economy due to its placement in the Adirondack Park as well as its Olympic background. The region's Olympic legacy is critical to its character, while its placement in the Adirondack Park means it's under very strong environmental protections that can both help and hinder the sustainability efforts of LFC.

NYOR is comprised of four different jurisdictions that include the Town of North Elba, the Village of Lake Placid, LPCSD, and ORDA, making it is the first multi-jurisdictional LEED for Communities effort. The Village of Lake Placid is also involved in New York State's CSC program in addition to LFC. As a public benefit corporation, ORDA maintains the region's world-class winter sports facilities (such as the Lake Placid Olympic Ski Jumping Complex and the Mount Van Hoevenberg Olympic Bobsled Run), as well as the ski resorts of Whiteface, Gore, and Belleayre. Whiteface and Gore are included in NYOR as satellite facilities, however, Belleayre is not included because it is far removed from the region and because ORDA is only concerned with Olympic level facilities.

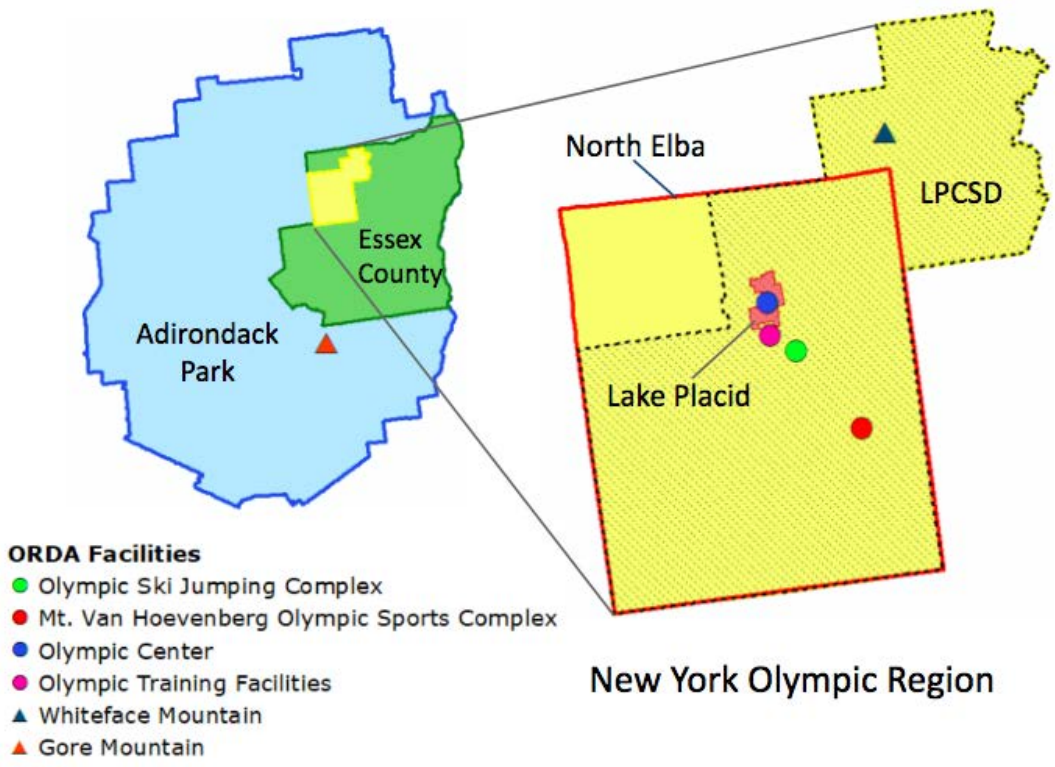

Figure 2.6 The New York Olympic Region

It is important to note that for much of the data collection discussed in the following sections of the paper, the Town of North Elba was the main reference area used. In the state of

New York, villages must reside within a town, therefore any data regarding Lake Placid is included in North Elba data, unless otherwise noted. Additionally, most of the residents of NYOR reside within the clearly defined town boundaries, making it the simplest border for data collection.

An integral part of NYOR's background is its placement in the Adirondack Park. The Adirondack Park is a highly regulated amalgam of public and private land which aims to uphold the "Forever Wild" clause of the state's constitution. Agencies such as the Adirondack Park Agency (APA) and the Department of Environmental Conservation (DEC) help create and enforce laws to preserve the quality of life and wilderness within the Park. They have control over both the 2.6 million acres of public and the 3.4 million acres of private lands in the Park. The state lands are divided into four main different classifications, which are Forest Preserve, State Forests, Wildlife Management Areas, and Conservation Easements. The Forest Preserve classification is then broken down into Wilderness, Wild Forest, Canoe (Adirondack specific), Primitive (Adirondack specific), Intensive Use, Travel Corridors (Adirondack specific), Historic (Adirondack specific), State Administrative, Detached Forest Preserve, and Wild, Scenic, and Recreational Rivers (Adirondack specific). These categories are based upon the land's capacity to withstand use. The State Forest classification is then broken down into Reforestation Areas, Multiple Use Areas, Unique Areas, and State Nature and Historic Preserves[13]. Because of these existing APA regulations within the Park, NYOR is already well on its way to being a leading sustainable community. However, projects that require construction may be difficult because new development is extremely limited.

Within NYOR the private land use classifications are a mix of Hamlet, Moderate Intensity, Low Intensity, Rural Use, and Resource Management. The state lands within the region fall under Wilderness, Wildforest, Intensive Use, Historic, and State Administrative. The jurisdiction also includes a mix of residential, commercial, and larger scale industrial structures and buildings.

One of the main challenges with Certifying the Olympic Region is its rural location. As part of the Adirondack Park, NYOR is isolated from urban centers and therefore has little data readily available for metric evaluation. Much of the data available was not specific to NYOR and instead existed only as county-wide data. As a result, some data had to be tailored to fit the region. These cases will be further explained throughout the paper.

Lake Placid was home to the Winter Olympics in both 1932 and 1980. This legacy, along with park recreation, is a large part of the area's tourist-driven economy. The historic Olympic facilities still standing, such as the hockey arena where the Miracle on Ice occurred, are highly trafficked by tourists, and still draw many visitors to the region. According to ORDA officials, nearly 800,000 people visited the Olympic facilities in the 2017-18 season. NYOR hopes to host Olympic events again in the future, and LFC Certification may improve the likelihood of an accepted bid from the International Olympic Committee. Additionally, other major sporting events are frequently held in Lake Placid. NYOR is currently preparing to host the 2023 World University Games, which are an international sporting event similar in scale to the Olympics[14].

These games, much like the Olympics, take great care in choosing their host locations. To prepare for the Games, ORDA is renovating much of their existing facilities, improving infrastructure, and making the old Olympic facilities more sustainable. Improving the region's well being and sustainability is a large part of plans to attract similar events to the area in the future.

The Village of Lake Placid's industry is service-based, with hotels, restaurants, and shops making up much of the village's main pull for tourists. This is a key aspect of the region's culture, which began in the early 1800s with the famous Adirondack Guides[15] and Great Camps[16]. The only 4-year college in the Adirondacks (Paul Smith's College, located just 30 minutes North of Lake Placid), is a hospitality and service-oriented college.

3.0 *Analysis*

3.1 *Investigator Background*

The primary investigators of this project were fourteen Clarkson University sophomores and juniors with a variety of majors ranging from engineering, to psychology, to business. The Clarkson Adirondack Semester Students (CASS) worked under the guidance of two professors, Erik Backus and Stephen Bird, and completed a 15 credit program hosted at Paul Smith's College. The classes, which lasted 3-6 weeks each, included: a course designed to acquaint the students with the community and the natural environment of the Adirondack Park; a session of training with ESRI's geographical information system program, ArcMap; an introduction to the ecology of the Adirondack Park; and an overview of the social and political issues the Park currently faces. Throughout the entire semester, the students worked on the Integrated Research Project course that focused on the LEED Certification of NYOR.

Professors Bird and Backus, the latter of whom is a member of the USGBC, provided an overview of the LFC process and how CASS can help with the Certification of a rural community. CASS's responsibilities for achieving Certification included collecting data for the base 14 metrics, choosing and creating Community Metrics, and suggesting future goals for NYOR. Additionally, CASS was tasked with evaluating the Certification process and providing recommendations to the USGBC for improvement of LFC. Throughout this semester, the efforts of CASS included creating presentations, meeting with stakeholders, and doing extensive research. CASS had the opportunity to visit various locations within the region to see first-hand the features of the community with which they would be working.

3.2 *Research Strategies*

The CASS team divided the fourteen Core Metrics among the group for research. To get the necessary data, we reached out to various stakeholders, individuals, and departments between the middle of September to November. For specific information on data collection, refer to Section 4.0 below.

The next stage of the project involved compiling future goals and finding Community Metrics for the NYOR Roadmap. In order to do this, CASS contacted the representatives of North Elba, Lake Placid, LPCSD, and ORDA. By meeting with stakeholders, CASS was able to interpret both individual and shared goals for the parties involved. A detailed list of all meetings can be found in Appendix A. Using these goals, CASS selected additional Community Metrics from the Arc website and created our own additional metrics which related to the pre-existing goals and future steps of our stakeholders. These Community Metrics were compiled into a single document which included possible sources for data collection and which stakeholder would take the lead on gathering the data. This document can be found in Appendix C, and more information about this process can be found in Section 5.0. To communicate the progress of the project to the community and stakeholders, several presentations were given. Details of these presentations can be found in Appendix B.

3.3 *Boundaries of the Investigation*

There were many conceptual and physical boundaries which shaped the progress and products of this investigation. As the semester progressed, we uncovered more roadblocks and uncertainties which we needed to resolve before we could move forward. Our goals in resolving all of these issues were to:

1. Create an accurate and intuitive data set which the stakeholders of NYOR could use to inform decision making,
2. Allow for ease of replicability of our process for future data collection in NYOR, and
3. Create a model for any future rural, tourism-oriented, or multi-jurisdictional communities.

In terms of conceptual boundaries, the most important challenge we faced was how, specifically, to fit the LFC process to our region. This required us to evaluate which of the four stakeholders each metric applied to. We came to the consensus that the 14 Core Metrics were most relevant to the Village of Lake Placid and to the Town of North Elba, as they deal mostly with information about resident populations. Much of the data for LPCSD and ORDA was already included in the town and village data (e.g. water consumption and municipal solid waste generated; see Section 4.0 for more details). Therefore, we decided that the numbers we arrived at for North Elba would be what we input into Arc as the NYOR numbers, seeing as all other jurisdictions resided completely or almost completely within this boundary. Any desire to track

stakeholder-specific metrics would be satisfied through the addition of Community Metrics during the Roadmapping phase of Certification.

Another conceptual challenge was the question of how to deal with the impact of tourists on our data. The 2017 Village of Lake Placid Annual Drinking Water Quality Report[17] estimated an average of 10,000 visitors to the region per day, over the course of a calendar year. The population of North Elba (including the population of Lake Placid) was 8,484 in that year[18]. This means that there are more visitors to the area than there are permanent residents. Because many of these visitors use town water and energy, contribute to town waste, and are capable of committing violent crime during their stay, we thought that it would be logical to include these visitors in the population of the New York Olympic Region. Therefore, we added the full estimate of 10,000 to NYOR's population for several Core Metrics (1 through 5, 14) in our initial calculations. The remainder of the metrics are either not population-based (12, 13), or they are specifically geared toward year-round residents (6 through 11).

