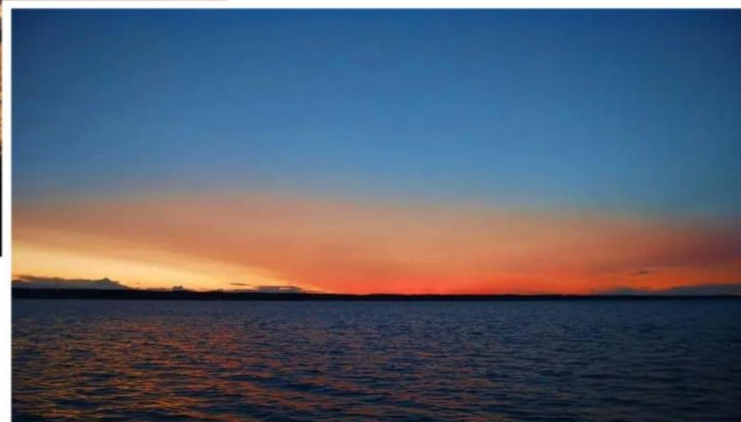
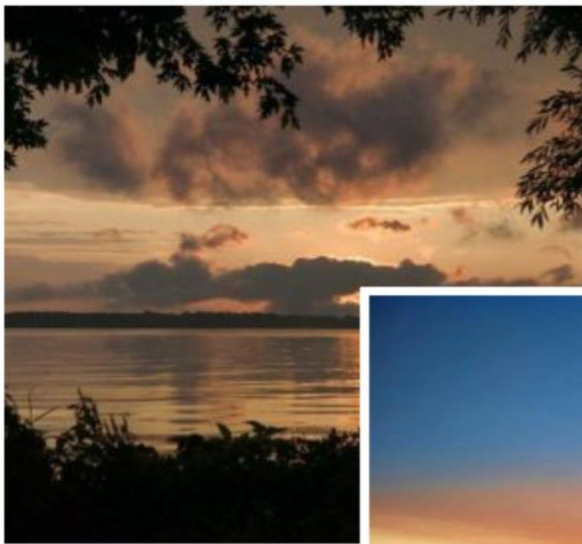
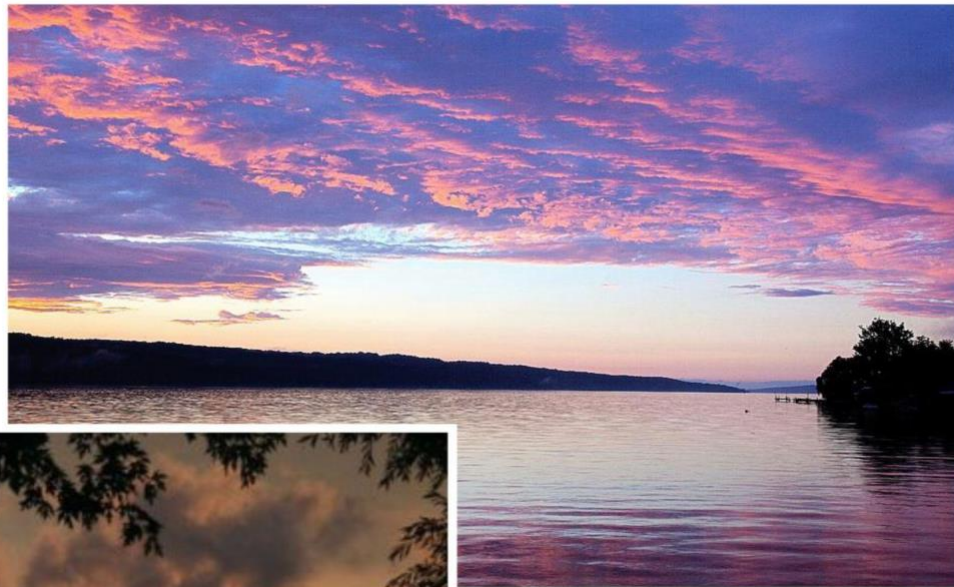


# Watershed Management Project Final Report

Yuke Li  
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# Introduction

For this Cayuga Watershed Management Project, the consulting team has reviewed the publicly released documents for data collection, knowledge enhancement, and analyses. The documents mainly included comprehensive plans, 9-Element Plans, and zoning laws. Because the town of Waterloo did not disclose its comprehensive plan and zoning laws, and the consulting team did not get contact with its Mayor and Clerk, the work in this report cannot demonstrate the town of Waterloo's true performance amongst all other municipalities. However, the most efforts have been put into this report and hope to provide insightful information to all the audience.

## Cayuga Watershed Background

### **Overview of the Cayuga Lake Watershed (CLW)**

The Cayuga Lake watershed, which is part of the Oswego River Basin in the central region of New York State, covers an area of 785 square miles (Genesee, 2001). There are 57 municipalities and seven counties, which are either all or partially in this area. The watershed is mainly located in a glaciated valley with flat terrain in the northern portion and hilly terrain in the southern part. The general climate here is humid continental with cold winters and warm summers (Genesee, 2000). As the second largest of New York's Finger Lakes, Cayuga Lake is 38.2 miles long and 1.75 miles wide with a maximum depth of 435 feet (Genesee, 2001). The waters in Cayuga Lake are moderately hard, containing some chloride and Phosphorus. The soils of these areas are among the most fertile in the nation (Genesee, 2000).

### **Client: Cayuga Lake Watershed Intermunicipal Organization (CWIO)**

The Cayuga Lake Watershed Intermunicipal Organization (CWIO), which was formed in 1998, has the mission to connect local governments in the Cayuga Lake watershed with partner agencies and organizations to manage, protect, and restore water quality collaboratively (Genesee, 2001). CWIO has struggled with surface runoff, erosion, and chemical pollutants for a long time (Genesee, 2000), and faces many new challenges, such as climate change and flood insurance rates.

In 2022, Cayuga Watershed Intermunicipal Organization followed the Cayuga Lake Restoration and Protection Plan to take action to address problems in six top focused areas, agriculture, ditches, land use, drinking water, stormwater, and wetlands. Over the last year, CWIO made efforts in reducing sediments from reaching waterways, developing practices for ditch systems, providing training on land use policies, enhancing the perception of preserving wetlands in relation to flooding, and many other actions to reinforce the importance of watershed management (Cayuga Lake Watershed Intermunicipal Organization, 2022).

## Team Background



Jinqiu Zuo (Vicky)



Aodong Mei (Ashley)



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## Literature Review

### Existing Concerns of Cayuga Watershed Management

The most important problems in the Cayuga watershed are poor water quality, in-stream and riparian habitat degradation, flooding, and streambank erosion. To address these concerns, the municipalities could follow the typical watershed management process, which involves four main phases: (1) setting up an organization, (2) identifying issues and opportunities, (3) creating a restoration strategy, and finally (4) carrying out the restoration strategy (Frothingham, 2010).

There are also some concerns that there are too little regulations adopted in the Cayuga Lake watershed, such as climate change regulation. Utilizing survey and secondary data from the NYS Climate Smart Communities, researchers found that only a quarter of NYS municipalities have applied laws and regulations related to climate change, even when most local officials realize the hazards of climate change (Allred et al., 2022). In the meantime, lacking environmental protection laws and other regulations has also been the focus of attention. Therefore, improving local laws and regulations is an essential way to deal with management problems in the Cayuga Lake watershed, especially in smaller municipalities and rural communities.

### Similar Watershed's Regulation and Implementation

The Cayuga Lake Watershed Intermunicipal Organization can learn from the following watersheds and apply their tools to solve persistent and emerging issues.

#### *Marshyangdi Watershed, Nepal*

Climate change threatens water security and the aquatic ecosystem by altering river flow regimes (Li et al., 2023). In response to climate change, the Marshyangdi watershed in Nepal has designed a data system collecting important climate factors (precipitation and temperature) to analyze and predict the

influence of climate change on the watershed (Singh et al., 2022). The municipalities in the Cayuga Lake watershed could also collect and analyze these data to avoid the loss due to climate change.

### ***Salmon Creek Watershed, New York***

Watersheds are often influenced by chemical pollutants from agricultural activity, especially in hydrologically sensitive areas (HSA). The Salmon Creek watershed created a web-based HSA prediction tool to identify areas at high risk of heavy runoff. This tool assists farmers to prioritize polluting agricultural activities to areas with low risks of heavy runoff (Dahlke et al., 2013). The municipalities in the Cayuga Lake watershed could study how to use this tool and organize their agricultural activities safely.

### ***Interior Wetlands Program***

The Fraser River flows into British Columbia and Canada, and its headwaters lie in the interior Rocky Mountains. The main problem that exists in the Fraser River is water pollution caused by agriculture, mining, industrial, and human development. This wetlands initiative focuses on habitat conservation, water quality, and quantity improvement, and sustainable agriculture through disseminating knowledge, training, and collaborating with local landowners to improve irrigation (Wang et al., 2016). The municipalities in the Cayuga Lake watershed are also facing these problems, they could use a combination of methods mentioned above to deal with the dilemma.



