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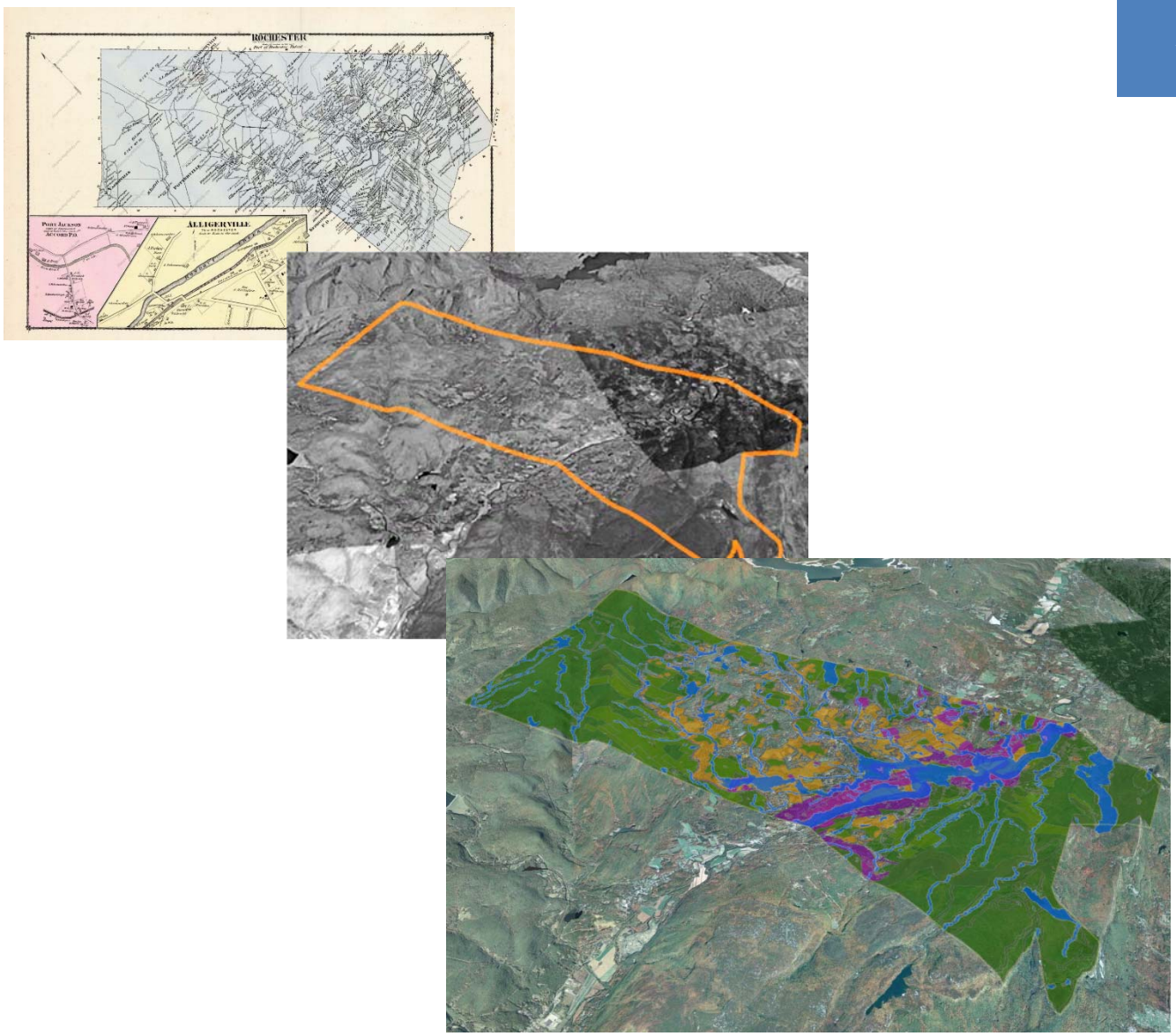

Town of Rochester, NY

OPEN SPACE INVENTORY

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TOR OSI Advisory and Review Team (ART)

- Angela Dorris – TOR Environmental Conservation Commission (ECC) Member
- Carl Chipman – TOR Town Supervisor
- Larry Dewitt – TOR Citizen
- Michael Baden – TOR Planning Board - Chair
- Steve Fornal – TOR Zoning Board of Appeals
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Executive Summary

Preserving, protecting, and making wise use of its finite natural, cultural and historical heritage is one of the most important undertakings for any municipality. The Town of Rochester (TOR), Ulster County, NY contracted with the author (Consultant) to develop an Open Space inventory (OSI), laying the groundwork for an upcoming, inter-municipal *open space plan* (OSP) with the Town of Wawarsing (TOW). This report details the design and development of the TOR inventory and presents the resulting data, maps and toolsets created, in collaboration with the TOR OSI project Advisory and Review Team (ART). Enabled through the generous support of a NYS-DEC Hudson River Estuary Program 2014 "Action-Agenda, Partnership Mini-Grant" the project began by reviewing, updating and expanding the 2006 draft Natural Resource Inventory (NRI) conducted by the Chazen Companies (2006).