However, the USGBC is hesitant to allow inclusion of the transient visitor population. This is because comparability between cities is an important part of the scoring process in LFC, and they have not allowed addition of visitors for any prior Certifications. We feel that NYOR's situation is an extreme one, and as such, that it is inherently incomparable to any Certifications the USGBC has done before. Even though it is the first community of its kind to attempt LFC Certification, it is not the only community of its kind. Therefore, we feel that it is important to set a precedent for any future rural, tourist-centric communities that may want to take part in LFC. Such communities might include those placed at the entrances to national parks (like Tusayan, Arizona on the South Rim of the Grand Canyon), or other recreation-based, former Olympic communities (like Park City, Utah). We feel that the benefits of representing this unique aspect of these communities in the scoring process are many, and so conversations with the USGBC on this subject are ongoing. However, for the initial Certification, NYOR's numbers will not include visitor population as per the USGBC's request. Numbers including the full tourist population will be expressed in additional Community Metrics, which are not scored, for comparison.

One key physical boundary defined our research. As discussed in Section 1.4, the New York Olympic Region is composed of four separate, but connected, jurisdictions. The geographical area which they all share stake in lies within the town of North Elba's boundary, and therefore, most of the data collected for the region's initial LFC Certification was specific to this well defined geographical and informational boundary. Some thought was given to further tailoring the geographical boundary by excluding data from the northwest corner of North Elba, which extends partway into the Village of Saranac Lake; a village with its own separate laws and regulations, and whose actions cannot be directly impacted by policy change enacted by NYOR. However, given our time and resource restraints, we could not discern an efficient way to accurately and universally remove Saranac Lake data from North Elba data, and as a result, it remains in our final dataset.

4.0 *Core Metrics*

In this section, we will explain individually the research processes and results of data collection for the 14 Core Metrics in NYOR. At the end of each section, we will list the decided upon number to be input into the Arc platform. For applicable sections, the number which includes tourist population will also be provided.

4.1 *Greenhouse Gas Emissions*

Metric one of the USGBC LFC Certification process is carbon dioxide equivalent in tons per capita, usually measured via a greenhouse gas inventory. A greenhouse gas (GHG) is defined as a gas that contributes to the greenhouse effect by absorbing infrared radiation[19]. Examples include carbon dioxide and chlorofluorocarbons. Greenhouse gasses have many local and global effects and are one of the primary causes of global warming. Reduction of GHG emissions worldwide is crucial in order to slow the effects of climate change and increase resource and energy security[1]. At the local level, responsible energy use and emissions tracking can help municipalities save money, improve their image, and become more environmentally responsible[20]. Tracking greenhouse gas emissions is important to create a baseline, track progress, and regulate emissions.

The USGBC recommends that the GHG inventory be specific to the region being Certified. There is no existing GHG inventory for NYOR; however, there are estimates for North Elba and Whiteface, and existing inventories for Essex County and ORDA facilities. Even though Essex County includes all of NYOR, the data is not sufficiently precise, and other actions are needed in order to obtain an inventory exclusive to NYOR.

All of our county data has been supplied by the New York State Energy Research and Development Authority (NYSERDA) in their 2010 North Country GHG Inventory[21]. A GHG estimate for North Elba was obtained from the U.S. Department of Energy State and Local Energy Data[22]. Whiteface emissions were estimated by comparing the electricity usage of Gore and Whiteface in 2016. Since they both used approximately 13,000,000 kilowatt hours and are both completely supplied by renewable resources it was determined that they must emit similar levels[23]. All greenhouse gas emission data in metric tons of carbon dioxide equivalent (MT CDE) can be found in Table 4.1. NYOR emissions per capita were determined using 2016 population information. The data was all converted into MT CDE using the U.S. Environmental Protection Agency's greenhouse gas equivalencies calculator[24]. Figure 4.1 shows the sources of GHG in North Elba. It can be assumed the breakdown is similar for all of the NYOR jurisdiction.

In the future, alternative data collection methods may have to be used such as performing our own GHG inventory in conjunction with the Climate Smart Communities program being initiated in Lake Placid, or using the EPA's *Local Greenhouse Gas Inventory Tool*[25].

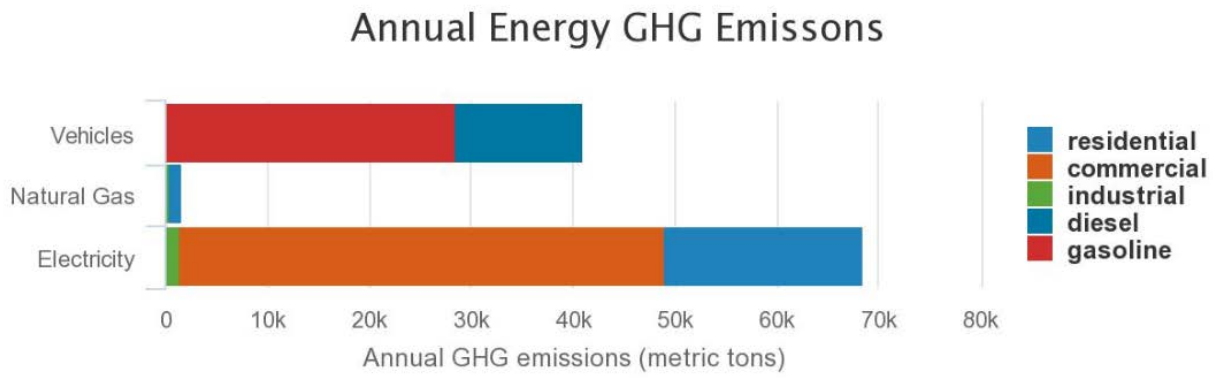

Figure 4.1 (State and Local Energy Data. 2018)

LOCATION	YEAR PERFORMED	TOTAL EMISSIONS (MT CDE)	MT CDE PER CAPITA
Essex County, NY	2010	868,508.00	22.06
Whiteface	Estimated for 2016	900.00	N/A
North Elba, NY	Estimated for 2016	111,000.00	12.00
Gore	2017	900.60	N/A
ORDA*	2015	7,717.19	N/A
NYOR	2017	112,800.60	13.14
United States	2006	5,902,750,000.00	19.78
*ORDA facilities within Essex County/North Elba boundaries included in Essex County/North Elba totals			
*ORDA emissions include all ORDA facilities			

Table 4.1 (State and Local Energy Data. 2018), (NYSERDA Executive Order 166 for ORDA. 2016) and (North Country Greenhouse Gas Inventory Report. 2010)

The value including tourist population was: 6.07 MT CDE per Capita
The value input into the Arc program was: 13.14 MT CDE per Capita

4.2 *Water Consumption*

The second metric for LEED Certification is water consumption measured in gallons per person per year. As the population rises, more water must be provided and distributed, decreasing the overall supply of fresh water while increasing energy needed to pump and clean water. In parallel with increased energy use is an increase in pollution and greenhouse gas

emissions. There has been an upsurge in demand for water without necessary improvements in efficiency or management of existing water supply[26]. Factors impacting water consumption include income, household size, habits, and environmental awareness[27]. With the growing demand for water comes more uncertainty of the total supply of fresh water available. Taking water out of rivers and lakes at higher rates can also negatively impact the surrounding ecosystems. These factors are important to keep in mind for communities trying to become more sustainable and lessen their environmental impact.

The first data source used was the United States Geological Survey (USGS) database. As was the case with many other metrics, the data from this source was too broad. The USGS website only includes water consumption for counties; in this case, the entirety of Essex County was available in an Excel table. Upon further investigation, water consumption data for the Village of Lake Placid was found through the 2017 Village Drinking Water Quality Report[17].

Gathering data for the Town of North Elba, however, was more challenging. The Town of North Elba's water is supplied by a variety of sources without a sole contact for collecting the data. Sources for the town include municipal sources, the village water system, and private wells.

The Ray Brook Water District, a hamlet nested within North Elba, informed us that Ray Brook's water is included in the 2017 Village Drinking Water Quality Report found earlier. We were told that the Town of North Elba potentially gets its water from other municipal sources, such as Saranac Lake, in addition to private wells. Saranac Lake was unable to provide data for the portion of North Elba that lies within the Village of Saranac Lake. The municipal water data was consolidated to the 2017 Village Drinking Water Quality Report. The next step was to focus on private water wells.

Since North Elba is a rural community, many homes use private wells as their water supply. Private wells are not metered, so acquiring a precise number, location, and flow rate of each individual well was impossible. Before getting in touch with the DEC, we attempted to map private wells using GIS but found no data available except for large-scale water pumps in the Village and Town. We also contacted the NY Department of Health, but a response from their data management service was not provided in the time frame of our research. The DEC provided a table of all wells constructed in North Elba since 2000, which only included 71 wells. However, this data did not include the unknown quantity of wells constructed before that date. The maximum flow rate capacity for the wells was given, which does not allow us to calculate the actual consumption from those wells. Using this information, the average flow rate for private wells was calculated and used to estimate water usage for the residents of North Elba using private wells.

Water consumption for the Village of Lake Placid was found to be about 304,000 gallons per year. This data was found through the 2017 Village of Lake Placid Annual Drinking Water Quality Report. The Village has its own municipal water system that withdraws water from Lake Placid through four pumps. These pumps output 1,500 gallons per minute averaging 83,000 gallons of water per day. The system serves 5,000 permanent residents, both in the Village and some customers of the Ray Brook Water District extending outside the Village into North Elba.

To account for the other 3,484 residents in North Elba, we estimated average flow rates for residential wells. This number was found to be 15.8 gallons per minute, which yields 8,304,480 gallons per year. This data was found by averaging the flow rate of private wells given in a spreadsheet provided by a DEC contact with every well constructed in North Elba since 2000. The total gallons per year for the entirety of North Elba was calculated by combining the Village data and the private well estimate and found to be 312,304,480 gallons per year. This was then divided by the total population of North Elba. The water consumption for the Town of North Elba was found to be 36,810.9948 gallons per person per year, which is only marginally higher than the national average, 36,500 gallons per person per year. See Appendix D for specific calculations.

Another challenge faced in calculating water usage in NYOR is how to account for the water consumption of ORDA's facilities. Whiteface and Gore are two ski resorts that consume massive quantities of water daily for snowmaking; however, both ski resorts draw their water from rivers (the Ausable and Hudson, respectively) rather than municipal sources, so their water consumption is better measured using additional Community Metrics, which will be discussed later in the Section 5.0 and can be seen in Appendix C.

The value including tourist population was: 16,805.924 gallons/yr/person
The value input into the Arc program was: 36,386.401 gallons/yr/person

4.3 *Municipal Solid Waste Generated*

Metric three is the total community-wide municipal solid waste generated from within community boundaries in a year divided by the total population of the community. This metric excludes construction waste and industrial process waste. In NYOR, waste data is tracked by the local transfer station as well as the waste management company, Casella.

Waste is a growing issue in the world. Currently, humans generate 1.3 billion tons of waste globally, and are projected to generate 2.2 billion tons by 2025[28]. As population rises, human consumption will likely continue to increase, resulting in a higher tonnage of waste generated, posing a threat to air and water quality, and human health. Having a reliable monitoring system put in place to keep track of waste in cities is critical as it can promote recycling and environmentally-friendly waste disposal methods[1]. If communities put an emphasis on promoting recycling efforts, this would decrease solid waste generated which would reduce the urban solid waste footprint[1].