# Goals and Timeline

There are four key objectives that the Watershed Management Project seeks to accomplish. The following objectives have been identified:

**1. Examine all pertinent important papers:** One of the main goals of the project was to thoroughly check all relevant important documents related to the watershed. This includes reports on the quality of the water, land use surveys, and environmental impact assessments. The project team can thoroughly comprehend the existing condition of the watershed and spot any potential problems or opportunities for improvement by going through these materials.

**2. Complete table:** Create a table which includes all crucial attributes of the watershed in a comprehensive manner. The project team will rely on this table as a central reference point throughout the entirety of the project. Its content will encompass data on the physical, environmental, and socio-economic facets of the watershed. The table facilitates identifying key issues and developing appropriate strategies for managing the watershed by the project team. In addition, monitoring progress, evaluating outcomes, and making adjustments as needed will enable the team to achieve project objectives effectively.

**3. Construct a heat map of the watershed:** With the help of this heat map, important information about the watershed, such as places with high or low water quality or dense vegetation cover, can be represented visually. The project team can determine any patterns or trends that can be helpful in directing their operations by examining this heat map.

**4. Recommendations:** Ultimately, the project team will create a set of recommendations for managing the watershed using the knowledge acquired via document review, table finalization, and heat map development procedures. These suggestions can call for taking steps to enhance the quality of the water, protect important habitats, or lessen erosion. The project team intends to guarantee that the watershed is healthy and sustainable for years to come by putting these suggestions into practice.

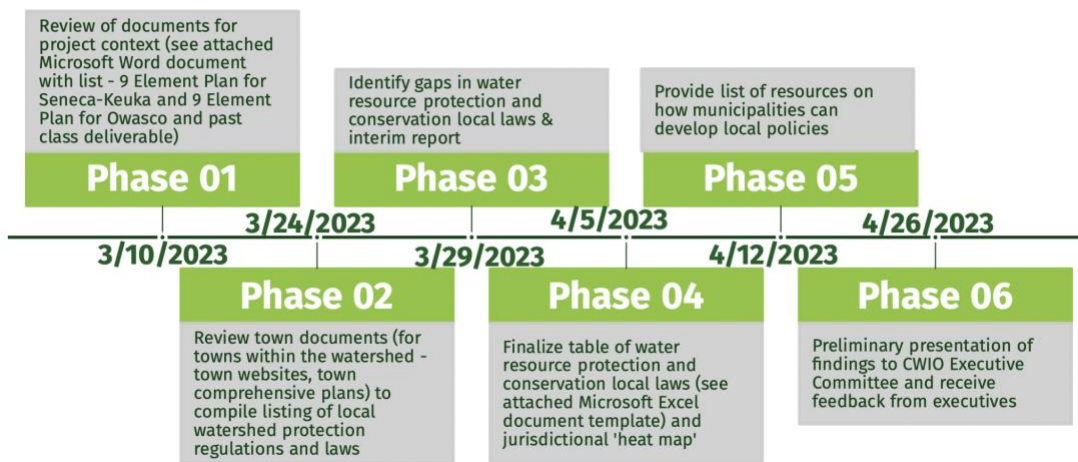


Figure 1. Timeline

## Methods Conducted

For this project, the main goal is to investigate the watershed management performance of Cayuga Watershed surrounding towns and villages and also how the extent of adopting counties' land use regulations and laws. Based on their performance, we will provide recommendations to improve future actions. Therefore, reviewing previous consulting reports and documents related to regulations and laws is an essential part of our work. The methods we conducted can be classified into 4 parts: (1) documents reviewed (2) 57 municipalities' regulation and laws adoption tracker, (3) heat map, and (4) recommendation research. Since we are now in the middle of this project, we have finished the first two parts and will illustrate those in detail on the following page.

## 9-Element Plan Review

9E Plans are created by the New York State Department of Environmental Conservation (NYSDEC) for Clean Water Planning across the state. The plans' format and content are consistent with the United States Environmental Protection Agency (USEPA) framework for watershed planning.

The 9E framework identifies sources and magnitude of pollutants, determines water quality goals or targets, defines pollution reductions needed to meet the goals, and describes the actions or best management practices (BMPs) needed to achieve the reductions that will improve water quality.

The below table states the criteria of the 9 elements (Ecologic, 2022).

	<b>Nine Element Criteria</b>
a (1)	Identify the <b>causes and sources of pollution</b> that need to be controlled
b (2)	Identify <b>water quality target</b> or goal and <b>pollutant reductions</b> needed to achieve goal
c (3)	Identify BMPs that will help to <b>achieve reductions</b> needed to meet water quality goal/target
d (4)	Describe the <b>financial and technical assistance</b> needed to implement BMPs identified in element <i>c</i>
e (5)	Describe the <b>outreach to stakeholders</b> and how their input was incorporated and the role of stakeholders to implement the plan
f (6)	Estimate a <b>schedule</b> to implement BMPs identified in plan

g (7)	Describe the <b>milestones</b> and estimated time frames for the implementation of BMPs
h (8)	Identify the criteria that will be used to <b>assess water quality improvement</b> as the plan is implemented
i (9)	Describe the monitoring plan that will <b>collect water quality data</b> need to measure water quality improvement (criteria identified in element <i>h</i> )

*Table 1. Seneca Keuka 9E Overview*

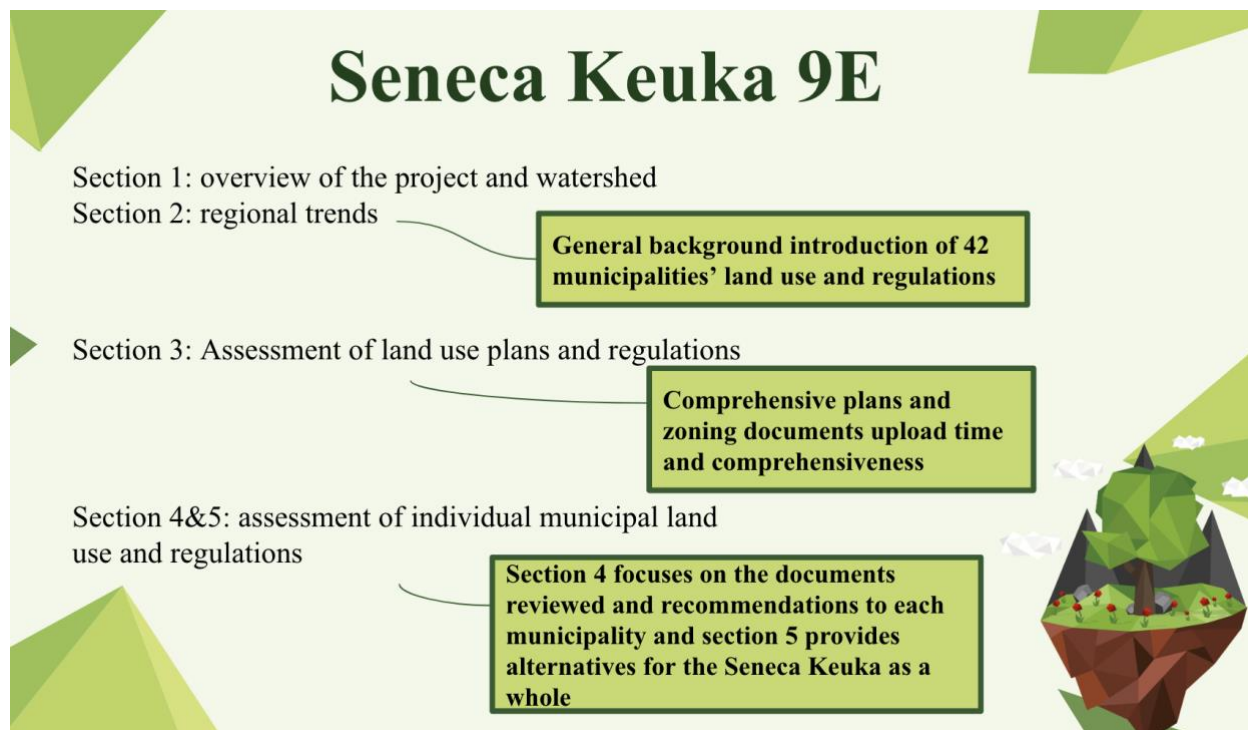
Cayuga Lake Watershed does not have a 9E plan which specifies regulations adopted by each municipality and comprehensive local law assessment of towns and villages performance in improving water quality. Work in this report follows the structure of the 9-Element plan of Owasco and Seneca Keuka to introduce all watershed management regulations and examine municipalities performance to provide Cayuga Lake Watershed Intermunicipal Organization (CWIO) effective information for their future decision making.