Using a largely geospatial approach, data depicting the significant and noteworthy natural, cultural, protected and other open space systems within a 1 mile radius around the boundaries of the TOR (official study area) were gathered and integrated into a TOR OSI geodatabase. Consideration of each, in detail, was undertaken during a series of meetings with the ART, to establish their content and value and to develop a means of grouping them which made sense and facilitated discussion. This process kept in mind the approach and results of the recently completed (2014) TOW open space inventory, to facilitate integration within the open space planning process. Over a series of meeting, members of the ART undertook a visioning and prioritization process, to establish the relative ranking of open space resources. This process helped to establish perspective on the group process as well as the relative context for how the TOR might approach resource conservation, given limited resources. The adopted group headings, sharing common footprints of the individual layers, include:

- Hydrological Resources and Aquatic Habitats
- Ecological Resources and Terrestrial Habitats
- Agricultural Systems and Sustainable Forest Resources
- Historical, Recreational and Scenic Resources

The ranking process also informed the development of a GIS parcel prioritization framework (PPF) layer, developed as a toolset for this project. This PPF layer was constructed by geospatially merging the distilled open space feature groups with the TOR tax parcel layer. This dataset will enable the identification and selection of lands either containing or spatially relating to other significant open space features. For instance, within the domain of a GIS, parcels greater than 50 acres that are largely forested and are adjacent to NYS Park or Forest lands, could be easily selected as contributing to and buffering important core forest habitat. A KML feature of this PPF tax layer has also been provided to the TOR ART.

In addition to the PPF data layer, a Stream Health\Stream Vulnerability (SH\SV) model was developed for this project. Outputs of the spatially-explicit tool both contribute an estimate of the locations of the true riparian zones within the TOR study area, but also return an index as to the relative health and vulnerability to erosion of the areas within zone. The layers are intended to aid the identification of areas or stream segments which may warrant closer, more detailed geospatial inspections, using air photos or field visits. Zones or parcels that contain sections of degraded riparian zones, could be considered for revegetation and restoration. Such endeavors could help improve water quality patterns, especially within heavily farmed areas.

This project shifted the focus of products from those of a traditional OSIs, in order to improve their effectiveness, utility and value. Most of the ~100+ spatial layers produced for the project were converted to KML format, for use within Google Earth. Two (ea.), four-hour, hands-on Google Earth Pro computer trainings were provided to the ART and TOR staff, to increase capacity and help establish a core set of spatial skills within the team. It is the hope that through being able to view each layer individually and in combination with any of the others, that both current and future planning exercises can be enhanced. The ability to explore, query, notate, share and add to the database, with comments, photos or GPS-transits or any other KML-formatted layers, should provide utility far and above what a static map graphic can. And the 3- and 4D (time) patterns and multi-date imagery found within Google Earth will offer unparalleled visualizations and insight into processes from the parcel to the watershed scale.

To support the geospatial approach, an online Google Drive portal was developed, providing a central, widely accessible Geospatial Data Catalog. Each of the multitude of KML layers has been documented and hot-linked, so that any TOR staff or Commission member, with appropriate access, can easily find, understand and download a single or group of the layers, as they are needed. Combined with a laptop and projector, this portal should provide utility that all-too-often lost or misplaced CD\DVDs cannot, and will hopefully provide great benefit during actual TOR Planning, Zoning, ECC or ZBA meetings.

Among the more significant open space opportunities that the TOR, individually, or TOR\TOW, collectively, might wish to consider, within an open space plan, include:

- Adoption of and support for an *ecological corridor linking the Catskill and Shawangunk regions* (TNC, NYNHP), to provide a degree of cohesion, function and capacity to the increasingly fragmented system. Helping to highlight the conservation value of and steer development away from the parcels within and adjacent to this connectivity feature can contribute enormously to regional ecological resilience
- Consideration of the *integrity and function of the riparian zones* within the region, relative to regional water quality patterns, especially within the central agricultural corridors. Identifying the specific regions and stream segments that might be improved through restoration of the vegetative buffer areas.
- Construction of *combined Recreation, Historical and Scenic resource features*, such as a D&H Canal scenic bikeway, spanning the two towns and linking to a regional network.

Introduction\Project Overview

The Town of Rochester, (TOR), Ulster County NY is increasingly known throughout the Catskill\Shawangunk region as possessing committed, conservation-minded citizens and officials who are actively engaged in protecting regional environmental and cultural assets. With generous, on-going support of the NYS-DEC Hudson River Estuary Program (HREP), the TOR Environmental Conservation Committee (ECC) has been establishing data, programs and information systems to serve as the foundation upon which informed conservation and smart-development patterns can be based.

This report details the efforts and results in establishing a 2015 Open Space Inventory for the TOR, with resources provided by a 2014 HREP "Action-Agenda, Partnership Mini-Grant". The approach of this project has been designed to integrate with the recently completed (2014) Open Space Inventory of the neighboring Town of Wawarsing (TOW). The two towns are initiating an inter-municipal Open Space Plan (2016), which is also supported with HREP assistance. While this TOR OSI project independently applies to the TOR, it sought to better enable planners and staff, working on the inter-municipal OSP, to assess and potentially reconcile features, dynamics, and common approaches, within and across the towns' boundaries. A wide range of citizen viewpoints is thought to exist across the TOR\TOW region on how best to approach open space and natural heritage issues. Using the best available data and science-based information, this joint OSP project will seek consensus across municipal lines, while, at the same time honoring significant differences or approaches, as they become clear.