Casella Waste Management, which services Whiteface and Gore as well as households throughout NYOR and the surrounding area, brings its waste to a landfill in Clinton County. Waste from Whiteface and Gore is only taken to Casella's landfill until a cap is reached; any waste generated at these facilities after this point is brought to the North Elba Transfer Station.

Additionally, it is believed that the waste data from the Transfer Station is generated by all of Essex County, as it is the most easily accessible transfer station in the area.

Because the two entities track waste data separately, with different techniques, and include data not relevant to our region, conceptualizing how this data should be used was challenging. There are private households in Essex County that hire Casella to collect waste. This includes Ray Brook, Wilmington, Saranac Lake, North Elba, and Lake Placid, however, our jurisdiction only includes Lake Placid, North Elba and Ray Brook. To get an accurate tonnage per person per year we needed to subtract the households from outside the NYOR boundary. We did this by finding the percent of Casella serviced households within Lake Placid and North Elba and applying it to the total waste collected from Casella.

Casella provided the total number of households from which they collect waste and what town they were located in. This made subtracting the locations within Wilmington and Saranac Lake from the total more convenient. After the places outside our jurisdiction were taken out, the remainder was divided by the original total number of households to find the percentage of households within the NYOR boundary. The percentage was then applied to the amount of waste provided by Casella which gave a total that only included what was generated within our jurisdiction.

A similar process was done for the North Elba Transfer Station. For the purpose of this project, we assumed the Transfer Station accepted waste from all of Essex County. Rather than account for a percent of households, we looked at the percent of population from Lake Placid and North Elba in terms of the total population of Essex County. The percentage was found by dividing the 2017 ACS North Elba population (which includes Lake Placid) by the 2017 ACS Essex County population. This percent was applied to the total amount of waste collected at the North Elba Transfer Station.

To find the total overall amount of waste, we combined the waste contribution of NYOR households from Casella with the waste contribution of North Elba's population from the Transfer Station. This number was then divided by the 2017 North Elba population to find the amount of waste generated in tons per person per year in NYOR.

The 2017 population of NYOR without tourists is 8,484. The specific numbers as well as facility breakdowns used in calculations can be found in Appendix E. For NYOR, the amount of waste generated per person yearly is 0.37 tons, which was the value input into the Arc platform. The NYOR number is significantly lower than the national average in 2015 of 0.801 tons per person per year, according to the EPA[29]. If tourists are included in the calculations, the population number would be 18,484, resulting in 0.172 tons per person.

The value including tourist population was: 0.172 tons/yr/person
The value input into the Arc program was: 0.37 tons/yr/person

4.4 *Municipal Solid Waste Diverted From Landfill*

Metric number four is the measured ratio of municipal solid waste diverted from landfills out of the total waste stream. This would include the percentages of recycling, composting, and energy recovery, but in NYOR, recycling is the only diversion method tracked. The rate percentage is the weight of diverted waste, divided by the sum of the weight of all the diverted waste and the weight of total landfill waste.

Casella and the North Elba Transfer Station were able to provide us with data that could be used to calculate a value for this metric. Casella collects waste from private homeowners and records solid waste amounts as well as what is diverted, which includes anything that is being recycled. The North Elba Transfer Station tracks their recycling by using punch cards, which record the amount of recyclables sold. In this way they track the weight of recycled material that leaves the transfer station. For our calculations, we had to assume that the amount sold was equivalent to the amount generated over a year.

To arrive at the final NYOR value, we had to again apply the percent of households to the Casella total and the percent of population to the total from the Transfer Station. The value from Casella was combined with the value from the Transfer Station to get the gross recycling amount from within our jurisdiction. To get the overall waste stream, we had to add the NYOR recycling total with the NYOR waste total. The recycling amount was divided by the overall waste stream to get a percentage of waste diverted from landfill.

The total waste generated was 3,813.22 tons and the recycling amount was 636.88 tons, therefore the percent of municipal solid waste diverted from landfills was 16.7%, which was the number input into the Arc platform.

The value input into the Arc program was: 16.7%

4.5 *Distance Traveled in Individual Vehicles Daily*

Metric five, Distance Traveled in Individual Vehicles Daily, otherwise known as vehicle miles traveled (VMT), is a measure of the distance traveled by vehicles within a city or community boundary. In addition to miles traveled within the boundary, half of travel to and from the region is accounted for. This metric is measured in miles per day per capita.

The VMT for NYOR, excluding the tourist population, was calculated to be 100.5 miles per person per day. This number is notably higher than the national average of 26.9 miles per person per day[30]. This is partly due to the fact that a high percentage of the vehicle traffic measured is coming into NYOR. Tourist travel has the largest impact on NYOR VMT, with 77.4% of VMT for North Elba coming from tourist travel into the region.

High amounts of vehicle travel deteriorates the natural environment and, in turn, peoples' health. Vehicles emissions include particulate matter, volatile organic compounds, and nitrogen

oxide, all three of which negatively impact air quality and can have serious health implications[31]. In fact, transportation emissions are responsible for nearly a quarter of global GHG emissions[32], which are major contributors to climate change[1]. VMT, therefore, is closely related to Air Quality and GHG emissions. Thus, taking steps toward reducing VMT reduces transportation-related emissions, mitigates the effects of climate change, improves air quality, lowers air pollution, and improves the health of local residents.

Cities with lower VMT tend to be safer, better connected, and healthier[33]. Methods to reduce reliance on vehicles include improving existing public transportation or constructing new public transportation, incentivizing alternative forms of travel, and investing in pedestrian and cyclist infrastructure. Improved public transportation can be utilized to shuttle tourists around notable sites in and out of a community, while also providing a reliable transportation network for local workers who may not have access to personal vehicles. Public transportation reduces dependence on personal vehicles, and aids in reducing the number of vehicles on the road, making for safer, less crowded streets[34]. Bike lanes and pedestrian pathways encourage community members to travel in non-motorized routes that can improve their own fitness and reduce the risk of health issues[33].

Improving public transportation systems in a rural region is a challenging process. Due to low population density, it is often not worth the cost to put in a rail or even increase bus infrastructure. Complicating the matter, development in the Adirondack Park is heavily regulated, making it difficult to build new large-scale infrastructure. Whatever method is used, care should be taken to not negatively impact the number of tourists drawn to the region, as tourists are a major economic driver in NYOR.

The value including tourist population was: 46.1 miles per person per day
The value input into the Arc program was: 100.5 miles per person per day

4.6 *Population with (at least) a High School Degree (25 and older)*

Metric number six, one of the two education metrics, measures the percentage of people over the age of 25 who have at least a high school diploma, or equivalent degree. Educational attainment within a community is important to measure for a variety of reasons. Higher educational attainment has been shown to improve well being and vitality of individuals and communities, lower the risk of unemployment, and improve the productivity of a workforce[35, 36, 37, 38, 39].

The data for this metric was found through the American Community Survey (ACS), which can be found on the FactFinder website run by the US Census Bureau. The American FactFinder website is a tool that can be used to research population, education, economic, and geographic details about specific locations. The data for this metric was found in the Community

Facts section of the website in the category “Education” in the table for “Educational Attainment.”

The calculations done to find the percentage included adding up the population of people 25 years and over who have at least a high school degree and dividing it by the total population over the age of 25. Specific numbers used in the calculations can be found in Appendix H.

The results from the 2017 ACS showed that in Lake Placid, the percent of the population with a high school degree was 88.2%. This was slightly lower than the percentage for North Elba, which was 90.2%. Given the boundaries of the investigation explained in Section 3.3, the final percentage for NYOR was 90.2%[40].

The same calculations were followed to calculate the national educational attainment, and the value for the United States were found to be 87.3%[16]. In comparison to the United States data, NYOR is 2.7% higher.

The value input into the Arc program was: 90.2%

4.7 *Population with (at least) a Bachelor's Degree (25 and older)*

Metric seven, the second education metric, measures the percentage of people over the age of 25 who have a Bachelor's degree or higher. Similar to the data for metric six, data for metric seven was found on the Census Bureau’s American FactFinder website in the table “Educational Attainment.”

The calculations done to find the percentage involved adding up the population of people 25 years and over who have at least a Bachelor’s degree and dividing it by the total population over the age of 25 years. Specific numbers used in the calculations can be found in Appendix I.

The results from the 2017 ACS showed that in Lake Placid, the percentage of the population with at least a Bachelor’s degree was 29.5%. This was slightly lower than the percentage for North Elba, which was 33.9%. Given the boundaries of the investigation explained in section 3.3, the final percentage for all NYOR was 33.9%[40].

The same calculations were followed to determine national educational attainment, and the value for the United States was found to be 30.9%[40]. In comparison to the United States data, North Elba is 3% higher.

The value input into the Arc program was: 33.9%

4.8 *Median Gross Rent as a Percent of Household Income*

Metric eight measures the median percent of household income spent on housing costs for renters. For this metric, the data was not readily available in the 2017 American Community

Survey. However, we were able to find data necessary to calculate this metric. For our calculations, we used the median annual household income for renters provided by the ACS ($49,632 for Lake Placid and $48,772 for North Elba) and median housing costs for renters ($833 per month in Lake Placid and $857 per month in North Elba). To calculate this metric, the monthly housing costs were converted to annual housing costs and divided by the median annual income. The median gross rent as a percent of income for Lake Placid and North Elba in 2017 were calculated to be 20% and 21% respectively.

Nearly a quarter of median household income, both for Lake Placid and North Elba, is used to pay off rent annually. The United States Department of Housing and Urban Development (HUD) classifies households that spend more than 30% of their annual income on housing as "cost burdened[41]." The ACS data for North Elba includes data for Lake Placid, therefore the value calculated for North Elba will be entered into the Arc platform as the value for NYOR. Although this value is lower than the 30% threshold set by HUD, this is only the median percent; housing costs are still a concern for stakeholders.

The value input into the Arc program was: 21% for 2017

4.9 *Gini Coefficient*

The Gini Coefficient is a standardized way of measuring income distribution inequality within a population. A Gini Coefficient of 0 represents perfect equality in income distribution, and a Gini Coefficient of 1 represents perfect inequality in income distribution. The Gini Coefficient is determined by looking at the cumulative percentage of income held by the cumulative population. In a situation with perfect equality, each individual would have the same income as every other individual. In reality, it is often the case that large amounts of income are held by small portions of the population; the greater the amount of income that is held by fewer individuals, the higher the Gini Coefficient. For a more detailed description of the Gini Coefficient, see Appendix J.

This data was found on the American FactFinder website by using the Advanced Search tool to locate the Gini Coefficients of the NYOR communities[42]. Lake Placid's Gini Coefficient was 0.408 and North Elba's was 0.402 in 2017, according to the ACS. However, since North Elba's boundary includes both North Elba and Lake Placid, North Elba's data will be input into the Arc platform. Ideally, the Gini Coefficient should be as close to zero as possible. To get a better understanding of NYOR's standing relative to the nation as a whole, we compared these two communities to the Gini Coefficient of the United States, which is 0.4815. Stakeholders were surprised that the local Gini Coefficient was better than the nation's. This discrepancy was due to the difference in income between permanent year-round residents and second homeowners in the region. However, the Gini coefficient is calculated only using the income of

permanent residents that file their taxes in the region, therefore seasonal or part-time residents do not impact the Gini Coefficient calculation.