The 9E plan of Owasco provides a general background of Owasco Watershed and introduces the environment around it. It assesses the water quality and living conditions of aquatic communities. Based on the assessment, this report reveals the existing water quality challenges and identifies effective watershed management strategies that can be implemented to improve lake water quality and reduce phosphorus.

The first part in 9E of Seneca Keuka summarizes the same content as 9E of Owasco, assessment of water quality, and identification of practical strategies to lower phosphorus. In addition, the second main part is a bit different in that it evaluates the land use regulations and local law. The later section enhances the consulting team’s understanding of Cayuga Watershed Management and offers more guidance to complete the whole project research.

Since the land use regulations and local law assessment are in accordance with the main projective objective and CWIO’s expectation, Part II of Seneca Keuka’s 9E will be elaborated as an example. We will take section 3 and section 5 as examples to complete our work.





*Figure 2. Seneca Keuka 9E Overview*

## Zoning Laws Review

This section will mainly focus on the discussion of regulations in (1) Special Land Use Districts, (2) Waterfront Protection, (3) Overlay Districts, and (4) Wetlands Protection of the town of Danby, the town of Fayette, and the village of Cayuga.

### **Special Land Use Districts**

Agriculture is important to water quality. Sustainable agriculture has the ability to significantly reduce water pollution by eliminating harmful fertilizers that seep into run-off water and ruin the natural environment. Therefore, the protection of agricultural land is significant and regulations on agricultural lands are indispensable. Town of Danby and the town of Fayette are two towns that heavily rely on the agriculture economy, and they have different special land use practices towards agricultural lands.

#### ***Town of Danby***

Agriculture is one of the main sources of the economy in Danby. Currently, there are seventeen farms in Danby and ten of them are qualified for the County Agricultural Assessment Program based on income and acreage. The town is making efforts to boost and control agriculture. The strategies the government used include the inception of a Farmer’s Market, the implementation of initiatives recommended by the Agriculture and Farmland Protection Plan, formation of Agricultural development Subcommittee will

look into possible ways to preserve farmland, Agricultural Resource Center developed by the Danby Agricultural and Environmental School will examine potential methods of protection.

### ***Town of Fayette***

The town of Fayette has been an agricultural community since it was first inhabited. Many productive commercial farms are located in the Town of Fayette. According to the Census of Agriculture, the county farms' entire output of agricultural products had a market value of \$45.2 million in 2002. The agricultural lands in Fayette are in the New York State Agricultural District Program. Some means of protection include Agricultural use value assessments, protection from local regulations, and protection from the public acquisition of farmland.

### ***Village of Cayuga***

Different from the first two towns' focus on agricultural districts, the village of Cayuga pays more attention to its waterfront districts and public access. The waterfront of Cayuga has played a significant role in its history and will remain essential in the future. However, Cayuga is now facing some challenges. The first one is the railroads. The Scenic Railway stops at the Village Office and Harris Park area each October, and they are next to the waterfront. However, the village of Cayuga only has one traffic control device and that is not enough to protect residents' safety. Now, the local government is considering installing additional traffic control devices to maximize residents' and pedestrians' safety.

Another challenge is the maintenance of the "State Pier", which is located close to the Village Hall. The "State Pier" gives locals fantastic access to the water and could provide both active and passive leisure possibilities like fishing, docking, etc. However, it is now in poor condition and the funding to maintain it becomes a problem that would need to be overcome.

## **Waterfront Protection**

The town of Danby and the town of Fayette do not have waterfront/watercourse within their districts, Village of Cayuga's waterfront protection will be discussed in detail.

### ***Village of Cayuga***

The village of Cayuga Local Waterfront Revitalization Program was adopted in 2020 and it is anticipated to complete by 2025. By looking at the Local Waterfront Revitalization Program, the new proposed amendments focus on two areas, historical consideration and Stormwater Pollution Prevention Plan (SWPPP). Some historical buildings, structures, and sites are located next to the waterfront of Cayuga Lake, just as previously mentioned "State Pier", but they are now in poor conditions or are not easily accessible. Therefore, one part of this waterfront revitalization program focuses on repairing old buildings and structures which have local significance to the village of Cayuga. Four main points are summarized from historical considerations related to amendments. First, it required that every attempt be made to either use a historic site for what it was intended to be or to find an appropriate use for it that

necessitates little to no alteration of the building, structure, or site and its environment. Second, a building, structure, or site's distinctive stylistic elements or instances of expert craftsmanship must be treated delicately. Third, wherever practicable, damaged architectural components shall be repaired as opposed to replaced. Fourth, surface cleaning of structures shall be undertaken with the gentlest means possible.

The Stormwater Pollution Prevention Plan (SWPPP) stipulates practices that shall be taken when the construction activity results in land disturbance of equal to or greater than one acre. Amendments are discussed around six main points. First, any prevention plans need to provide required background information. Second, land development activities that meet conditions “A”, “B”, or “C” below need to have water quantity and quality controls. The third point listed SWPPP requirements for Condition A, B, and C. Fourth and fifth are contractor certification and technical standards respectively, and finally is the maintenance and inspection during construction.

## Overlay Districts

### *Town of Fayette*

The town of Fayette has overlay districts with the town of Varick and these two towns seek balance in agricultural land and natural resources in their development. The Future Land Use and Conservation Map graphically depicts their overlaid districts in Agricultural Districts, well-drained soils, streams, wetlands and flood hazard zones.

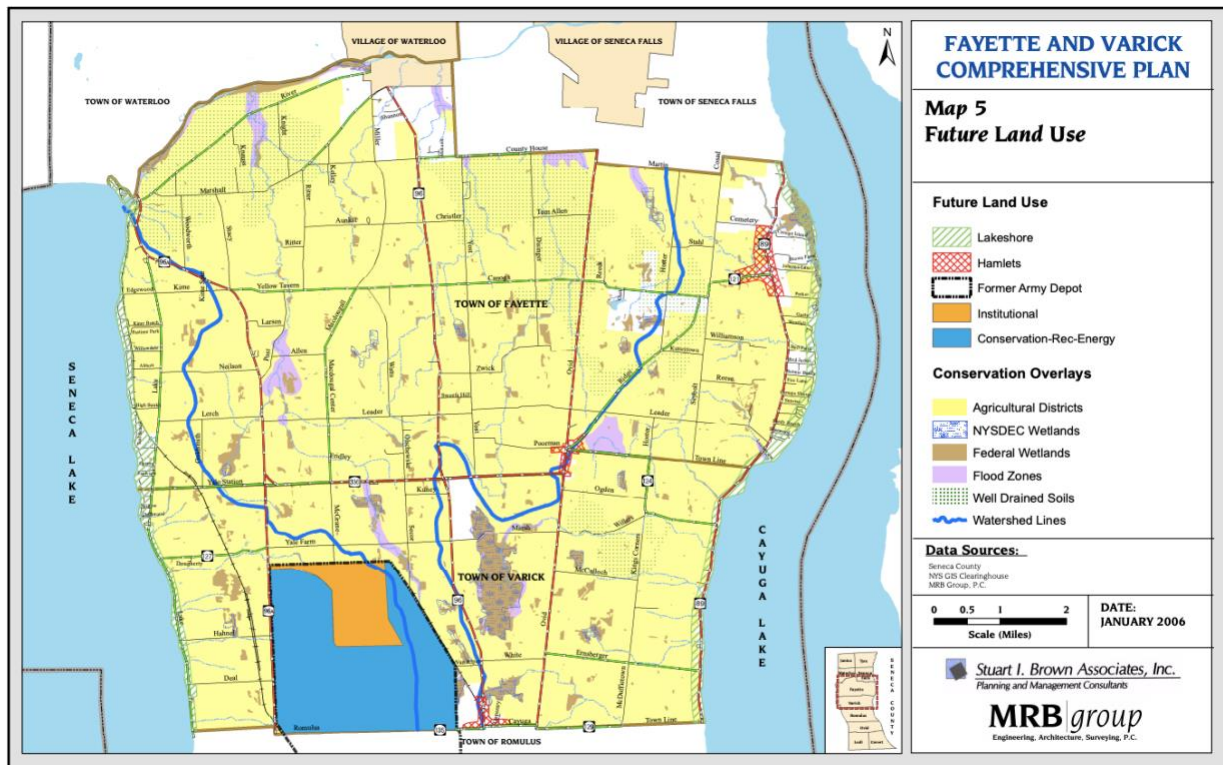


Figure 3. Town of Fayette Future Land Use

Because of the existence of “overlay”, the local government's power to control agricultural activities is constrained by the Agricultural District program. Consequently, the town of Fayette and Varick cannot ban certain agricultural operations from hamlets or other populated areas if the land is located within an Agricultural District.

## **Protection of Wetlands**

The towns of Danby and Fayette are municipalities that have many wetlands within their districts. Wetlands are crucial to the environment, water quality, and residents’ health, thus, protection is necessary.