Such a regional approach promises to more effectively protect the important natural and open spaces resources of each town, at a scale and dimension not available to either, singularly. When it comes to preserving important landscape linkages, corridors, habitats and aquatic resources, larger, watershed approaches nearly always work better. In addition, plans and programs to preserve important cultural and historical features such as robust agricultural systems, rail\bike\ski trails, and hydrological and flood control measures, all benefit from a broad, regional approach.

TOR Background: History of the Region

Regional Setting\Context

The rural Town of Rochester, NY (pop. 2010: 7,313) is located within the west-central portion of Ulster County, (Image 1) linking the Catskill Park region, to the northwest, with the peaks of the Shawangunk Mountains (Gunks), along its southeast boundary. The fertile Rondout Valley divides the ~88 sq. mi.

town along a southwest-northeast passage, forming a central agricultural, transportation and commercial corridor. In addition to the central Rondout Creek system, the TOR encompasses five major (HUC12) sub-watersheds and stream systems (Image 2.):

- the wild and scenic *Vernooy Kill* to the northwest of the TOR
- the greater *Mombaccus Creek* system (including *Sapbush Creek and Mill Brook*), which is the only drainage not shared with a neighboring municipality
- the largest basin: the *Stony Kill*, which drains systems both south (*Peters Kill*) and north of the Rondout (*North Peters Kill*)
- the *Mettacahonts Creek*, Vly *Brook, Rochester Creek* unit and
- the *Coxing Kill, Kripplebush Creek*, which connect to the Rondout east of the TOR

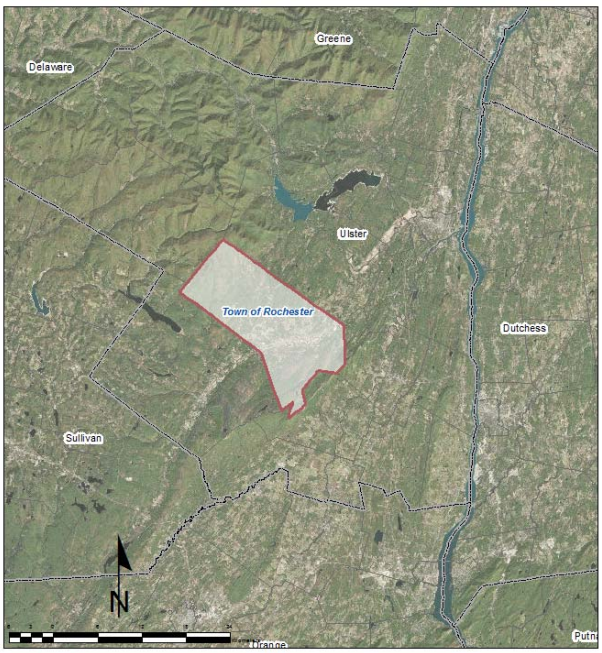


Figure 2. Town of Rochester, Ulster County NY

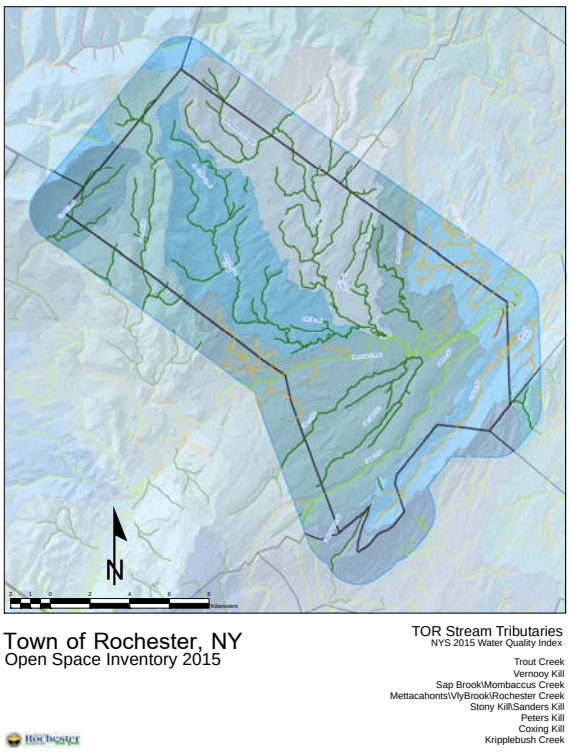


Figure 2. HUC-12 Watersheds and Major Streams TOR

Notable is the absence of significant lakes within the TOR; the Rondout Creek, connecting streams and a few small ponds representing most available surface water. The Rondout Creek merges with the Wallkill River some seven miles east in Rosendale, before winding its way to the meet the Hudson in Kingston NY.