The value input into the Arc program was: 0.4017 for 2017

4.10 *Median Household Income*

Metric 10, the first metric in the category of prosperity, is the median annual income of all households in the jurisdiction. This data, in conjunction with metric 11, acts as a measure of the economic situation experienced by the average resident of the area. Its significance to the LFC project lies in the project's human-centric approach to smart community development. The data was found on the American FactFinder website in the "Income" section of the Community Facts tool in the "Selected Economic Characteristics" table.

According to the ACS, in 2017 North Elba recorded a median household income of $60,651 and Lake Placid recorded a median income of $53,487; this does not include seasonal or part-time residents. This information would be beneficial to the community due to the visible divide between season or part-time residents and the year round population. To provide context, the median household income for the United States was recorded as $57,652 in 2017.

The value input into the Arc program was: $60,651

4.11 *Unemployment Rate*

The unemployment rate of an area, metric eleven, is defined as the percentage of the labor force above the age of 16 years that do not have a formal, legally recognized employment[1]. As with metric ten, the data for this metric was found on the American FactFinder website. In 2017, the unemployment rate in Lake Placid was recorded as 8.8% and North Elba recorded a rate of 6.7%. North Elba's lower unemployment rate could be attributed to a better fit between the skills of the workforce and the skills required by the available jobs. Furthermore, due to the seasonal nature of employment in certain sectors (such as ORDA facilities), the unemployment rate will fluctuate to a measurable degree on a monthly basis. However, in both cases, there is not much deviation from the unemployment rate of the United States, which was recorded as 6.6% in 2017.

The value input into the Arc program was: 6.6%

4.12 *Median Air Quality Index*

Median AQI is a yearly measure of a region's air quality. It is found by taking the maximum AQI reading for the most prominent airborne pollutant on each day of the year, and then selecting the median value from the list of readings for the year. Created by the EPA, AQI is a unitless number between 0 and 500 used to characterize air quality based on the concentrations of given airborne pollutants. An AQI in the 0-50 range is considered "good", while an AQI between 301-500 is considered "hazardous". The calculations vary by each pollutant[43].

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects.

Table 4.12: The Air Quality Index categories, numerical values, and their corresponding meanings.

NYOR's AQI data comes from air pollutant concentration measurements made at the Marble Mountain Lodge on a shoulder of Whiteface Mountain. At approximately 1800 feet in elevation, this research station managed by the University at Albany's Atmospheric Sciences Research Center (ASRC) gives a relatively accurate representation of the quality of air which the people of the region breathe at ground level. Pollutant concentrations measured at this station include gases such as carbon monoxide (CO), sulfur dioxide (SO_2), ozone (O_3), and nitrous oxides (NO_X), as well as both small and coarse particulate matter ($PM_{2.5}$ and PM_{10}) which are particles with diameter less than 2.5 microns and 10 microns, respectively[44].

The most common pollutants in this region are O_3 and $PM_{2.5}$. Ozone can form at ground level due to chemical reactions between gases emitted from vehicles, factories, or numerous other pollution sources. This formation process is facilitated by sunlight, so ozone is often at its highest concentration during the summer. Small particulate matter can take many forms, but some common examples are ash from wildfires or molecules emitted by aerosol cans. Both of

these pollutants can have negative health impacts on humans when concentrated too heavily[45]. In 2017, the Marble Mountain Lodge station measured O_3 as the most prominent pollutant on 362 days of the year, and $PM_{2.5}$ on 3 days of the year, contributing to a calculated median AQI of 39 for the year[46].

The value input into the Arc program was: 39

4.13 *Air Quality Days Unhealthy for Sensitive Groups*

On the AQI scale, the "unhealthy for sensitive groups" zone lies between 101-150. This metric is a measure of how many days are within that zone per year. Sensitive groups are divided into two different groups: people affected by small particulate pollution and people affected by ozone. People affected by small particulate pollution include people with lung diseases, people with heart diseases, children, and older adults, while people affected by ozone include people with lung diseases children, older adults, and active people[45].

Both sensitive groups are affected by different potential health risks when AQI reaches the 101-150 range. These health risks can vary from small health risks such as chest pains and fatigue for people with existing heart diseases, but can lead to even larger risks such as heart palpitations, shortness of breath, heart attacks, or even death. Lung diseases such as asthma or chronic bronchitis can be aggravated when people that suffer from these lung diseases are exposed to either ozone or small particulate pollution. They may also suffer from symptoms such as reduced lung function, the lungs becoming susceptible to infection, irritation of the respiratory system, and inflammation and damage to the cells lining the lung[45].

In 2017, NYOR experienced 0 days unhealthy for sensitive groups[46].

The value input into the Arc program was: 0 days

4.14 *Violent Crime*

Violent crime, the fourteenth metric, measures the number of violent crimes per capita per year in the region. Our research began with the Federal Bureau of Investigation (FBI), which defined violent crime. According to the FBI, violent crime must involve force or threat of force; specifically, the four offenses of murder and nonnegligent manslaughter, forcible rape, robbery, and aggravated assault[47].

The next step in our process was to start looking for data on violent crimes that have occurred in recent years. From the New York State Crime Report: 2016 Final Data, we found two different sets of data for Essex County (Appendices 3 and 6 in the New York State Crime Report, or NYSCR)[48]. The first set of data, Appendix 3 of the NYSCR, gave the crime rate value of violent crime per 100,000 people. The second set of data, Appendix 6 of the NYSCR, gave

information on the percent change of total violent crime from year to year separated into the four categories of violent crime in Essex County[48].

In search of more data, we contacted the Lake Placid Village Police Department who suggested we file a Freedom of Information Law (FOIL) request. However, because this option is costly and time consuming, we continued the rest of our research online. After further investigation, we found data from the New York State Division of Criminal Justice Services (NYS DCJS) on violent crime rates per 100,000 people that closely correlated with the data found from the New York State Crime Report: 2017 Final Data[49]. The most useful data set provided by the DCJS was an Excel file that gives the individual number of violent crimes reported in Essex County, and who the crimes were reported to, from 2013-2017[49]. Included in this data set is the Lake Placid Village Police Department and the New York State Police. After contacting the Ray Brook State Police and confirming that North Elba is protected by the State Police rather than a town police force, we were able to derive accurate and precise data for North Elba. We used the NYS DCJS Index Crimes Reported Excel file, and after subtracting all other police departments in Essex County we were able to acquire data for North Elba that matched other data sources. With this accurate and reliable data measured in crimes per capita per year, we were able to enter it into the Arc platform. It is important to note the population difference in Lake Placid and North Elba when comparing violent crime. Lake Placid is roughly 3.5 times smaller than Lake Placid; this accounts for the higher total number of violent crime reported in North Elba. This is mitigated by converting the data into per capita per year.

Our data, as entered in the Arc platform for the year of 2017, came out to 0.00578 total violent crimes reported per capita in North Elba and .00079 total violent crimes reported per capita in the Village of Lake Placid. This data is important because LEED for Communities and Cities focus on sustainability in terms of the Human Experience. Living in safe communities promotes a positive Human Experience. Smart cities see a reduction in violent crime compared to non-smart cities. One hospital in Wales saw a 42% decrease in crime-related injuries after implementing a new crime data sharing and collective smart city program[50].

The value including tourist population was: 0.00265 Total Violent Crimes Reported per Capita
The value input into the Arc program was: 0.00578 Total Violent Crimes Reported per Capita

5.0 *Community Metrics*

As discussed in Section 2.3, there were two options for improving the community's base score beyond the Core Metrics. NYOR made the decision to track additional metrics within the community, following Option B. The metrics chosen by the community stakeholders were compiled by the Clarkson student team and consisted of metrics taken directly from the USGBC list, metrics modified from the USGBC list, and metrics created for NYOR specifically. The

metrics were suggested to the stakeholders based on their stated goals and current projects and were divided into four themes and thirteen categories. The categories within the Human Experience theme were Community Engagement and Satisfaction, Connectivity, Health and Accessibility, Sustainable Recreation, and Affordable Housing and Prosperity. The Energy theme included categories of Energy Consumption, Renewable and Alternative Energy, Electricity, and Building Efficiency. The Waste theme was broken into categories of Recycling and Waste Management, and the Water theme into categories of Water Monitoring and Water Sources (see Appendix D). In each of these categories, several metrics were chosen, modified, or created to measure the progress of community goals.

Several meetings were held between CASS and stakeholder representatives to create a comprehensive list of metrics that matched the community's expectations and provided the information required by the USGBC. At these meetings, each metric was discussed to determine relevance, ease of data collection, possible sources of data collection, concerned stakeholders, and "lead" stakeholders (those responsible for data collection and input into Arc).

Given the incredibly unique nature of the New York Olympic region, many metrics had to be created to thoroughly account for community goals. In some cases, this was a simple task; for instance, the Village of Lake Placid wanted all connected municipal water users to be metered, which can be measured with the straightforward metric of "percent of metered connected users." Other goals were more difficult to find clear measurements for. Water usage for snowmaking at ORDA's winter sports facilities posed an interesting challenge, as the snowmaking operations at each ORDA venue are very different. To overcome this challenge, three separate metrics were created to track snowmaking: total energy used for snowmaking, total water used for snowmaking, and total water extracted from rivers for snowmaking. Some of the metrics the stakeholders decided to include may have to be modified in the future, and new metrics may be added, as goals and data collection methods continue to evolve.

6.0 *Challenges*

6.1 *Research Challenges*

As with any research project, many challenges were faced during the process of Certifying NYOR as a LEED Community. Several of these obstacles involved the boundaries of data collection. Because information was often available at the county level, which was not precise enough for this project, estimates had to be calculated for several metrics. North Elba was used as the default boundary for data collection, but this included a portion of Saranac Lake that is not affiliated with the LFC efforts in NYOR.

Timewise, CASS was restricted to a 3 month period of time in which to familiarize ourselves with the area, with the LFC program, and to collect and analyze all of our data - all while taking a 15 credit course load. As a result, any problems we encountered with the

availability of data could not be resolved through investigation, but rather had to be temporarily amended through proxy calculations. Time may have been the greatest challenge we faced; however, it did not hinder us from completing the initial LFC Certification for NYOR, or from compiling a thorough analysis of the LFC Certification process for communities such as NYOR.

The implementation of any new infrastructure in a rural community will always pose some difficulties, however, the LFC project taking place here presents its own unique challenges. The multi-jurisdictional nature of the area raises the question of operational boundaries and authorities to appeal to when collecting data. Furthermore, the LFC program in NYOR would be the template by which other rural areas will model similar programs. Therefore, replication of our methodology will be key to ensuring easier implementation of this program in future communities. To this end, we have worked to ensure that our data gathering process is made readily available to those who wish to pursue this project.

Communication provided challenges as well. Despite consistent and early efforts to arrange stakeholder meetings with all parties represented, we were unable to do so until late in our semester, and therefore questions about who to contact for necessary information were delayed. Additionally, contacting individuals and organizations to gather data occasionally proved to be difficult and time consuming.