### ***Town of Danby***

In Danby's comprehensive plan, this town suggests various approaches to protect wetlands to achieve three different objectives. The first objective is the maintenance, enhancement, and protection of natural resources through public and private activities. The approach to achieve this goal is educating town officials and residents to improve their awareness and propensity to protect wetlands. The second objective is to protect water resources from sedimentation, run-off from erosion, drainage, contamination, and flooding. The strategies are to develop a funding program for a Town salt to protect surrounding wetlands, support State and Federal agencies’ protection enforcement efforts, and seek out assistance from the County Soil and Water Conservation District for wetlands restoration. The last objective related to wetlands is to preserve natural resources in both Danby and the greater community. The approach for achieving this is to limit development in areas of Danby identified as wetlands.

### ***Town of Fayette***

The Town of Fayette borders Cayuga Lake on its shores for about four miles. The wetlands within the town of Fayette and Varick here are regulated by the State and Federal governments under New York State’s Freshwater Wetlands Act and only qualified individuals can verify the boundaries. One wetland area is the Canoga Marsh Wildlife Management Area. This natural wetland serves as a habitat for fish spawning, marsh birds, and other wildlife and it is one of the few freshwater marshes on Cayuga Lake. Other than adopting regulations that protect wetlands, the Wetland Reserve program is a program that aims to restore wetlands on the former Seneca Army Depot. In 2004, \$6.6 million was spent on this program statewide.

The Village of Cayuga does not adopt regulations related to wetlands protections, but it has specific classifications of wetlands in its latest Comprehensive Plan (See *Appendix 1: Village of Cayuga Wetlands Classification*)

# Data Analysis

## Heat Map of Laws and Regulations Adopted by 57 Municipalities

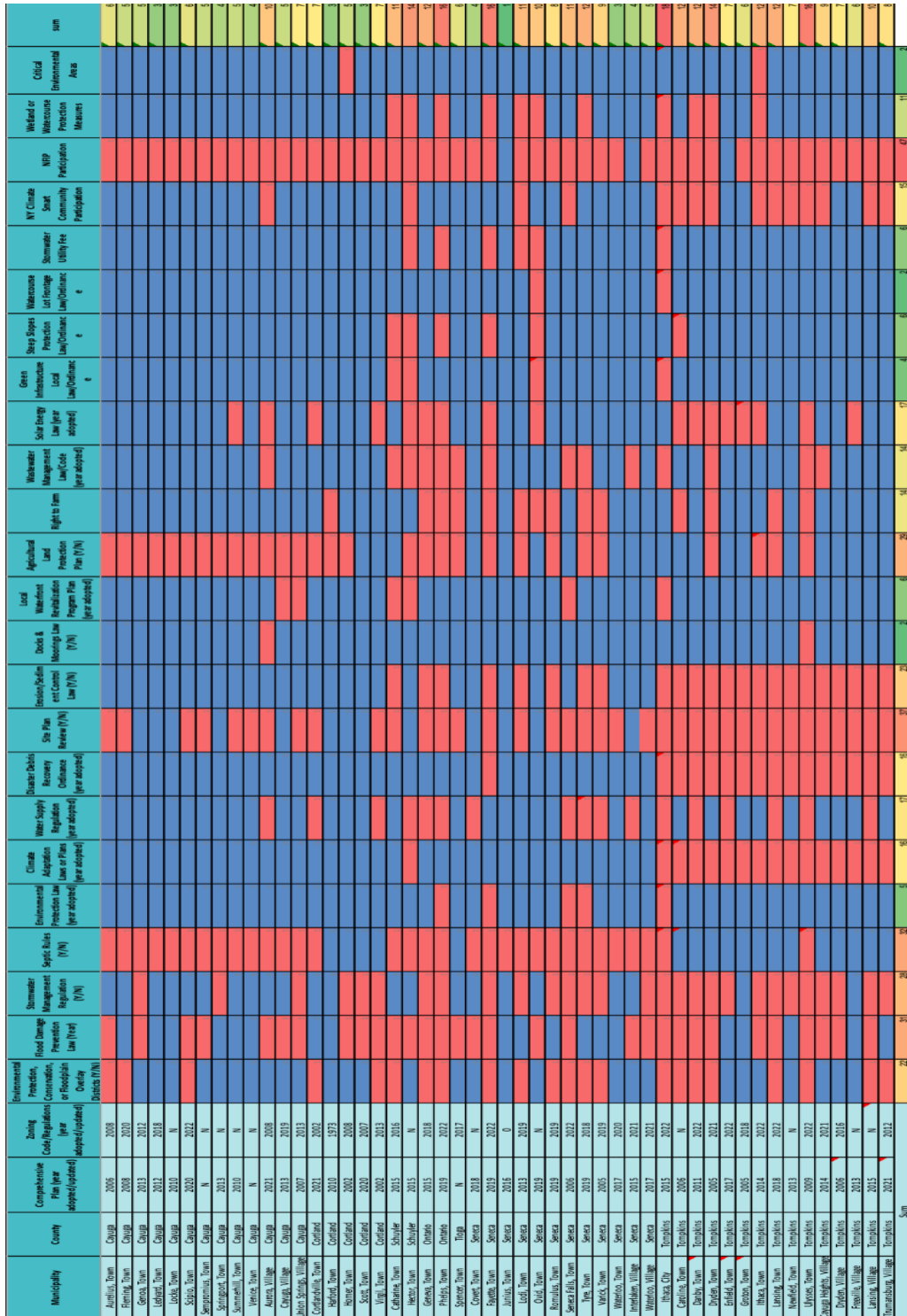


Figure 4. Heat Map of the Regulations Adopted by the Municipalities in the Cayuga Lake Watershed

The team checked the information on the official websites of municipalities in Cayuga Lake watershed and finished the heat map (Figure 5). The data the team collected reflected watershed management information from 57 different municipalities, including:

- |                         |                      |                          |
|-------------------------|----------------------|--------------------------|
| •Aurelius, Town         | •Virgil, Town        | •Waterloo, Village       |
| •Fleming, Town          | •Catharine, Town     | •Ithaca, City            |
| •Genoa, Town            | •Hector, Town        | •Caroline, Town          |
| •Ledyard, Town          | •Geneva, Town        | •Danby, Town             |
| •Locke, Town            | •Phelps, Town        | •Dryden, Town            |
| •Scipio, Town           | •Spencer, Town       | •Enfield, Town           |
| •Sempronius, Town       | •Covert, Town        | •Groton, Town            |
| •Springport, Town       | •Fayette, Town       | •Ithaca, Town            |
| •Summerhill, Town       | •Junius, Town        | •Lansing, Town           |
| •Venice, Town           | •Lodi, Town          | •Newfield, Town          |
| •Aurora, Village        | •Ovid, Town          | •Ulysses, Town           |
| •Cayuga, Village        | •Romulus, Town       | •Cayuga Heights, Village |
| •Union Springs, Village | •Seneca Falls, Town  | •Dryden, Village         |
| •Cortlandville, Town    | •Tyre, Town          | •Freeville, Village      |
| •Harford, Town          | •Varick, Town        | •Lansing, Village        |
| •Homer, Town            | •Waterloo, Town      | •Trumansburg, Village    |
| •Scott, Town            | •Interlaken, Village |                          |

The purpose of drawing this heat map is to fully understand the situation of each municipality, analyze the innovations and shortcomings of their existing regulations, and conduct more in-depth research. In the middle of the heat map, the red cells show that there are reliable resources to confirm that the municipalities have adopted these regulations, while the blue cells mean that there isn't enough evidence to support that conclusion. The numbers in the last row of the heat map represent how many municipalities have adopted the specific regulations, while the numbers in the last column of the heat map represent how many regulations have been used by specific municipalities. In addition, different colors show the quantity. The darker the red, the more regulations they have adopted. Moreover, if the exact year in which these regulations were adopted can be found, this information would be recorded in the heat map. The heat map is a summary of the contributions of the cities, towns, and villages in seven counties for Cayuga Lake watershed management.