As with most of the region, the primary geological bedrock formations within the TOR are Devonian sedimentary sandstone, shale and limestone with hard, erosion-resistant conglomerates forming high ridges (Image 3). Bluestone sandstone has long been mined within the Catskill region and limestone was successfully commercially extracted across the region. The TOR contains a few small karst regions and

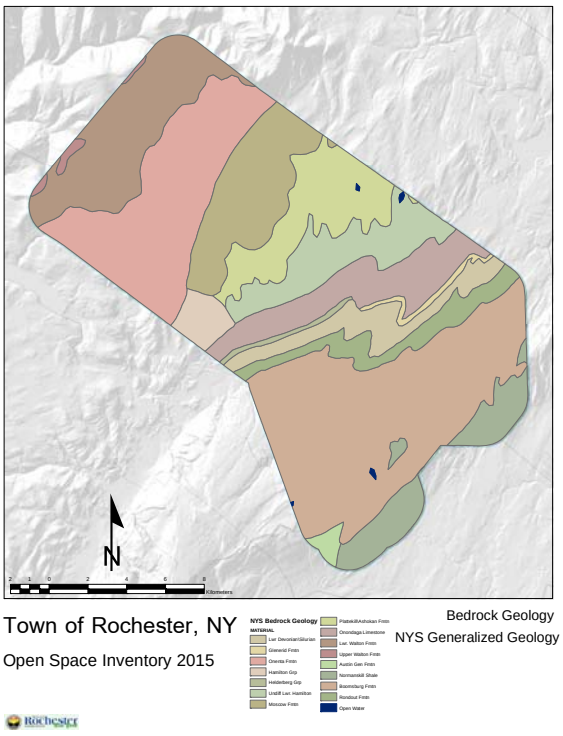


Figure 4. TOR Bedrock Geology (NYS General)

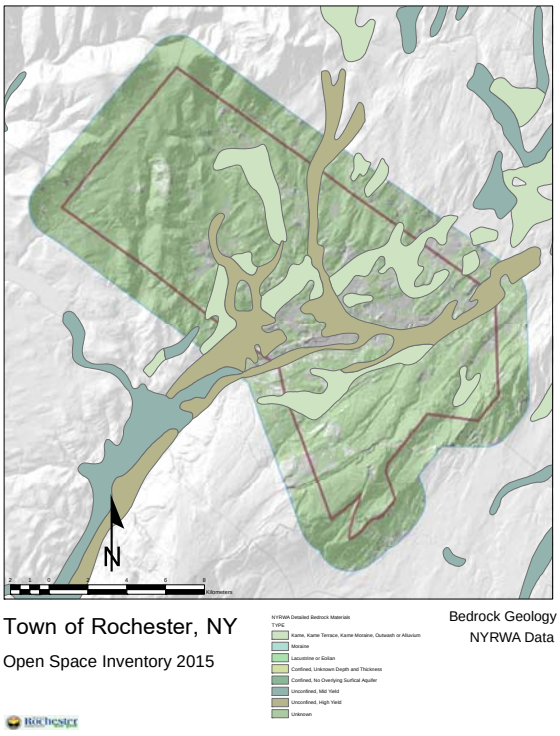


Figure 4. TOR Surficial Geology (Detailed, NYRWA)

underground cave systems add complexity to the regions water supplies. The Shawangunk Ridge section forms the northern end of a long ridge that extends from the Appalachian Mountains in Virginia.

Glacial activity affected the surficial geology of the valley and till and scoured bedrock now make up most of the regions materials (Figure 4.). Isolated outwash sand and gravel deposits now support some 17 mining enterprises within the TOR and provide important construction materials (Figure 5). Soils within the steeper, forested NW and SE sections of TOR tend to be thin, acidic and marginally productive, though the lower alluvial sections of the valley floor support over 8,500 acres of Prime and Soils of State-wide Significance. These soils have supported important agricultural industries within the town, since the days of early settlement (late 1600's).

The Rondout Valley falls within a broad, forest transition zone; the oak-hickory forests carpeting the Gunks, gradually blend into more northern hardwood\beech associations within the Catskill region. The highly changing elevational gradients and associated soil catenas support diverse plant communities and multiple rare and threatened species and plant communities call the region home. While historically, forests have been extensively cut to support sawmills, boat-building and the regions tanning industry, the now mature, second-growth forest that have regrown, represent some 85 % of the TOR land cover.