6.2 *Challenges with LFC*

The LEED for Communities platform has limitations with the scope of the Core Metrics and the scoring system. To allow for community comparison, the weighting of the Core Metrics are uniform across different communities. However, the relevance of the Core Metrics and their significance to the community vary by location. Not only does this mean that points are not equally valuable across all categories and each community, but that some communities will need to measure metrics that are less important to them, are difficult to find data for, or are challenging to make improvements upon. Furthermore, points do not directly correlate to progress. Communities may make improvements that do not receive enough points, if any, to improve their Certification standing or they may earn points in areas that are not in the best interest of the community.

Decision makers need to be aware of the disconnect between scoring and progress. Community Metrics resolve many of these issues; however, they require additional resources to measure, and improvements are not reflected in the community's Performance Score. This can be problematic for smaller communities with fewer resources.

Some of the limitations of LFC are specific to rural communities. Rural communities do not have access to the same levels of information for tracking that urban communities do. Population density is often too low to warrant surveys or implementation of new data tracking systems, so data collection at the local level is rare. Larger organizations, such as the state government, can provide large data sets that include rural communities. However, this data is

often not specific to the community in question. For some purposes, this data can reasonably be used. In some cases, however, approximations may have to be used instead of accurate measurements. This makes tracking progress over time more difficult as approximations lack the accuracy and precision for proper cross-community comparisons.

Communities with highly tourist-dependent economies also face challenges with the LFC process. Perhaps the most significant question they raise is whether or not the transient visitor populations should be included in a region's total population count. In areas with high tourist traffic, such as NYOR, including the visitor population in per capita measurements provides a more accurate assessment of the impact of an individual on use of resources. To exclude tourists from population counts in a community such as NYOR puts an undue burden on permanent residents and does not hold tourists accountable for their impacts on the environment.

The next section will focus on recommendations to resolve these issues.

7.0 *Future Steps*

7.1 *Recommendations to USGBC for Improvement*

As this project progressed, CASS faced many challenges and roadblocks we believe should be addressed by the USGBC. The following sections outline our suggestions for improving the LEED For Communities program based on our experiences in Certifying NYOR.

7.1.1 Population

We recommend that the USGBC allow communities that have consistent daily visitor populations the option to include visitor population in their region's population for metrics 1 through 5 and 14. As mentioned before, the tourist population of the New York Olympic Region exceeds the full time residential population (10,000 to 8,484, respectively). The tourists have a significant impact on the community and the metric data measured. It would misrepresent the environmental impacts of the region's residents to exclude visitor impacts. This could make the program unfavorable for rural, tourist-based communities, and therefore lessen the utility of the LEED for Communities project overall.

7.1.2 Community Metrics

Currently, there is little incentive within the program to follow through with tracking and improving Community Metrics. A community can only gain a maximum of 10 Base Score points when they track Community Metrics; these 10 points only account for 20 metrics, and do not account for improvement made on these metrics. Without allowing for points or other forms of incentives or recognition, many improvements seen in Community Metrics will not be reflected in the Performance Score. We recommend that there be some sort of consideration made within LFC for improvements on Community Metrics.

7.1.3 Create a distinction between LEED for Cities and LEED for Communities

Most of the communities that are now LFC Certified are cities. Because of NYOR's unique setting and rurality, the 14 Core Metrics were not an easy or effective way to provide baseline data for the community. LFC is a great program to keep communities thinking about their sustainability efforts, but currently, the system is not completely compatible with all types of communities, especially NYOR. For NYOR, many data points were not easily found, readily available, or specific enough to the area that we wanted. Beyond ease of finding data, urban and rural communities have different priorities and concerns that shouldn't be overlooked. CASS believes it would be beneficial to have separate LFC programs for Cities and Communities that take the differences between urban and rural communities into account.

7.1.4 Greenhouse Gas Emissions

The USGBC should consider providing a service to assist communities who do not have the resources to perform a local GHG inventory. USGBC could possibly work in conjunction with the EPA to provide the necessary tools and knowledge to perform this task. This would help many communities overcome a significant obstacle to Certification.

7.1.5 Water Consumption

In NYOR, not all water consumption is metered and an unknown number of wells are utilized. For our data collection, we figured out the average water usage from connected to metered users and then extrapolated well water use. We found that to be an appropriate approach, though we would recommend setting a standard for finding the most accurate and relevant data when there are private wells to be accounted for.

In NYOR, as in many rural communities, not all water consumption is tracked. Many households use private wells that are not metered; CASS believes a standard should be set by the USGBC to account for this lack of data uniformly across rural communities. We believe the method used in NYOR (calculating the average water usage of metered users and extrapolating well water usage) is a satisfactory method of accounting for private water use.

7.1.6 Distance Traveled in Individual Vehicles Daily

The goal of this metric is to focus on reducing VMT within a community, but it can be difficult to do so in a rural community like NYOR. There is difficulty implementing new public transportation infrastructure in rural communities because the infrastructure costs are greater than the return benefit due to low population density. We recommend that the USGBC look at assigning different weights to the Metric Categories in LEED for Communities than LEED for Cities in recognition that rural communities may value these differently.

7.1.7 Population with (a least) a Bachelor's Degree

In rural communities, Bachelor's degrees are often less valuable than they are in cities. Across the nation, there has been a shift towards technical training rather than higher education, and in rural communities especially there tend to be a greater number of jobs requiring skilled labor[51]. Allowing communities to track the number of people with Associate's degrees and trade school Certifications may be more beneficial and representative of the actual needs of the community. Thus, we recommend LEED for Communities track these in addition to Bachelor's degrees under the education category in the Core Metrics.

7.1.8 Violent Crime

To maintain a good quality of life, it is evident that violent crime should be reduced. Though it is not counted as a violent crime, domestic abuse should not be overlooked. We recommend creating another metric, whether it be part of the Core Metrics or a highly recommended Community Metric, to track domestic abuse. According to Coker[52], domestic abuse damages mental and physical health, therefore reducing the quality of life for those affected.

7.2 *Continuation of LFC in NYOR*

LFC is an ongoing process that does not end when a Performance Score is awarded. The following sections detail our recommendations to NYOR as they move forward with this process.

7.2.1 Future Data Collection and Input

There are several options for continued data collection and tracking. CASS's involvement ends December 2018, so future data collection will need to be carried out by a different group or groups. Options include future Adirondack Semester students, Clarkson Honors Program students, and Lake Placid High School students; additionally, NYOR could create a committee for data collection and input. There will also need to be improvements in data sources and data availability. For example, a GHG inventory will have to be performed specifically for NYOR. Furthermore, efforts can be made to streamline the data collection process by making organizations aware of the need for particular types of data. In the future, the Village Drinking Water Quality Report could include water consumption per person per year; Casella and the North Elba Transfer Station can track waste and recycling and have a report prepared for NYOR annually; stakeholders can discuss potential ways to track VMT of residents and visitors separately and automatically; and the relevant police forces could provide violent crime statistics in an annual report.

7.2.2 Recommendations for NYOR

A huge part of this program is developing future plans for how data can and will be collected for the community. We have collected an initial data set and recorded our processes so that data collection and input can be replicated. As stated in 7.2.1, the LPCSD students could help with data collection and input moving forward. By collecting data for NYOR through clubs and environmental courses provided at the school, students will gain a better understanding of the sustainability efforts and progress made in their community. For data collection and input beyond the scope of a high school course, a committee could be created by the Town and Village, ideally including an ORDA representative. Creating a committee specifically for managing LFC within NYOR would be beneficial for the upkeep of data collection and input required to maintain Certification.

Clarkson University also plans to continue to assist NYOR in their LFC efforts. A Memorandum of Understanding is being finalized between NYOR and Clarkson that will allow NYOR continued access to Clarkson students, faculty, and resources. In addition to some of the members of CASS potentially continuing their involvement in the project, Clarkson's Honors students may become involved and research opportunities may be created for the larger Clarkson community.

7.2.3 Recommendations for LPCSD

Involvement from LPCSD will be very beneficial for both NYOR and the school district itself. Students in the Lake Placid High School AP Environmental Science class, as well as students involved in clubs, are already working on community sustainability projects that are relevant to LFC efforts. Continuing and encouraging these projects will help to give students a sense of ownership of ways they have impacted and helped their own community. As new student projects relevant to community sustainability are created, Community Metrics should be added to track the progress and impact of LPCSD students.

7.2.4 Recommendations for TNE and VLP

As an effort to promote sustainability, the Town of North Elba and the Village of Lake Placid should invest in electric vehicle (EV) charging stations. This will encourage drivers to utilize their electric vehicles. Charging stations in strategic locations will encourage a reduction of GHG emissions. Additionally, the availability of EV charging stations can be used as a marketing tool to encourage EV tourism; people with electric cars are more inclined to visit places that provide charging stations, which could be used as a pull to bring more environmentally conscious people into the area.

7.2.5 Recommendations for ORDA

A model regarding sustainable ski resorts would be Vail Resorts' Epic Promise. It would be beneficial to ORDA to consider competing against Vail either directly as a campaign, or indirectly as a set of objectives. The goals of the Epic Promise include Zero Net Emissions, Zero

Waste to Landfills, Zero Net Operating Impact on Forests, and Community Giving. ORDA has already began the process of including many these ideas in everyday operations; both Gore and Whiteface are in the process of switching over to renewable energy to power their facilities. Furthermore, due to their location within the Park, both ski mountains are already conscious of their impact on the forests surrounding their facilities. Moving forward, ORDA could commit to reducing or eliminating single-use plastics, work with the school to reduce food waste by utilizing a digester, and actively track waste diverted from landfills. In regards to the Community Giving goal, ORDA could track the ways that their facilities are used to support local groups and event. Because ORDA is a public benefit corporation, however, it would not make sense to offer grants like Vail does, but hosting and supporting events still provides support to the community.

7.0 *Conclusion*

This investigation was the first step in the longer process of NYOR improving sustainability. The efforts of CASS have established a solid foundation from which the NYOR community can build and develop their smart city practices. With key connections made between community officials, and research processes defined, the community now has an enhanced ability to measure and track their progress in reducing their environmental impacts. This investigation has also served as an outline for future rural or tourist based communities to follow when seeking either LFC Certification, or participation in one of the numerous other smart city frameworks.

We believe that the strategy of linking local universities with rural communities is an effective one, and is especially useful for communities with fewer human and financial resources available for projects such as this. The positive effects of these relationships between academic institutions and communities are felt in both directions. From community projects, students gain real world research and problem solving experience, while providing outside ideas and perspectives which may inspire fresh approaches that advance the community's goals. With this in mind, the relationship between Clarkson and NYOR will continue.

Though NYOR's Performance Score is still unknown at this time, NYOR has set precedents for future rural, tourist-centric, or multijurisdictional communities and CASS is confident that the community will continue to improve its sustainability with a strong focus on quality of life for NYOR residents.