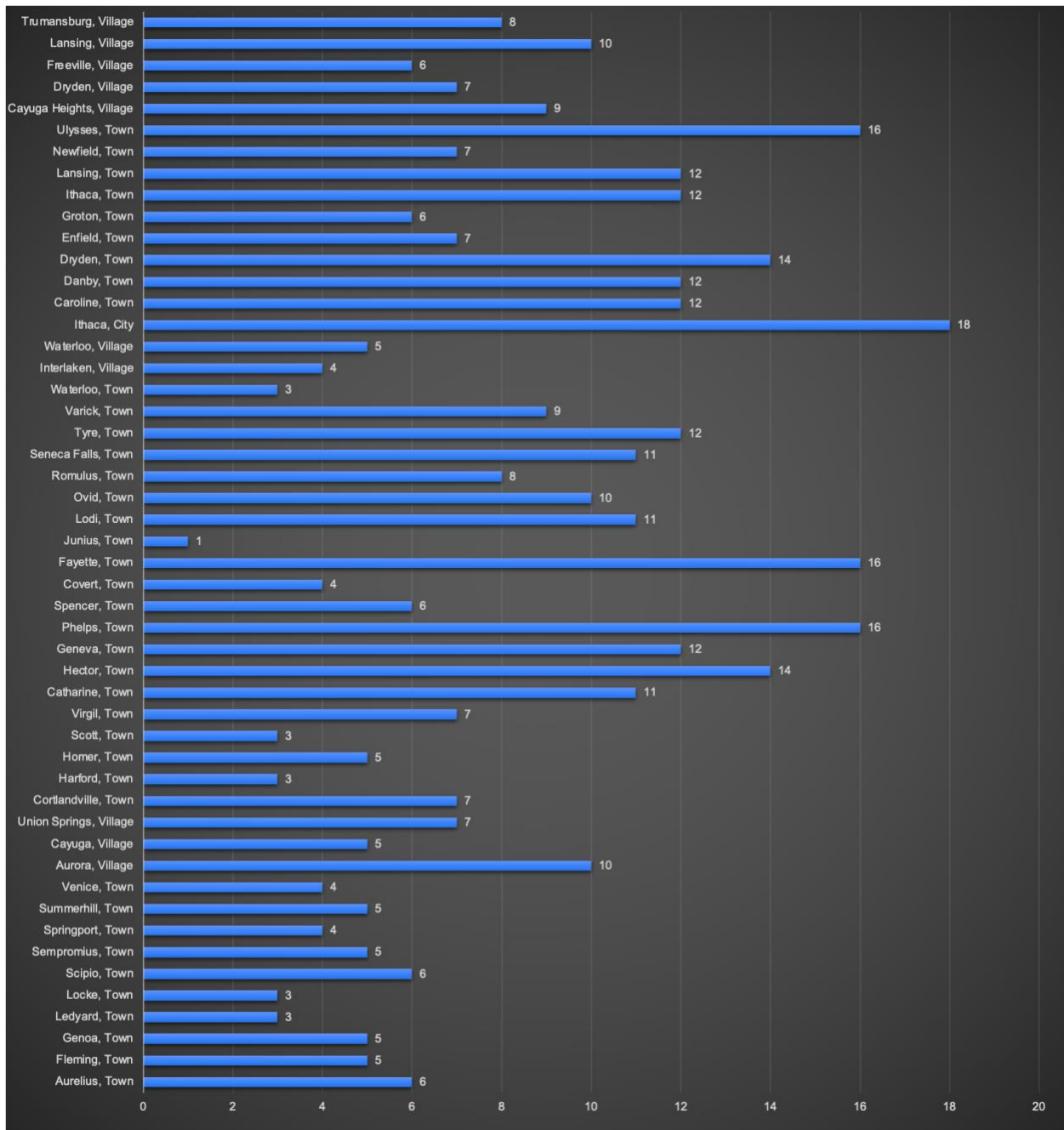
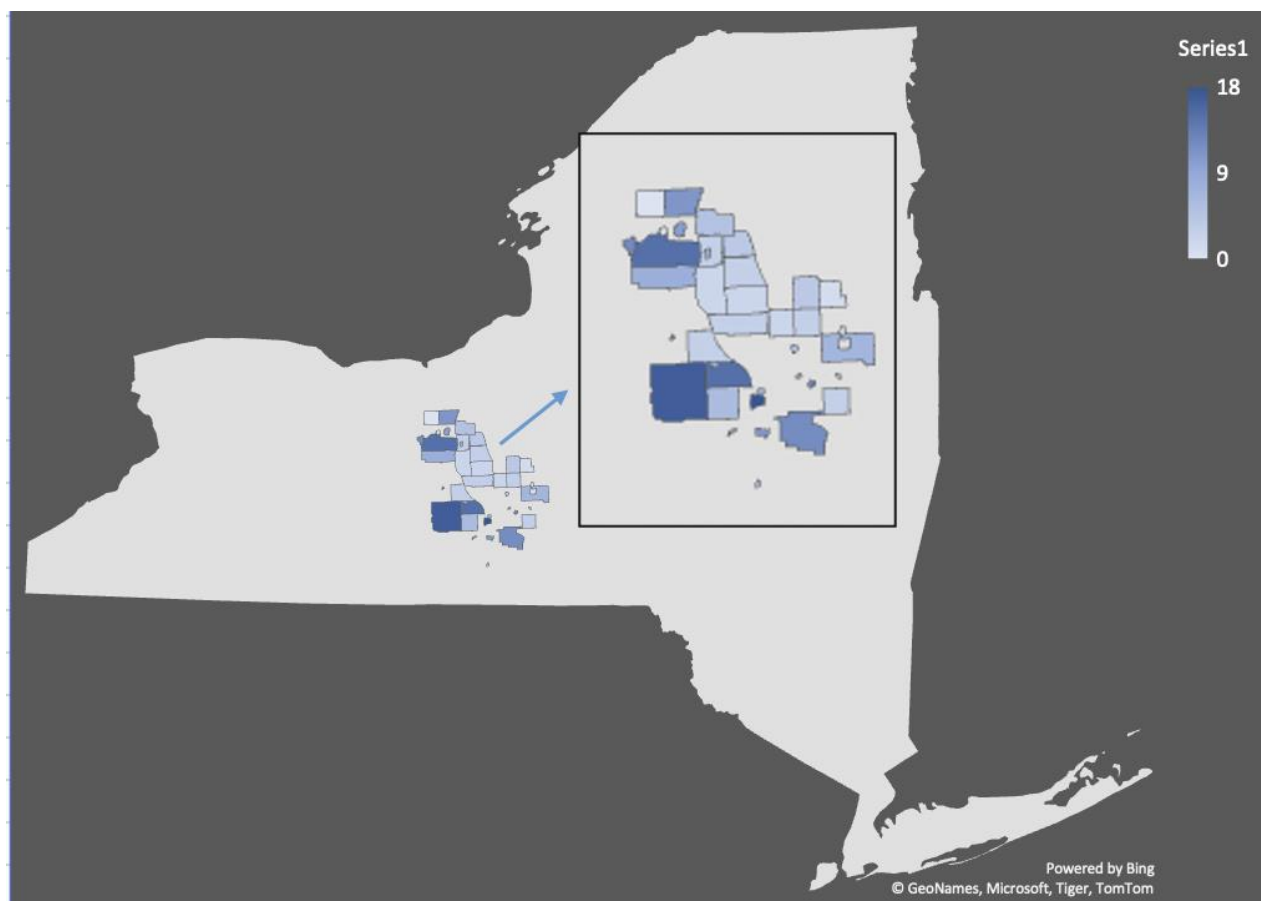


Figure 5. Histogram showing the Number of Regulations Adopted by each Municipality

A combination of methods has been utilized to conduct a detailed analysis of the contents in the heat map. First, a histogram has been made to visualize the result in the last column of the heat map, which shows the number of regulations adopted by each municipality. These municipalities are clustered by county in the histogram and the data has also been merged into a real map (Figure 7), and the darker the blue, the more regulations these municipalities have adopted. From these graphs and the pie chart (Figure 8), it is obvious that Tompkins County and Seneca County are taking most steps to maintain watershed protection. There are also some municipalities that have proposed some innovative regulations. For instance, the Tyre Town of Seneca County has investigated the primary water supply of

their residents and found that groundwater is the main resource. Therefore, they gave priority to the preservation of groundwater quality and analyzed the several factors influencing the groundwater. Among them, microbial contamination caused a large portion of water pollution, so they advocated that liquid waste and solid waste, which can be conducive to the breeding of rodents and insects, should not be allowed to be put into the watershed. In the documents review part, the team focused on these cities, towns, and villages, that have conducted sufficient research and analysis on the problems, as well as putting forward relatively novel solutions.