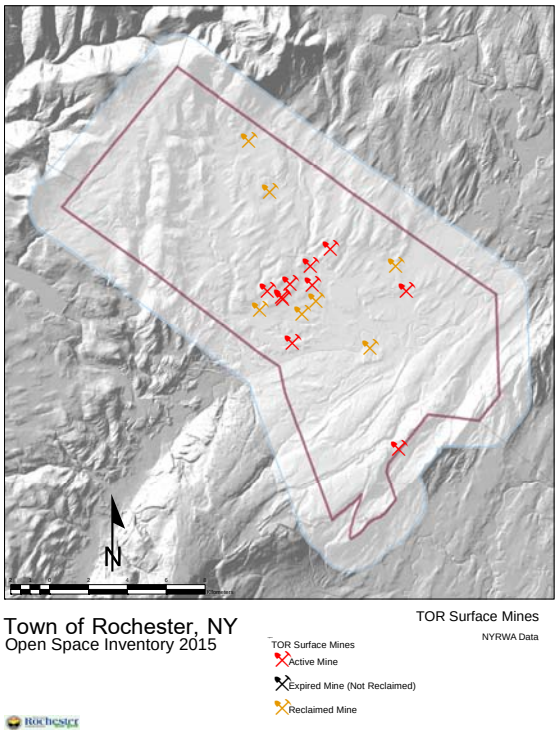


Figure 5. Mining Operations TOR (NYRWA)

History and Settlement

Since European colonists first encountered Native Americans (Lenni-Lenape) in western Ulster county (~1663), what is now known as the TOR has undergone several waves of settlement and development. The D&H Canal period (1825-1902) brought coal and commerce to the region, fostering development of hubs at Port Jefferson (now Accord) and Alligerville. And while both stage and rail lines would successively expand transportation through the Kingston-Neversink corridor (now Rt. 209), wholesale industrial or commercial development was never quite widely established. Agriculture, recreation, tourism and holidays based on easy access to abundant and vital green spaces have formed a core of the TOR economy, since nearly its inception. Small wood, grain and paper mills, set up on feeder streams helped the establishment of some 22 hamlet settlements within modern day TOR. Though many of these are now difficult to find, some 14 still provide vital links to the TORs historic past; bearing both markers and signage.

- Accord
- Alligerville
- Cherrytown
- Kerhonkson
- Kyserike
- Liebhart
- Mettacahonts
- Mombaccus
- Palentown
- Pataukunk
- Potterville
- Tabasco
- Whitfield
- Yeagerville

Overall population trends within the TOR have both risen and fallen since the early 19th century. Decadal censuses since 1820 have swung greatly, and saw rises of some 43% from one decade to the next as well as descents of over 35%. (https://en.wikipedia.org/wiki/Rochester,_Ulster_County,_New_York). Current population numbers (7,313) remain some 3.5X those of the 2,063 count from the 1820 count. Assessment by the TOR Historical Preservation Commission suggests that town population growth has long been self-replacing, with immigration from outside representing small fractions of the town. Late 19th century figures suggested that at that time, some 90% of the all population growth came from within the TOR. Looking to the future, it will be seen if vacation and second home buyers, looking to take advantage of the great scenic beauty and abundant green spaces, will balance the net population loss that Cornell University suggests that Ulster County may experience over the next 25 years.
(https://pad.human.cornell.edu/counties/projections.cfm)

2015 OSI Project: Structure, Products and Deliverables

In August, 2015, the TOR contracted with the author, John Mickelson of Geospatial and Ecological Services (the Consultant), to develop an Open Space Inventory for the town. The terms of agreement established the following tasks and deliverables as part of the project Scope of Work (SOW):

1. Updating the (draft) Chazen 2006 Natural Resource Inventory (NRI) (using GIS technologies)
2. Performing a current (2015) Open Space Inventory (OSI) (using GIS technologies)
3. Producing a geospatial Stream Health\Stream Vulnerability (SH\SV) Model to assist assessment of local riparian issues
4. Undertaking a Parcel Prioritization Framework (PPF) with an assembled Advisory and Review Team (ART)

A more detailed discussion of the SOW tasks, includes the following:

1. Updating the (draft) 2006 Natural Resource Inventory (using GIS technologies)
    a. The draft 2006 NRI, produced by the Chazen Companies, (http://townofrochester.ny.gov/Pages/RochesterNY_BComm/ec/NRI_Rochester_20060724_jkj_.pdf) outlined and detailed the natural resources found within the TOR region and should provide a valuable and useful reference for years to come. Included within their report (Appendix I, Table I) are tabular overviews, descriptions and detailed tax parcel, wetland, topographic, slope and air photo map compositions for natural systems including:
        i. Topography and Surficial Geology
        ii. Bedrock Geology and Groundwater resources
        iii. Surficial Water, Streams, Wetlands and Floodplains
        iv. Agriculture
        v. Dominant Vegetation Types and Wildlife

1. Includes list of Rare Plants and Animals listed by the NY Natural Heritage Program that may occur within the TOR (2006)

vi. Protected Lands and Conservation Targets (Shawangunk Ridge Biodiversity Partnership)

The geospatial data representing the 23 basic layers listed within the 1996 report, were checked through each original, contributing agency, and, when possible, updated and including within a TOR OSI geospatial database, created for this project.

2. Performing a current (2015) Open Space Inventory (using GIS technologies)
    a. Performing the open space inventory represented the majority of time investment for the project, and is described in detail below. Some 100+ layers, were compiled, representing features such as:
        i. Administrative layers
        ii. Ag\Forestry
        iii. Biophysical
        iv. Cultural
        v. Ecological\Terrestrial Habitat
        vi. Historical
        vii. Hydrological\Aquatic Habitat
        viii. NYRWA (from their 2006 project)
        ix. Existing Protected Areas
        x. Recreational
        xi. Scenic
        xii. Data Created for this Project (PPF, SH\SV)
    b. The data matrix (print version of the online Geospatial Data Catalog) is included as a separate PDF Appendix, (*TOR_OpenSpaceInventory2015_GeospatialDataCatalog.PDF*) to this report.