8.0 *Acknowledgements*

This project was a massive undertaking that was aided by many organizations and individuals, and we would like to give our utmost gratitude and appreciation to everyone who helped this project move forward throughout the semester. This work would not have been

possible without the support of Clarkson University and Paul Smith's College. A special thank you to Stephen Bird and Erik Backus, the directors of the Adirondack Semester Program. We appreciate all of your guidance throughout the whole semester. We want to show sincere gratitude to Vastal Bhatt for helping us get started on the process of finding data. Our program would like to take the time to give thanks to the Mayor of Lake Placid, Mayor Craig Randall, for helping to point us in the right direction on where to find data and giving us names to further help us reach contact. We thank Dean Dietrich, Chairperson of the Lake Placid and North Elba Community Development Commission, for assistance with putting the students in contact with local resources to get information about the metrics. We gratefully wish to thank the Olympic Regional Development Authority in Lake Placid, especially the President and CEO Mike Pratt; Director of Planning and Construction Robert Hammond; Cort Honey; and Nick Zachara. We would also like to thank the Lake Placid Electric Superintendent, Kimball Daby, for his assistance and involvement.

We are especially grateful to all of our professors this semester for providing us with the knowledge needed to succeed this semester. Thank you to Professor Stephen Langdon for educating us on our local environment, Professor Bethany Garretson for her Sense of Place class which gave us our first introduction to the Adirondack Park, Professor Bill Olsen for helping us understand our surroundings by mapping the Adirondack Park with GIS, and Professors Martin Heintzelman and Christopher Robinson for helping us think critically about social, political, and economic issues in the Adirondacks.

We are grateful to Harry Gordon for his help on our presentations and for letting us present with him at the Clean Energy Economy Conference in Glens Falls.

Finally, we would like to thank Keith McKeever (APA), Mark Rooks (APA), Jamie Rogers (ANCA), Jay Rand (North Elba Town Board), Jason Leon (Village Trustee), Steve Baumgartner (Smith Group), Kelly Carter (Wild Center), Kris Cheney-Seymour (Nordic Program Manager at Mt. Van Hoevenberg), and Mike Leblanc (Assistant General Manager at Whiteface) for meeting with us and answering all our questions.

Thank you to everyone who was involved in this project; it would not have been possible without your help.

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10.0 *Appendices*

Appendix A - *Meetings Held*

Date of Meeting	Location	Individuals Present	Brief Description of Notes
September 7, 2018	Lake Placid Olympic Center	ORDA Representatives: Bob Hammond, Mike Pratt, Cort Honey, and Nick Zachara Lake Placid Central School District: Erik Backus	● First meeting with ORDA ● Modernization and efficiency efforts being made ● Future goals for the company ● Discussion of environmental impacts
September 7, 2018	Lake Placid Olympic Center	USGBC Director of Cities and Communities: Vatsal Bhatt Clarkson students: Kevin Brooks and Thomas Gitlin	● Availability of public versus private data ● Helped determine where we should start with collecting data ● Needed to define the boundaries of the region
September 13, 2018	Pontiac Bay, Saranac Lake	Lake Placid Central School District: Tammy Morgan LPCSD Environmental Science Class Adirondack Semester Professor: Erik Backus DEC, Land, Wood Consulting Representatives	● Went to the remediation of Pontiac Bay and Brandy Brook construction site in Saranac Lake
September 13, 2018	Beach House, Lake Placid	Chairperson of Lake Placid/North Elba Community Development Commission: Dean Dietrich Adirondack Semester Professor: Erik Backus	● First meeting with a Lake Placid representative ● Discussed the 10 year comprehensive plan Lake Placid has ● Talked about the demographics of the city have changed ● Environmental concerns that exist in the community ● Provided a list of resources that would be available for data collection ● Did not have any specific parameters that they wanted fulfilled at the time, but willing to work with different proposals ● Gave ideas for potential

			future projects Lake Placid was interested in completing
September 20, 2018	Adirondack Park Agency	Adirondack Semester Professor: Stephen Langdon APA Representatives: Keith McKeever and Mark Rooks	● The APA wants to start integrating an energy policy into their actions ● Differences between the laws for public and private lands within the Park
October 10, 2018	SUNY Adirondack	Forestry Roundtable Conference	● Main point of the conference was sustaining private forests as working landscapes ● Economic, ecological, societal importance of the Park to New York ● Consideration of making the Forestry Roundtable a stakeholder group
October 19, 2018	Paul Smith's College	Adirondack Semester Professors: Stephen Bird and Erik Backus LEED Fellow and FAIA: Harry Gordon	● First meeting with Harry Gordon ● Discussion and feedback about the presentation ● Figuring out how to incorporate Harry into the presentation we had
November 5, 2018	Beach House, Lake Placid	ORDA Project Coordinators: Cort Honey and Nick Zachara Chairperson of Lake Placid/North Elba Community Development Commission: Dean Dietrich North Elba Town Board: Jay Rand Lake Placid Superintendent: Roger Catania Adirondack Semester Professors: Erik Backus and Stephen Bird	● First meeting with all of the stakeholders involved ● Distributed a handout that described the up to date progress of the project ● Provided other contacts for unfinished metrics ● Spoke to what individual stakeholders wanted to improve on
November 14, 2018	Lake Placid Central School District	Lake Placid Central School District: Tammy Morgan LPCSD Environmental Science Class Lake Placid Elementary School: Jason Leon Youth Climate Program Coordinator: Kelly Carter	● Briefly walked through how to use Arc ● Talked about how the students can help with data collection in the future

November 16, 2018	Paul Smith's College, Beach House in Lake Placid	ORDA Project Coordinators: Cort Honey and Nick Zachara Chairperson of Lake Placid/North Elba Community Development Commission: Dean Dietrich North Elba Town Board: Jay Rand Adirondack Semester Professors: Erik Backus and Stephen Bird	● Teleconference ● Had sent documents previously concerning Community Metrics ● Have both USGBC additional metrics as well as ones that were made up by the students ● Started changing the Community Metric list provided to find the ones most relevant ● Stakeholders were working together to figure out who was going to take lead on each metric
November 26, 2018	Beach House, Lake Placid	ORDA Project Coordinators: Cort Honey and Nick Zachara Chairperson of Lake Placid/North Elba Community Development Commission: Dean Dietrich Lake Placid Electric Superintendent: Kimball Daby Adirondack Semester Professors: Erik Backus and Stephen Bird	● Went through the revised Community Metrics ● Stakeholders provided other data sources that could be utilized for gathering information ● Discussed the process of getting approval for the project and possible Certification

Table 10A: Meetings Held

Appendix B - *Presentations Given*

Date	Location	Notes
October 25, 2018	Glens Falls, Climate Energy Economy Conference	● First public presentation ● Answered questions from the audience ● Received feedback and potential sources for information
December 10, 2018	Lake Placid, ORDA Conservation Center	● Public presentation in Lake Placid
December 12, 2018	Clarkson University, Moore House	● Public presentation at Clarkson University

Table 10B: Presentations Given

Appendix C - *List of Community Metrics*

Theme	Category	Indicator	Description	Origin of Metric
Human Experience	Community Engagement and Satisfaction	Voter turnout	Percent of eligible voting population turnout	New
		Number of farmers' markets per year	Number of farmers' markets held by the LPHS team per year	New
		Number of participants in farmers' markets per year	Number of participants at farmers' markets held by the LPHS team per year	New
		Total area of public parks and playgrounds		Modified from USGBC
		# *public access* buildings with access to high speed internet (100Mbps*)		New
		# *residential* buildings with access to high speed internet (100 Mbps*)		New
		Miles *recreational* bike infrastructure per square mile	Miles of bike infrastructure (bike paths, designated bike lanes) per square mile of jurisdiction	Modified from USGBC
		# volunteers at events		New
		Public access to facilities	hours of access to ORDA facilities	New
	Connectivity	Miles *transportation* bike infrastructure per square mile	Miles of bike infrastructure (bike paths, designated bike lanes) per square mile of jurisdiction	Modified from USGBC
		Miles pedestrian infrastructure per square mile	Miles of sidewalk, trails, etc per square mile of jurisdiction	From USGBC
		Number of visitors who use public transportation	Number of visitors who use public transportation (sort by destination?)	New
		Number of residents who commute with public transportation	Number of people who commute to work via public transportation (not including taxis)	Modified from USGBC

		% workers without access to a vehicle	% of workers 16 and over in households without access to a vehicle (ACS description)	Modified from USGBC
	Health and Accessibility	Miles trails ADA compliant	Miles of trails compliant with the Americans with Disabilities Act	New
		Miles of Universal Access trails		New
		# people who live within given distance of a trail		New
		Population with health insurance coverage		From USGBC
	Sustainable Recreation	Miles singletrack mountain bike trails	Miles of mountain bike trails considered singletrack (users must be single file; generally 18 to 24 inches)	New
		Miles sustainable multi-use trails		New
		Miles maintained Nordic ski trails		New
		Miles maintained alpine ski trails		New
	Affordable Housing and Prosperity	% population below poverty line		From USGBC
		Collection of unemployment benefits	Weekly or monthly, median number collected by residents?	New
		Cost of living		From USGBC
		% of population who spend more than 30% of income on housing		New
		# residential properties listed for short term rental		New
		# residential properties not owned by locals		New
Energy	Energy consumption	Total energy used for snowmaking (kWh)	Venue Facilities	New
		Total energy used for large scale refrigeration (kWh)	Venue Facilities	New
		Total energy use in NYOR		From USGBC

		Total LPCSD energy use		New
		Total residential energy use		From USGBC
		Total commercial energy use		From USGBC
		Total municipal energy use		From USGBC
	Renewable and alternative energy	% energy consumed from renewables		From USGBC
		% energy consumed from renewables by LPCSD		New
		# electric vehicle charging stations	Supercharge? Level 2? etc?	New
		Total energy *consumed* from renewables		From USGBC
		Renewable energy *produced* from solar		From USGBC
		Renewable energy *produced* from wind		Modified from USGBC
		Renewable energy *produced* from hydro		Modified from USGBC
		Renewable energy *produced* from biomass		Modified from USGBC
		# of businesses adjacent to geothermal sidewalks		New
		# of houses with geothermal heating		New
	Electricity	Total electricity *produced*		Modified from USGBC
		Total electricity *consumed*		Modified from USGBC
	Building Efficiency	# LEED Certified buildings		Modified from USGBC
		# buildings certified under a sustainability program		Modified from USGBC
		# people using green appliance incentive programs	Energy STAR, etc.	Modified from USGBC
		Heating Degree Days	# days with average outdoor temperature below set standard	From USGBC

		Cooling Degree Days	# days with average outdoor temperature above set standard	From USGBC
Waste	Recycling	Total recyclable waste collected		Modified from USGBC
		Total recyclable waste collected at large community events	Waste collected as part of LPHS student project	New
		Total municipal recycling coverage	# addresses serviced	New
	Waste management	# businesses committed to reducing or eliminating single-use plastics		New
		Municipal solid waste collection coverage	# addresses serviced	Modified from USGBC
Water	Water monitoring	% metered connected users		New
		Gallons rainwater collected per year	Gallons of rainwater collected as part of LPHS student project	New
		Annual rainfall		New
		Pump efficiency	By facility; only for days (or hours) when snow was made	New
		Annual water usage for snowmaking	By facility; only for days (or hours) when snow was made	New
	Water Sources	# households with self supplied water	# households supplied by private wells or surface water bodies	Modified from USGBC
		# households with municipal water		New
		Total extraction at weirs	Hudson and Ausable	New
		Proportion of households with public water	Proportion of households with public water supply	Modified from USGBC

Table 10C: List of Community Metrics

Appendix D - *Water Consumption Calculations*

Municipal Water for Village of Lake Placid
Source of Water: Lake Placid
Four pumps, 1,500 gallons per minute
Permanent residents: 5,000
2017 water total: 304,000,000 gallons

North Elba
Average flow rate: 15.8 gallons/minute
8,304,480 gallons/year

North Elba and Village of Lake Placid combined
Population of North Elba: 8,484 people

$$(8{,}304{,}480 + 304{,}000{,}000) \div 8{,}484$$

36,810.9948 gallons/year/person

Appendix E - *Municipal Solid Waste Generated Calculations*

Casella Waste in 2017

Households included: 697	Commercial waste: 4,567.23 tons
Households outside of North Elba: 383	Residential waste: 787.93 tons
Total in North Elba: 314	Total waste: 5,355.16 tons

First, to calculate the percent of waste from NYOR households, the number of households in NYOR is divided total number of households serviced by Casella,

$$\frac{314}{697} = 0.450502 \rightarrow 45.1\%$$

45.1% represents the percent of waste from households in NYOR.