*Figure 6. Heat Map showing the Number of Regulations Adopted by each Municipality*



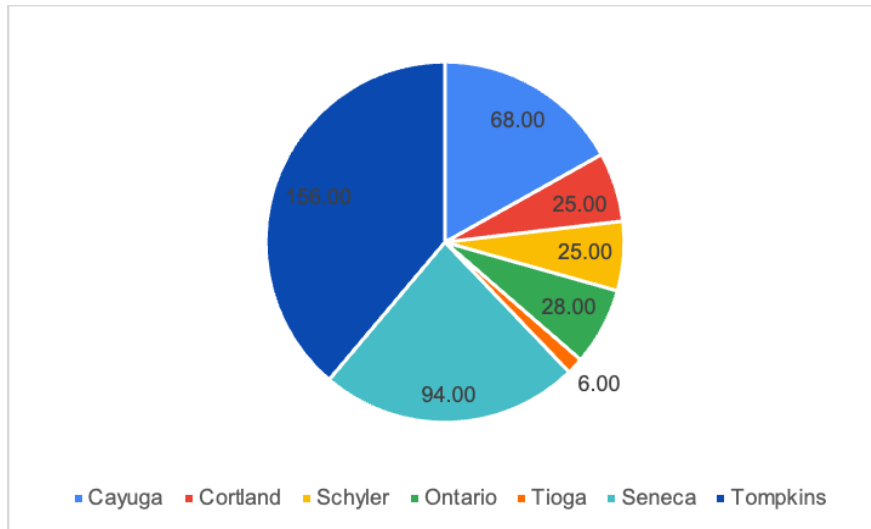


Figure 7. Pie Chart showing the Number of Regulations Adopted by Each County

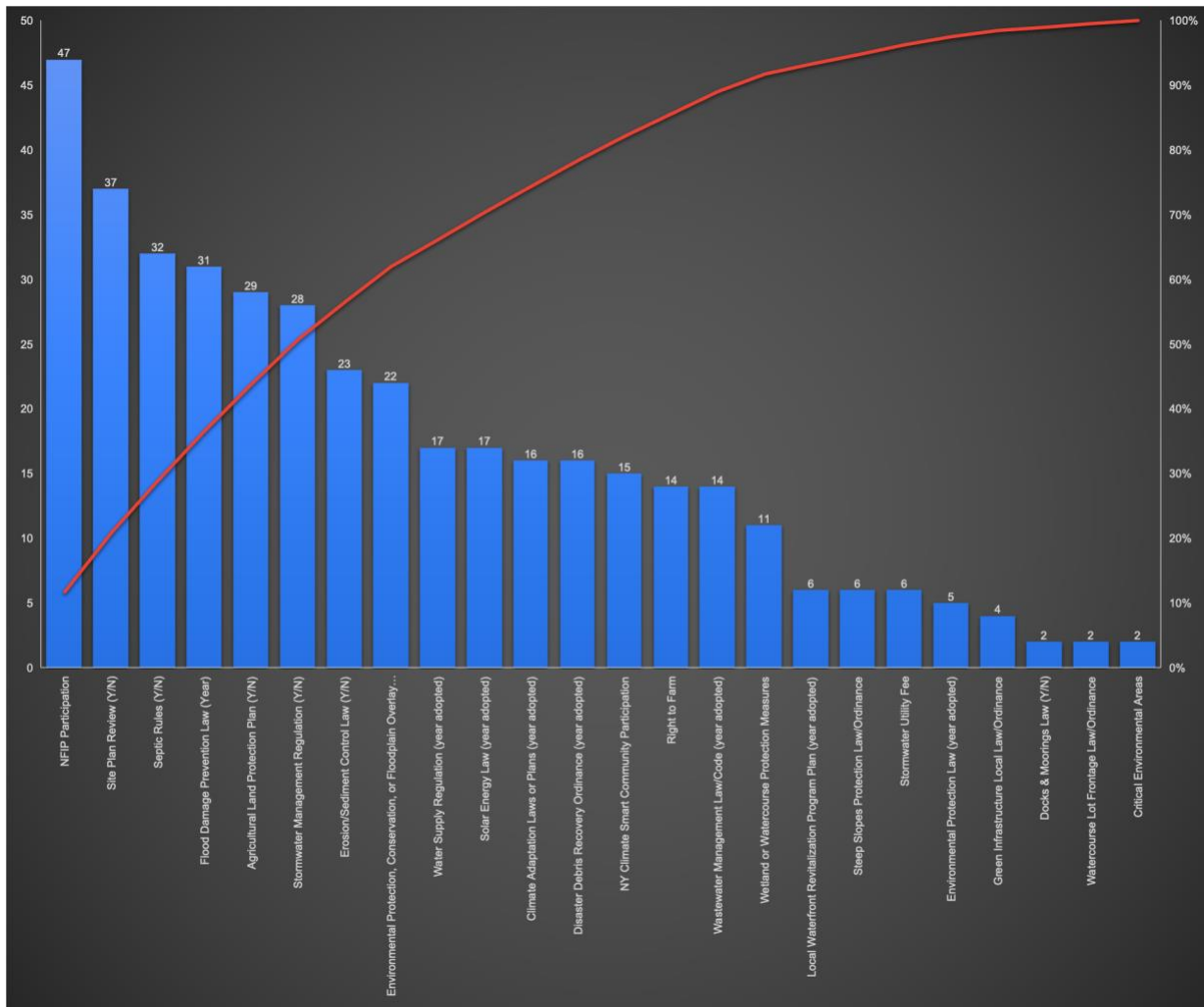


Figure 8. Histogram showing the Number of Municipalities Adopting each Regulation

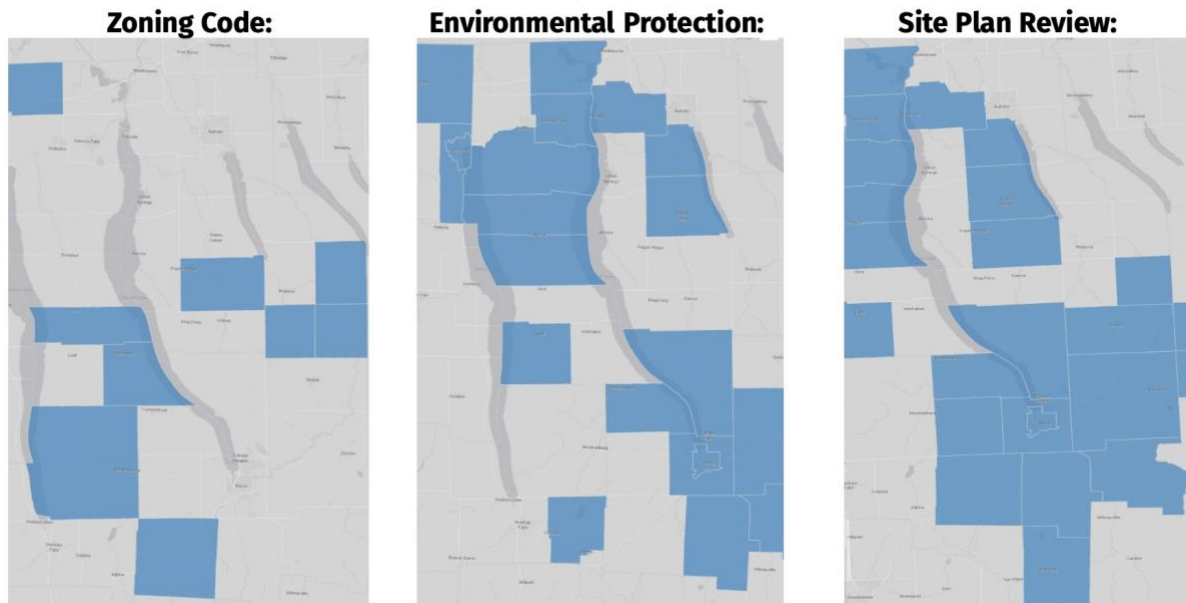
Similarly, the team also made a histogram to visualize the result of the last row of the heat map (Figure 9). It clearly shows which regulations are adopted widely and which are not. According to this graph, septic rules, agricultural land protection plan, environmental protection, and flood damage prevention laws have been used by more than half municipalities in the Cayuga Lake watershed, while steep slope protection law, green infrastructure, and watercourse lot frontage law have just been considered by few municipalities. Therefore, more attention should be given to these less adopted regulations, the team will take the steep slope management regulation as an example to introduce how to improve this situation.

## **Steep Slope Management Regulations**

The heat map in the part of the data analysis found that most municipalities in the Cayuga Lake Watershed lacked regulations for steep slope management. In the meantime, municipalities in the Cayuga Lake watershed should pay attention to the steep slope administration for several reasons. Firstly, the high elevations of the Cayuga Lake watershed combined with high valleys created many areas with steep slopes. Secondly, increasing climate problems increase the heavy rain and make the slope more dangerous (Genesee, 2000). Finally, steep slopes can damage the environment. It is more likely for a steep slope with little vegetation to erode and become unstable, thereby damaging more things near the slopes.

The New York State model of local laws to increase resilience has summarized the key elements for making regulations for steep slope management. First and foremost, a clear definition of the steep slope is required. According to the previous laws and regulations (Genesee, 2001), areas with an average slope equal to or greater than 15% and larger than 500 square feet are usually defined as steep slopes. In these areas, the government also needs to consider the ideal restrictions for development. Most municipalities in New York State have already required permission for developing the land when the slope is larger than 15 percent and prohibit land use when the slope is greater than 25%. It is possible to give more detailed restrictions on the use of steep slopes, such as limiting the proportion of land use according to the steepness of the land. For example, the government can make a regulation that less than 10% of the land can be used when the slope is between 20% and 25%. Moreover, mitigation measures are also important in the management of steep slopes. Proper measures should be taken for the restoration of the area to its natural condition and the protection of adjoining property owners from damage resulting from steep slope disturbances.