3. Producing a geospatial Stream Health\Stream Vulnerability (SH\SV) Model to assist assessment of local riparian issues
    a. The TOR ECC is deeply concerned about and working to better understand water quality dynamics within the TOR region. To aid this effort, a geospatial model was developed, to help steer field investigations along TOR stream and riparian systems. These systems might benefit from action, restoration or remediation, to help stem sedimentation or overland pollution. This model is also discussed in more detail later in the report.

4. Undertaking a Parcel Prioritization Framework (PPF) with an assembled Advisory and Review Team (ART)
    a. To support the upcoming open space planning process, soon to be jointly undertaken by the towns of Rochester and Wawarsing, the TOR OSI RFP requested the inclusion of a Parcel Prioritization Framework (PPF). This exercise takes the ranked OSI group layers and outcomes and loads or merges then into the TOR tax parcel layer. Thus each parcel can be considered from a range of perspectives, as to its content and potential value, relative to an open space option. Area and Percent composition has been installed in each tax parcel within the TOR, integrating combined features such as: Hydrologic and Aquatic systems, Ecological, Recreational, Historical, Scenic and other major open space classes. These values, when combined with a weighting or ranking valuation, will allow persons exploring open space plan options, to better visualize the spatial patterns, juxtaposition and regional context, relative to other existing resources and features.

Additional Project Components:

In order to increase the potential value, utility and effectiveness of the final project outputs, several additional components were added by the Consultant. As traditional GIS data outputs (CD, paper map sets, printed reports, etc…) too frequently get lost or forgotten in someone's desk drawer, the materials developed for this project have been placed within a central, online "cloud" data repository. This Google Drive portal, owned and managed by the TOR ECC, allows all credentialed stakeholders to easily find, access, understand and use the complete suite of developed materials and 100+ geospatial features, though a single, central sharing-point. Each layer is linked through a descriptive catalog service that explains the layers origin, approximate date of development, coverage extent and notes as to any important use features. More importantly, as conventional OSIs are usually conducted with the aid of a geographic information system (GIS), the geospatial layers produced tend to strictly be bound for the desk of a trained GIS professional. We hold that with the proliferation of free, open source and widely accessible geospatial tools (i.e. Google Earth Pro), such projects no longer need to constrain the consideration, exploration, assessment and compilation of spatial materials to individuals with expensive hardware, software and years of training.

The advent of "GIS for the masses", in the form of Google Earth Pro and Google Maps now allows remarkable access to layers representing both the 3-dimensional world as well as the 4th dimension (time) in which we live. The power in these tools lies in the capacity to mix, match, add to, customize, update and share layers stemming from an OSI, in ways that static, printed maps and materials fail to. The patterns and processes that can be depicted, within the context of a changing, 3-dimensional landscape adds tremendously to a municipality's ability to effectively assess and consider trade-offs and options within current and future planning activities. Multi-date and historical air photos now allow us to quickly visualize changes to the land cover patterns of a particular site. With such a visualization platform in place, the foundation is laid upon which future changes, developments or remediations within the TOR can be easily included or considered. Paper maps will always lack such capacity and are too often lost, torn or become dog-eared to match the regenerative capability of re-printable digital geospatial layers.

To catalyze and facilitate the full use of these spatial layers, two (ea.) half-day, hands-on Google Earth Pro computer trainings were provided to the ART as well as to several TOR Planning and Zoning staff members. These trainings, supported through the kind efforts of Ulster County Information Services and Department of the Environment, were accompanied with a customized 70+ page Google Earth training manual. This guide includes step-by-step methods of locating, loading, visualizing, symbolizing and sharing data and Place-Layers within the Google Earth software suite. Training data consisted of actual TOR OSI layers and examples of both a Parcel Prioritization Framework and a Stream Health\Stream Vulnerability model, also developed for this project.

It is the expressed intention of this project to more fully empower TOR staff and citizens, so that their planning efforts will be enhanced in their effectiveness and ultimate success. Possessing the ability to load, compose and query any combination of the OSI KML layers, zooming in and out across scales, should support this goal. New layers, locations or development proposals can easily be added so that Planning\Zoning or ECC meetings can consider neighboring impacts and weigh trade tradeoffs, in 3 and 4 dimensions, with notes and photos easily included.