This percent is applied to the total waste collected by Casella to determine the waste generated by NYOR households,

$$5{,}355.16(0.450502) = 2412.51029 \text{ [illegible]}$$

North Elba Transfer Station Waste in 2017

Population of Essex County: 37,956	Total Transfer Station waste: 3,417.25 tons
Population of NYOR: 8,484	

To calculate for the percent of waste generated by population of NYOR, the 2017 population of NYOR is divided by the 2017 Essex County population:

$$\frac{8{,}484}{37{,}956} = 0.223521 \rightarrow 22.4\%$$

22.4% represents the percent of Essex County that resides in NYOR.

This percent is applied to the total waste data provided by the North Elba Transfer Station to determine waste generated by NYOR residents,

$$3{,}417.25(0.223521) = 763.83 \text{ [illegible]}$$

The total NYOR waste is determined by adding the calculated total from Casella to the calculated total from the Transfer Station,

$$2412.51029 + 763.8271 = 3{,}176.337 \text{ [illegible]}$$

To calculate the waste generated per person per year, the combined NYOR total is divided by the population of NYOR

$$3{,}176.337/8{,}484 \rightarrow 0.37 \text{ [illegible]}$$

Appendix F - *Municipal Solid Waste Diverted from Landfill Calculations*

Casella Waste Management Recycling in 2017

Commercial recycling: 764.76 tons
Residential recycling: 411.25 tons
Total recycling: 1,176.01 tons

The same process used to determine NYOR's waste contribution was used to determine NYOR's recycling contribution. The total recycling amount provided by Casella was multiplied by the percentage of Casella serviced households in NYOR (45.1%), calculated in Appendix E. The result is the amount of recycling generated by Casella's NYOR customers.

$$1{,}176.01(0.450502) = 529.794857 \text{ [illegible]}$$

North Elba Transfer Station Recycling in 2017

Total North Elba Transfer Station Recycling: 479.08 tons

To find the contribution of NYOR residents to the North Elba Transfer Station's recycling, the total amount of recycling provided by the Transfer Station ws multiplied by the percentage of Essex County residents that live in NYOR (22.4%), as calculated in Appendix E. The result is the amount of recycling generated by NYOR residents that use the Transfer Station.

$$497.08(0.223521) = 107.08 \text{ [illegible]}$$

The total NYOR recycling amount was the combination of the two calculated recycling values.

$$529.794857 + 107.084441 = 636.879298 \text{ [illegible]}$$

To calculate the total NYOR waste stream the total NYOR recycling amount had to be added to the total NYOR waste generated amount.

$$3{,}176.337 + 636.879298 = 3{,}813.2163 \text{ [illegible]}$$

To find the percent of recycling diverted, the total NYOR recycling was divided by the total NYOR waste stream.

$$\frac{636.879298}{3{,}813.2163} = 0.167 \rightarrow 16.7\%$$

Appendix G - *Distance Traveled in Individual Vehicles Daily Calculations*

VMT for NYOR was calculated using traffic counts from the New York State Department of Transportation (NYS DOT). The counts were most widely available on major non-residential roads. For areas that remain uncounted, an approximation was used. While this approximation may not be as accurate as measurements utilizing vehicle counts, it appears to be a reliable way to account for roads which lack traffic counts in the data. Out of the total VMT in North Elba and Lake Placid, 90.1% and 84.4% of the VMT were on counted roads, respectively.

Traffic counts were measured in Annual Average of Daily Traffic (AADT). To convert this to VMT, the AADT was multiplied by the length of the counted road segment. The results for all roads in a jurisdiction were summed to get an overall VMT for counted roads in an area. Uncounted roads were assessed by calculating an average VMT per mile on each road functional class in Essex County and then multiplied by the length of all uncounted roads within the North Elba and Lake Placid boundaries.

To factor in half of tourist travel to and from the region, common areas of origin and the average duration of stay were gathered from ROOST's 2017 Leisure Travel Study[53]. This data was for Essex County, but is assumed to be an acceptable proxy for the NYOR region since Lake Placid and North Elba are the major destinations within the county. A weighted distance traveled was obtained by multiplying the distance to each area of origin by the percentage of tourists from that area. However, the area of origin data did not account for 18.9% of tourists. To account for this, the weighted distance traveled was adjusted to account for all tourists using the average distance traveled for the percentage of tourists unaccounted for. The sum was multiplied by the number of tourists entering the region in a day, which was the tourists in the region divided by the average duration of stay. The total VMT from uncounted roads, counted roads, and tourist travel into the region was summed and then divided by the population.

Several notes should be made about the VMT calculations. First, both residential and tourist vehicles are accounted for in the vehicle counts, however, tourists are not included in the population count for the number being input into Arc. Second, the North Elba VMT calculation accounts for the roads inside of Lake Placid, as Lake Placid is nested within the jurisdiction of North Elba. Traffic count data is expected to be accurate as the counts took place over a year's time, and were averaged to produce a daily value. The averaging of a year's worth of data mitigates the fluctuation in visitors that occurs both on a daily and seasonal basis. The result is expected to be an underestimate due to the lack of data for residential travel outside the investigation boundary. If this data were available, half of the travel outside the region would be included in the calculations. The final number of miles traveled by tourists is an underestimate as tourists traveling from extreme distances are less frequent, making them less likely to be reported and more difficult to measure. This means that the extra miles traveled in those trips are unaccounted for in the calculations above. Of the total VMT count for North Elba and Lake Placid, only 22.6% and 3.7% respectively were from travel inside their jurisdiction. This shows that the majority of VMT can be attributed to tourist travel to and from the region. This

phenomenon is likely unique to rural regions with tourist-based economies. Finally, Saranac Lake has been excluded, despite partly being inside of North Elba, due to lack of data. As Saranac Lake is not a member of NYOR, this was not a significant concern.

Vehicle Miles Traveled Equations

$$VMT_{per\ capita} = VMT_{area} \div P_{region}$$

$$VMT_{area} = VMT_{residents} + VMT_{tourists} + VMT_{residents,outside} + VMT_{outside,residents}$$

$$VMT_{residents} = \sum_{i=1}^{n} (V_i * L_i)$$

$$VMT_{tourists} = \sum_{i=1}^{n} (VMT_{area,functional,i} \div L_{area,functional,i} * L_{area,functional,i})$$

$$VMT_{residents,outside} = \frac{T_{area}}{2 * T_i * T_{area}} \sum_{i=1}^{n} (D_i * P_i)$$

$VMT_{outside,residents}$: travel outside of the region by residents; assumed to be 0 due to lack of data

V_i: Vehicle Count in Annual Average Daily Traffic

L_i: Length of road segment

$L_{area,functional,i}$: countywide total length of roads of a particular functional class

$L_{area,functional,i}$: regional total length of roads of a particular functional class

T_{area}: average number of tourists in the area on any given day

T_i: duration of stay; used to calculate the number of tourists entering an area on a given day

T_{area}: total percentage accounted for in area of residency data

D_i: distance to area of origin

P_i: percent of tourists from a given area of origin

P_{region}: Population in region; this could either be the census population or the population could be modified to better represent those generating VMT

Appendix H - *Population with (at least) a High School Degree (25 and older) Calculations*

North Elba (inclusive of Lake Placid in ACS)	
High School graduate (includes equivalency)	1,817
Some college, no degree	1,368
Associate's degree	534
Bachelor's degree	1,224
Graduate or professional degree	1,011
Total Population	6,603
Total Combined Population with (at least) a High School Degree	5,954
Total Combined Population with (at least) a Bachelor's Degree	2,235
Population over the age of 25 with (at least) a High School Degree (%)	90
Population over the age of 25 with (at least) a Bachelor's Degree (%)	33.9

Table 10H: North Elba Education Level Data

First, to calculate the percentage of the population over 25 that have at least a high school degree, the population ranging from “high school graduate” to “graduate or professional degree” is added together. This sums everyone in North Elba who has at least a high school diploma.

$$1{,}817 + 1{,}368 + 534 + 1{,}224 + 1{,}011 = 5{,}954$$

Then, the sum of everyone with over a high school diploma is divided by the total population in North Elba over the age of 25.

$$\frac{5{,}954}{6{,}603} = 0.9017 \rightarrow 90.2\%$$

Appendix I - *Population with (at least) a Bachelor's Degree (25 and older) Calculations*

North Elba (inclusive of Lake Placid in ACS)	
High School graduate (includes equivalency)	1,817
Some college, no degree	1,368
Associate's degree	534
Bachelor's degree	1,224
Graduate or professional degree	1,011
Total Population	6,603
Total Combined Population with (at least) a High School Degree	5,954
Total Combined Population with (at least) a Bachelor's Degree	2,235
Population over the age of 25 with (at least) a High School Degree (%)	90
Population over the age of 25 with (at least) a Bachelor's Degree (%)	33.9

Table 10I: North Elba Education Level Data

First, to calculate the percentage of the population over 25 that have at least a bachelor's degree, the populations for "bachelor's degree" and "graduate or professional degree" are added together which sums everyone in North Elba who has at least bachelor's degree.

$$1{,}224 + 1{,}011 = 2{,}235$$

Then, the sum of everyone with over a bachelor's degree is divided by the total population in North Elba over the age of 25.

$$\frac{2{,}235}{6{,}603} = 0.3385 \rightarrow 33.9\%$$

Appendix J - *Gini Index Calculation and Limitations*

The Gini Coefficient is one of the most popular, though not the only method of measuring and viewing income inequality. The Gini Coefficient, known as the Gini Index when expressed as a percentage, is primarily affected by the middle portion of the income distribution spectrum. The Gini Coefficient is less affected by inequalities at the high and low end of the income distribution spectrum, therefore communities with concerns about specific types of inequality may need to track another measure of inequality in their Community Metrics[54].