## Heat Map of Specific Regulations



*Figure 9. Heat Map for Zoning Code, Environmental Protection Laws, and Site Plan Review*

Finally, the team also made a heat map showing the names and boundaries of the municipalities of Cayuga Lake Watershed, especially for the zoning code, environmental protection laws, and site plan review (Figure 6). In the part of environmental protection laws and site plan review, the blue cells represent the municipalities that have adopted the regulations. In the zoning code part, the team noticed that most towns and villages have their own zoning codes, so blue cells represent which municipalities didn't have their own zoning codes. These graphs implied that many municipalities attach great importance to the management of their part of the watershed. Among the three elements we inspected, they have already carried out sufficient work. However, other towns and villages, they are less proactive in watershed management, not even writing zoning codes. Zoning codes, environmental protection laws, and site plan reviews are the main resources for others to understand the work progress of the municipalities and for them to summarize and review their own work. Therefore, it is necessary to make and update these documents.

# Recommendations

## ***Recommendation 1: Continue Focusing on Stakeholder Participation***

Stakeholder participation is essential for effective watershed management. To ensure success, CWIO needs to continuously assess and improve stakeholder engagement strategies. This involves maintaining existing strategies, exploring new methods such as social media and mobile applications, and tailoring programs to meet specific stakeholder needs. CWIO must also emphasize the importance of watershed management through workshops, webinars, and other educational formats. It is crucial to continuously evaluate and optimize stakeholder engagement processes to ensure maximum efficiency and effectiveness. These recommendations of regular assessments, maintenance, exploration, tailoring, emphasis, and continuous evaluation can help CWIO identify areas of improvement and make necessary adjustments to engage stakeholders more effectively. By following these strategies, CWIO can ensure that stakeholders are engaged and invested in the success of our watershed management efforts.

## ***Recommendation 2: Increase Community Participation***

Being involved in decision-making is essential as it increases awareness of the significance of managing watersheds, nurtures a feeling of personal commitment to the process, and results in the development of sustainable solutions in the long run. Insufficient community involvement in watershed management, however, results in a lack of support for ecological initiatives according to studies. This issue can be addressed by adopting a planning and decision-making approach that is based on community involvement. This cycle of problem identification, goal setting, and solution creation includes community members, public interest groups, and government agencies. When community members are involved in the decision-making process, they gain a better understanding and appreciation for watershed management and environmental projects.

## ***Recommendation 3: Conduct regular surveys and questionnaires to assess community concerns.***

Gathering community feedback plays a vital role in identifying and addressing the most pressing environmental issues in the watershed. Regular surveys and questionnaires should be conducted to gauge public opinion and gather insight into community concerns and priorities related to watershed management. This information can guide management planning, informing decisions about where to allocate resources and what specific areas of the watershed require attention. When community members feel that their voices are being heard and their concerns are taken seriously, they are more likely to become invested in the success of management efforts. This investment can manifest in various forms, including increased volunteerism, support for funding initiatives, and advocacy for policies that promote environmental protection and restoration. By prioritizing community feedback and incorporating it into management decision-making processes, stakeholders can develop a more comprehensive and inclusive approach to watershed management. This approach can foster a sense of shared responsibility and ownership over the health and sustainability of the watershed, ultimately leading to more effective and successful management outcomes.

## Conclusion

The team collected information, analyzed the data, and clarified the requirements and concerns among 57 municipalities to distinguish which communities are taking the most steps to maintain watershed protection. This report follows the structure of the 9-Element Plan of Seneca-Keuka, conducting a comprehensive analysis of municipalities' performance in adopting regulations. Moreover, we made heat maps and histograms to visualize our results based on the data we collected. These graphs show that septic rules, agricultural land protection plans, environmental protection, and flood damage prevention laws have been utilized widely in the Cayuga Lake watershed, while steep slope protection law, green infrastructure, and watercourse lot frontage law have just been adopted by few municipalities, which implied that more attention should be given to these less adopted regulations. In addition, the New York State model of local laws to increase resilience can provide some inspiration in developing these policies. The watershed management is in progress, and it will be more successful if it focuses more on stakeholder participation and enhances community involvement.


# Appendix

## Appendix 1: Village of Cayuga Wetlands Classification

Figure 19: Village of Cayuga Wetland Classifications

Name	Code	System	Class	Subclass	Water Regime
<b>Non-Tidal Aquatic Bed</b>	PABFh Impounded	Palustrine Non-tidal Wetland	Aquatic Bed woody vegetation >6 meters tall	n/a	Semi -permanently Flooded Surface water persists most growing seasons, others high water table
<b>Non-Tidal Emergent Vegetation</b>	PEM1E	Palustrine Non-tidal Wetland	Emergent erect, rooted aquatic Plants	Persistent stand at least until beginning of next growing season	Seasonally Flooded/Saturated Surface water present for extended periods
<b>Forested Wetlands</b>	PFO1E	Palustrine Non-tidal Wetland	Forested woody vegetation >6m tall	Broad-Leaved Deciduous woody trees/shrubs, shed in cold season	Seasonally Flooded/Saturated Surface water present for extended periods

<b>Non-Tidal Scrub-Shrub</b>	PSS1E	Palustrine Non-tidal Wetland	Scrub-Shrub Woody plants <6 meters	Broad-Leaved Deciduous woody trees/shrubs, shed in cold season	Seasonally Flooded/Saturated Surface water present for extended periods
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Appendix 2: Raw Data Summary Table

B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
County	Comprehensive Plan Year (year adopted/updated)	Zoning Code Regulations adopted/updated	Environmental Protection, Conservation, or Floodplain Overlay Districts (Y/N)	Flood Damage Prevention Law (Year)	Stormwater Management Regulation (Y/N)	Septic Rule (Y/N)	Environmental Protection Law (year adopted)	Climate Adaptation Law or Plan (year adopted)	Water Supply Regulations (year adopted)	Disaster Debris Recovery Ordinance (year adopted)	Site Plan Review (Y/N)	Forest/Buffer Ordinance (Y/N)	Docks & Mooring Law (Y/N)	Local Woodforest Rehabilitation Program Plan (year adopted)	Agricultural Land Right to Farm (Y/N)	Wastewater Management Law Code (year adopted)	Solar Energy Law (year adopted)	Green Infrastructure Local Law/Ordinance	Step Slope Protection Law/Ordinance	Watercourse Lit. Fringe Law/Ordinance	Stormwater Utility Fee	NY Climate Smart Community Participation	NPZ Participation	Wellhead or Watershed Protection Measure	Critical Environmental Areas	
1	Cayuga	2006	2008 Y																							
2	Cayuga	2008	2020 (Oversee)																							
3	Cayuga	2013	2012 N		1992 Y																					
4	Cayuga	2012	2018 N																							
5	Cayuga	2020	2022 Y	Waterfront	2007 N																					
6	Cayuga	2020	2022 Y	Waterfront	2007 N																					
7	Cayuga	2010	2018 N																							
8	Cayuga	2013	2013 Y																							
9	Cayuga	2010	2018 N																							
10	Cayuga	2010	2018 N																							
11	Cayuga	2021	2008 N		2007 N				2018 N																	
12	Cayuga	2013	2019 N		2007 N																					
13	Cayuga	2007	2013 N		2007 Y																					
14	Cayuga	2021	2021 Y																							
15	Cayuga	2021	2021 Y																							
16	Cayuga	2022	2008 N		2010 Y																					
17	Cayuga	2022	2008 N		2009 Y																					
18	Cayuga	2022	2008 N		2010 Y																					
19	Cayuga	2022	2008 N		2010 Y																					
20	Schuyler	2015	2015 (Amended 2017)		2010 Y																					
21	Schuyler	2015	2018 Y		1997 N				2020																	
22	Schuyler	2015	2018 Y		1997 Y				1981																	
23	Schuyler	2015	2018 Y		1997 Y				1986																	
24	Tioga	N	2017 N		1987 N																					
25	Seneca	2013	2013 (Ag. Aquifer Ph)																							
26	Seneca	2019	2022 Y		2016 Y				2021 N																	
27	Seneca	2016	2019 Y		1997 N																					
28	Seneca	2013	2019 Y		1997 N																					
29	Seneca	2013	2019 Y		1997 N																					
30	Seneca	2013	2019 Y		1997 N																					
31	Seneca	2013	2019 Y		1997 N																					
32	Seneca	2013	2019 Y		1997 N																					
33	Seneca	2013	2019 Y		1997 N																					
34	Seneca	2013	2019 Y		1997 N																					
35	Seneca	2013	2019 Y		1997 N																					
36	Seneca	2013	2019 Y		1997 N																					
37	Tompkins	2015	2021 N		1987 Y 2022																					
38	Tompkins	2015	2021 N		1987 Y 2007																					
39	Tompkins	2015	2021 Y		2011 Y 2007																					
40	Tompkins	2015	2021 Y		2011 Y 2007																					
41	Tompkins	2017	2022 N																							
42	Tompkins	2017	2022 N																							
43	Tompkins	2017	2022 N																							
44	Tompkins	2017	2022 N																							
45	Tompkins	2018	2022 Y		1985 Y 2008																					
46	Tompkins	2018	2022 Y		2015 Y 2009																					
47	Tompkins	2018	2022 Y		2015 Y 2009																					
48	Tompkins	2018	2022 Y		2015 Y 2009																					
49	Tompkins	2018	2022 Y		2015 Y 2009																					
50	Tompkins	2018	2022 Y		2015 Y 2009																					
51	Tompkins	2021	2021 Y		2008 Y 2008																					