Establishing a TOR Advisory and Review Team (ART)

Fundamental to the project was the generous time, support, engagement, expertise and guidance provided by the convened TOR OSI Advisory and Review Team (ART). This six-member team was solicited and engaged from among a wide range of committed TOR officials, Committee members and engaged citizens. While many TOR people shared their views, expertise and opinions as to what features and natural resources, historical and cultural assets should be included within the inventory, the core ART consisted of:

- Carl Chipman – TOR Town Supervisor
- Laura Finestone – TOR Environmental Conservation Commission (ECC)- Chair
- Michael Baden – TOR Planning Board - Chair
- Larry Dewitt – TOR Citizen
- Angela Dorris – TOR Environmental Conservation Commission (ECC) Member
- Steve Fornal – TOR Zoning Board of Appeals

In addition, John Mickelson, of Geospatial & Ecological Services, the Consultant, served as ART coordinator and project lead. Laura Heady, the Biodiversity Outreach Coordinator with the Hudson River Estuary Program (New York State Department DEC) devoted a great deal of time helping with project conception, development and strategic planning and offered her expertise and feedback during a number of the ART meetings. Amanda LaValle, coordinator of the Ulster County Department of the Environment, provided valuable insight, guidance and feedback from project conception through delivery.

Eight meetings were conducted with the ART over the six month project period, with a final ninth held January, 26, 2016 to review the final products.

- **Thursday, August 13, 2015** TOR Offices, Accord, NY – OSI introductory meeting, held at the TOR central offices, to overview the contracted OSI and associated products. The Consultant presented the ART with the project approach, the agreed upon deliverables and the proposed process of establishing, reviewing and finalizing the PPF. In addition the development of an online, centralized Google-Drive based Geospatial Catalog was introduced, which would be coupled by a series of hand-on Google Earth trainings for the ART and TOR staff.
- **Wednesday, September 2, 2015** TOR Offices, Accord NY – saw the first of three PPF meetings. The ART team met to conduct a visioning process and to begin to consider potential priorities among TOR open space components. Each member was asked to consider and share: "were you were to meet a TOR

resident from 50 years in the future; what are two things that you'd like them to know, that you and our ART helped protect". This process was very lively and helped solidify the perspectives, intentions, background and hopes of the collective group. It also helped to establish the beginnings of the PPF. The Consultant offered a presentation of a suite of all potential open space assets, lands and resources, in map and real-time Google Earth format. With the complexity and number of possible features and their overlapping relationships, ways to group and simplify consideration them were also explored. This enabled the ART to begin to reflect not only on what open space assets and priorities might ideally be included, but also where within the region they fall and their inter-related context.

While it was fully agreed that all open space lands and resources contain inherent value, the issue addressed was: in the face of limited time and financial assets, if the TOR could ensure the integrity of one over another, what might the preferential sequence be? To help better understand this, an online Google Forms-based survey (https://goo.gl/TnkbHf) was subsequently conducted with the ART, via email. Each member was asked to consider and independently rank groups of six open space features, to begin to understand what open space priorities might look like for the TOR.

- **Tuesday, September 15, 2015** TOR Offices, Accord NY– Within this second PPF meeting, the ART reviewed the results of the online PPF poll, which had been tallied and ranked by votes, from most to last. While the voting and ranking was done anonymously, group members readily discussed their reasons behind choosing one group above another. The process (based on number of choices and rank counts) returned the following sorted groupings:

RANK	GROUP SCORE
1	HYDROLOGICAL & AQUATIC HABITAT RESOURCES
2	ECOLOGICAL RESOURCES & TERRESTRIAL HABITAT
3	AGRICULTURAL & CULTURAL RESOURCES
4	RECREATIONAL RESOURCES
5	SCENIC RESOURCES
6	NON-BUILT OPEN SPACE

Members discussed and most agreed that fairly practical matters informed their ranking choices. For example: without adequate amounts of clean, available water, life in the TOR would become challenging for humans and nature alike. Maintaining the abundant, high-quality and vital forests and ecological green spaces that that the TOR is known for, would serve multiple and overlapping purposes; preserving quality of life, rural character not to mention, at the same time, water quality, recreational and scenic resources. While the category components (discussed in more detail below) would change and shift some, this basic prioritized rank array would hold throughout the rest of the OSI process.

- **Wednesday, September 23, 2015** TOR Offices, Accord NY- This third and final PPF meeting began with a presentation by hydrogeologist Steve Winkley, of the NY Rural Water Association (NYRWA). Under the auspices of an internal grant that the NYRWA obtained, Steve conducted and authored the 2006 TOR Groundwater study (https://goo.gl/2xaTr5) which assesses, maps and reports on the detailed hydrological and drinking water systems found within the TOR region. Steve presented and shared with the OSI team, the geospatial data from this highly valuable study, which produced detailed field-based maps of TOR ground water resources, aquifers and recharge areas. The study also provided insight as to well locations and yields, potential sources of contamination and strategies that the TOR could adopt to protect its precious ground water resources.

The Consultant offered ways to work with all of the open space components considered to date, but in a manner easing and facilitating analysis. The integrated and ranked groups, joined by common themes, were presented in "flattened" clusters, representing the collective footprint of the layers representing each

group. This approach was accepted, as each of the individual components was made available through access to a Google Earth KML file. This ensured that the combined "loadings" and composition of each group could always understood as the sum of each of its accessible components. The utility provided by merging the integrated, ranked open space groups, with the TOR tax parcel database was demonstrated. Multiple lots of a particular size, within a given distance to an existing park or protected area, that contain both large amounts and percent cover of core forest habitat, can now be quickly identified with a single, simple query. The same opportunity exists for all of the integrated open space layer groups, now permanently fused with each TOR parcel. The Consultant offered examples and approaches as to what he, as an experienced landscape ecologist, might suggest the ART broadly consider as applications of the PPF. Ecological, important habitat features like landscape corridors and regional (Catskill\Shawangunk) linkages could greatly be supported and enhanced. Core areas of existing permanent park lands and protected areas could be buffered, to help protect degradation due to "nibbling away at the edges". Important Historical and\or Cultural areas could be approached, through the utilization of overlay districts or protection zones.