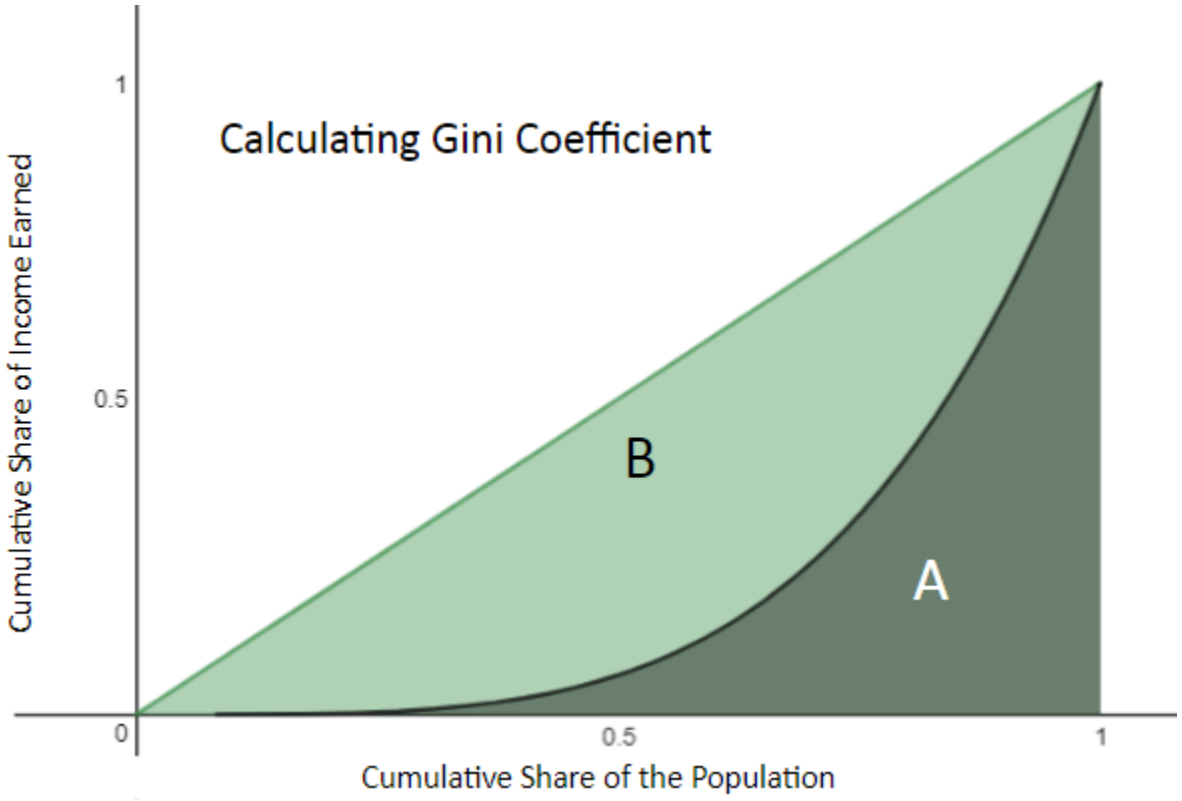

Figure 10J: Gini Coefficient Chart

Graphically, perfect income equality is represented by the line $f(x) = x$ from zero to one, where the horizontal axis is the cumulative proportion of the population and the vertical axis is the cumulative proportion of the income earned, so that the cumulative population increases at the same rate as the cumulative income (10% of the population has 10% of the income, 20% of the population has 20% of the income, and so on). This line of perfect equality, $f(x) = x$, is the green line in the graph above. The line that represents the actual increase in share of income in relation to the increase in population is known as the Lorenz Curve, or $L(x)$. A fictional Lorenz Curve is represented on the graph above by the black line.

To calculate the Gini Coefficient, the area B, shown in the graph as the green area between $f(x) = x$ and the Lorenz Curve, must be divided by the total area beneath $f(x) = x$. The

total area under the line *f(x) = x* is known to be 0.5, and the area under the Lorenz Curve can be calculated as follows

$$A = \int_0^1 f(x)\,dx$$

Therefore, the area B can be calculated as

$$B = 0.5 - \int_0^1 f(x)\,dx$$

Next, to calculate the Gini Coefficient, *G*, the area B must be divided by total area under the line *f(x) = x*

$$G = \frac{0.5 - \int_0^1 f(x)\,dx}{0.5}$$

or

$$G = 1 - 2\int_0^1 f(x)\,dx^{(x}$$

This equation will result in a number between 0 and 1, which will be the Gini Coefficient[55].

Appendix K - *Air Quality Calculations*

Air Quality Index Equation

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}}(C_p - BP_{Lo}) + I_{Lo}$$

I_p- The index for pollutant p

C_p- The rounded concentration of pollutant p

BP_{Hi}- The breakpoint that is greater than or equal to C_p

BP_{Lo}- The breakpoint that is less than or equal to C_p

I_{Hi}- The AQI value corresponding to BP_{Hi}

I_{Lo}- the AQI value corresponding to BP_{Lo}

The Air Quality Index is calculated is through the equation above. As shown, the index of a pollutant uses several different factors in order for it to be calculated. There are a total of six different pollutants that are calculated using this equation including ozone (O_3) measured in parts per million for both an 8-hour span and a 1-hour span; small particulate matter ($PM_{2.5}$) and coarse particulate matter (PM_{10}) which are both measured in $\mu g/m^3$; carbon monoxide (CO) in parts per million; sulfur dioxide (SO_2) in parts per million; and nitrogen dioxide (NO_2) in parts per million[56]. Each pollutant corresponds with breaking points, represented in the equation as $BP_{Hi}$and BP_{Lo} . Each breaking point has a range that corresponds with a AQI range, represented in the equation as I_{Hi} and I_{Lo}. These breaking points are shown in Table 10k below.

Breakpoints for AQI

These Breakpoints							equal these AQIs…	**Category**
O_3 (ppm) 8-hour	**O_3 (ppm) 1-hour[1]**	**$PM_{2.5}$ ($\mu g/m^3$)**	**PM_{10} ($\mu g/m^3$)**	**CO (ppm)**	**SO_2 (ppm)**	**NO_2 (ppm)**	**AQI**	
0.000-0.064	-	0.0 – 15.4	0 – 54	0.0-4.4	0.000-0.034	([2])	0 – 50	Good
0.065-0.084	-	15.5 – 40.4	55 – 154	4.5-9.4	0.035-0.144	([2])	51 – 100	Moderate
0.085-0.104	0.125-0.164	40.5 – 65.4	155 – 254	9.5-12.4	0.145-0.224	([2])	101 – 150	Unhealthy for sensitive groups
0.105-0.124	0.165-0.204	65.5 – 150.4	255 – 354	12.5-15.4	0.225-0.304	([2])	151 – 200	Unhealthy
0.125-0.374	0.205-0.404	150.5–250.4	355 – 424	15.5-30.4	0.305-0.604	0.65-1.24	201 – 300	Very Unhealthy
([3])	0.405-0.504	250.5-350.4	425 – 504	30.5-40.4	0.605-0.804	1.25-1.64	301 – 400	Hazardous
([3])	0.505-0.604	350.5-500.4	505 – 604	40.5-50.4	0.805-1.004	1.65-2.04	401 – 500	Hazardous

Table 10K: The breaking points for the different existion pollutants are shown above. As show, each pollutant has their own set of breaking points that correspond with different AQI categories

Appendix L - *Violent Crime Charts and Figures*

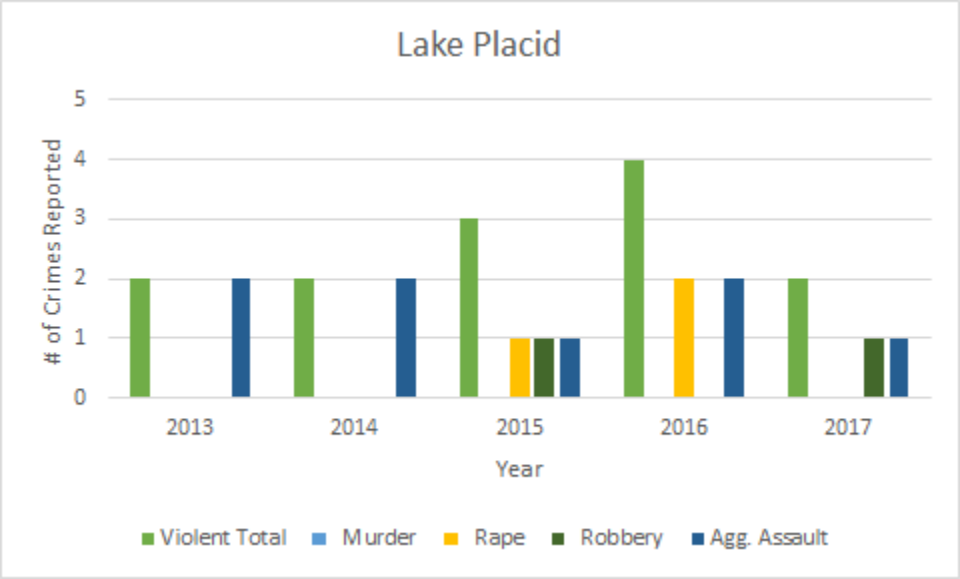

Figure 10La: Total Violent Crime in Lake Placid

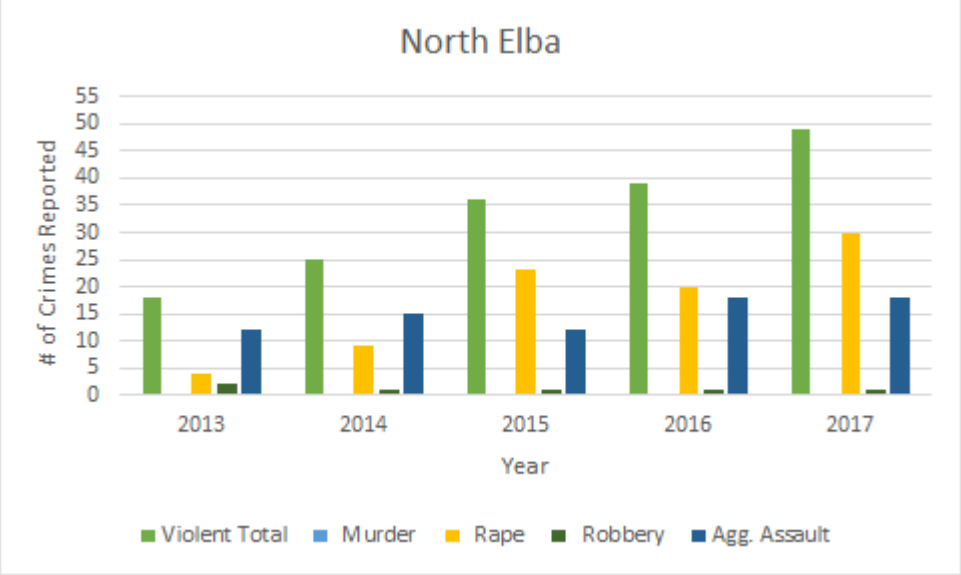

Figure 10Lb: Total Violent Crime in North Elba

New York State Index Crime Summary by County
2015 vs. 2016

County	Year	**Total**	**Violent**	Murder	Rape	Robbery	Agg. Assault	**Property**	Burglary	Larceny	MV Theft
Essex	2015	**382**	**46**	0	25	2	19	**336**	97	227	12
	2016	**394**	**57**	0	22	1	34	**337**	99	230	8
	% change	**3.1%**	**23.9%**	NA	-12.0%	-50.0%	78.9%	**0.3%**	2.1%	1.3%	-33.3%

Table 10La: New York State Crime Report Appendix 3

New York State Index Crime Summary by County: 2016 Rates per 100,000 Population

County	Index	Violent	Property
Essex	1,076.1	155.7	920.4

Table 10Lb: New York State Crime Report Appendix 6