## Reference

- Allred, S. B., Chatrchyan, A. M., & Tsintsadze, G. (2022). Local municipal capacity for climate change action in New York State: Exploring the urban-rural divide. *Review of Policy Research*, 39(5), 570-601.
- Cayuga Lake Watershed Intermunicipal Organization. (2022). Annual report 2022. *Cayuga Lake Watershed Intermunicipal Organization*. <https://cwio.org/wp-content/uploads/2023/01/2022-CWIO-Annual-Report.pdf>.
- Cayuga Lake Watershed Intermunicipal Organization. (2022). Annual report 2022. *Cayuga Lake Watershed Intermunicipal Organization*. <https://cwio.org/wp-content/uploads/2023/01/2022-CWIO-Annual-Report.pdf>.
- Cayuga Lake Watershed Network. Issues in the Cayuga lake watershed. *CCE-Tompkins*. <https://cctompkins.org/resources/issues-in-the-cayuga-lake-watershed>.
- Dahlke, H., Easton, Z., Fuka, D., Walter, M., & Steenhuis, T. (2013). Real-time forecast of hydrologically sensitive areas in the Salmon Creek watershed, New York State, using an online prediction tool. *Water (Switzerland)*, 5(3), 917–944. <https://doi-org.proxy.library.cornell.edu/10.3390/w5030917>
- Ecologic, LLC., & Anchor QEA, LLC. (August, 2022). Seneca-Keuka watershed nine element plan for phosphorus. *Seneca Watershed Intermunicipal Organization*. [file:///Users/ikkii/Desktop/Cornell%202023%20spring/PADM5900%20Consulting/CWIO%20project%20resources/9element\\_senecakeuka.pdf](file:///Users/ikkii/Desktop/Cornell%202023%20spring/PADM5900%20Consulting/CWIO%20project%20resources/9element_senecakeuka.pdf)
- Ecologic, LLC. (September 2022). Owasco lake watershed nine element plan for phosphorus reduction. *Cayuga County Department of Planning and Economic Development*. [file:///Users/ikkii/Desktop/Cornell%202023%20spring/PADM5900%20Consulting/CWIO%20project%20resources/9element\\_owasco.pdf](file:///Users/ikkii/Desktop/Cornell%202023%20spring/PADM5900%20Consulting/CWIO%20project%20resources/9element_owasco.pdf)
- Frothingham, M. K. (2010). Community input to the watershed management process: determining the perceived state of Cayuga creek, Niagara county, NY. *Middle States Geographer*, 43, 50-59. <https://msaag.aag.org/wp-content/uploads/2013/04/7-MSG-2010-Frothingham.pdf>.
- Li, X., Gao, H., Fu, D., Chang, P., Nielsen-Gammon, J., Gangrade, S., Kao, S.-C., Morales Hernández, M., Voisin, N., & Zhang, Z. (2023). Impacts of climate change on future hurricane induced rainfall and flooding in a coastal watershed: A case study on Hurricane Harvey. *Journal of Hydrology*, 616. <https://doi.org/10.1016/j.jhydrol.2022.128774>
- Singh, R., Kayastha, S. P., & Pandey, V. P. (2022). Climate change and river health of the Marshyangdi Watershed, Nepal: An assessment using integrated approach. *Environmental Research*, 215. <https://doi.org/10.1016/j.envres.2022.114104>
- Town of Tyre Planning Committee. (2018). Tyre zoning law 2018. *The Town of Tyre*. <https://tyreny.com/wp-content/uploads/2019/07/Final-Zoning-Law.pdf>
- Wang, G., Mang, S., Cai, H., Liu, S., Zhang, Z., Wang, L., & Innes, L. J. (June 30, 2016). Integrated watershed management: evolution, development, and emerging trends. *Journal of Forestry Research*, 27, 967-994. <https://link.springer.com/article/10.1007/s11676-016-0293-3>.
- Tidball, G. K. & Bjorkman, T. (March 14, 2019). Towns of Fayette and Varick comprehensive plan. Town of Fayette. <https://townoffayetteny.org/wp-content/uploads/2019/03/comprehensive-plan.pdf>.
- Town of Danby. (September 12, 2011). Town of Danby comprehensive plan. Town of Danby. <https://danby.ny.gov/docs/2011-town-of-danby-comprehensive-plan/>.
- Village of Cayuga Local Waterfront Revitalization Program. Regional Economic Development Council. <https://regionalcouncils.ny.gov/cfa/project/310889>.



Village of Cayuga. Village of Cayuga Local Waterfront Revitalization Program appendix B new or amended local laws or regulations. Village of Cayuga. [https://wixlabs-pdf-dev.appspot.com/assets/pdfs/web/viewer.html?file=%2Fpdfproxy%3Finstance%3DiZ9iGd092gikcJ8CgXhJibUbnqVDNXsgLMI8Zgcu7AA.eyJpbnN0YW5jZUlkIjoiMzNiNGVvOTItMGMzOS00ZjhlLWFjNTUtYWl4YWQ4ZjllYTEwIiwiaXBwRGVmSWQiOiIxM2VIMTBhMy11Y2I5LTdlZmYtNDI5OC1kMmY5ZjM0YWwNmMGQiLCJtZXRhU2l0ZUlkIjoiNjMzNDZmMTktMTdlMC00ZWZmLThjZWUtZTk3ZDhkY2ZlYTkwiIiwic2lnbkRhdGUiOiIyMDIzLTA0LTE0VDEzOjM2OjQ4LjM0MloiLCJkZW1vTW9kZSI6ZmFsc2UsImFpZCI6IjQ1MTk1NmE3LWMyYjctNDQ4Ny1hZjVjLWYwOTZhZGJhZDRhZCI6ImJpVG9rZW4iOiI1MDgwZjI4Yi0xYmQ5LTAxMjEtMjBiYi00MmY3NTUzNjAwODAiLCJzaXRIT3duZXJJZCI6IjgyOTJhOGJjLTJjN2QtNGFlNi05ZGY3LTQwZDAzOTQ4NGNiYyJ9%26compId%3Dcomp-147e1mii%26url%3Dhttps%3A%2F%2Fdocs.wixstatic.com%2Fugd%2F8292a8\\_4afae0304dbc4d4ba0aa8e7da61422ea.pdf#page=1&links=true&originalFileName=Appendix%20B%20DRAFT%20-%20New%20or%20Amended%20Local%20Laws%20or%20Regulations&locale=en&allowDownload=true&allowPrinting=true](https://wixlabs-pdf-dev.appspot.com/assets/pdfs/web/viewer.html?file=%2Fpdfproxy%3Finstance%3DiZ9iGd092gikcJ8CgXhJibUbnqVDNXsgLMI8Zgcu7AA.eyJpbnN0YW5jZUlkIjoiMzNiNGVvOTItMGMzOS00ZjhlLWFjNTUtYWl4YWQ4ZjllYTEwIiwiaXBwRGVmSWQiOiIxM2VIMTBhMy11Y2I5LTdlZmYtNDI5OC1kMmY5ZjM0YWwNmMGQiLCJtZXRhU2l0ZUlkIjoiNjMzNDZmMTktMTdlMC00ZWZmLThjZWUtZTk3ZDhkY2ZlYTkwiIiwic2lnbkRhdGUiOiIyMDIzLTA0LTE0VDEzOjM2OjQ4LjM0MloiLCJkZW1vTW9kZSI6ZmFsc2UsImFpZCI6IjQ1MTk1NmE3LWMyYjctNDQ4Ny1hZjVjLWYwOTZhZGJhZDRhZCI6ImJpVG9rZW4iOiI1MDgwZjI4Yi0xYmQ5LTAxMjEtMjBiYi00MmY3NTUzNjAwODAiLCJzaXRIT3duZXJJZCI6IjgyOTJhOGJjLTJjN2QtNGFlNi05ZGY3LTQwZDAzOTQ4NGNiYyJ9%26compId%3Dcomp-147e1mii%26url%3Dhttps%3A%2F%2Fdocs.wixstatic.com%2Fugd%2F8292a8_4afae0304dbc4d4ba0aa8e7da61422ea.pdf#page=1&links=true&originalFileName=Appendix%20B%20DRAFT%20-%20New%20or%20Amended%20Local%20Laws%20or%20Regulations&locale=en&allowDownload=true&allowPrinting=true)