- **Thursday, October. 15 2015** Ulster County Information Services Offices, Kingston NY- The group's first Google Earth Pro training was conducted in a computer lab in Kingston, thanks to the generous assistance of the Ulster County Departments of the Environment and Information Services. While the 4-hour focus was on the fundamental navigation, loading, querying and sharing of KML\KMZ files, the examples were all drawn from the extensive geospatial data library and online "cloud" portal created for this project. An introduction to geospatial technologies as followed by examples of how the ART and the TOR in general can leverage the digital toolboxes to more effectively plan for and protect the regions important resources. The Consultant was delighted that members of the TOR Planning\Zoning\Zoning Board of Appeals were also able to attend; thereby providing increased capacity both for the TOR as well as, potentially, for the upcoming open space plan.
- **Thursday, November 5, 2015** Town of Wawarsing Offices, Ellenville NY – The Consultant and ART member Larry Dewitt met with the Hank Alicandri and his TOW ECC team and presented an overview of the TOR OSI project to date. The purpose was to exchange perspectives and help facilitate a coherent and unified approach to the upcoming inter-municipal open space plan. Mr. Alicandri made the GIS data CD, from the TOW 2014 OSI available to the ART and TOW ECC members were, in exchange, invited to subsequent Google Earth Pro trainings. Considerations of commonalities and differences in OSI approaches were shared and discussed, though it appeared unlikely that the two towns would encounter significant obstacles to their upcoming project.
- **Tuesday, November 24, 2015** Ulster County Information Services Offices, Kingston NY - In addition to a second, half-day refresher course on navigating the Google Earth interface, an overview of the full range of OSI layers developed to date and the updated online Geospatial Data Catalog was presented to the ART. The Consultant presented the results of the Stream Health\Stream Vulnerability model run to the team. This place-based model outputs geospatial layers, indicating the extent and location of the true riparian zones within the TOR. In addition, it suggests which areas and locations might support Healthy or Unhealthy riparian land cover and which might be Vulnerable to erosion and\or sedimentation. These patterns can help the TOR decide which riparian reaches might warrant additional attention remotely, using high-resolution air photos (via Google Earth) or potentially field inspections.
- **Monday, November 30, 2015** TOR Offices, Accord NY – The ART met one last time in 2015, to review the project and discuss the PPF logic model and opportunities. It was demonstrated that the TOR Tax Parcel layer now has all of the integrated OSI layers fused into the data structure, so that each parcel can be assessed, queried, grouped and prioritized within the upcoming open space planning process. The Consultant offered output examples and map graphics of what he, as an ecologist, might suggest the TOR consider for priority areas using each of the open space integrated groups.

What is Open Space? Why Protect it?

For the purposes of this project, open space has been defined quite simply as lands and areas that are undeveloped or marginally developed and\or important cultural or historical lands that the TOR might wish to help protect from unregulated development and sprawl. These areas include large regions of scenic forests, parks, wetlands and lands supporting natural habitat and vegetation. The interwoven matrix of surficial waters, lakes and streams as well as wetlands, floodplains and aquifer recharge areas are included. Active agricultural lands are included, as they add to the value of the regions character, tourism popularity and scenic beauty not to mention the jobs, income and fresh, local foods they provide. Outdoor recreational features as diverse as hiking\biking\ski trails are included as well as important hunting, fishing and parklands favored for passive recreation and leisure. Historical hamlet areas, districts listed with Historical Preservation agencies and stone homes and farm lands that preserve connections to our shared heritage form another key component. Many hold that the term "Open Space" suggests incorrectly that, since few man-made structures or disturbances are present, that there is little of significance present, and the area is somehow waiting to be used or improved by humans. We strongly suggest that the opposite is true; that the remarkable natural heritage that sustain our lives functions better and serves highest and best uses *in* their undeveloped state. Regardless of the term, all of the assets above add greatly to the critically important rural character and high-quality of life that TOR natives, second-homers and visitors alike value so highly.

Planning for and protecting open space can not only save these precious resources for the enjoyment of future generations, but allow significant financial savings in the process. By steering expansion and housing into identified growth zones, where roads, sewers and water systems already exist, sprawl, habit fragmentation and water pollution can be minimized and managed. Open space has been found to provide a net plus to municipal coffers, where developed lands typically do not provide enough tax revenue for the municipal services they require. And the spiritual and aesthetic dimension of nature and open space, though difficult to measure, is also priceless. As humans, nature represents our common ground, one of the things that binds us together; that renews us, when we're tired; that inspires us, when we become brittle; that grounds us, when we get lost in this digital world.

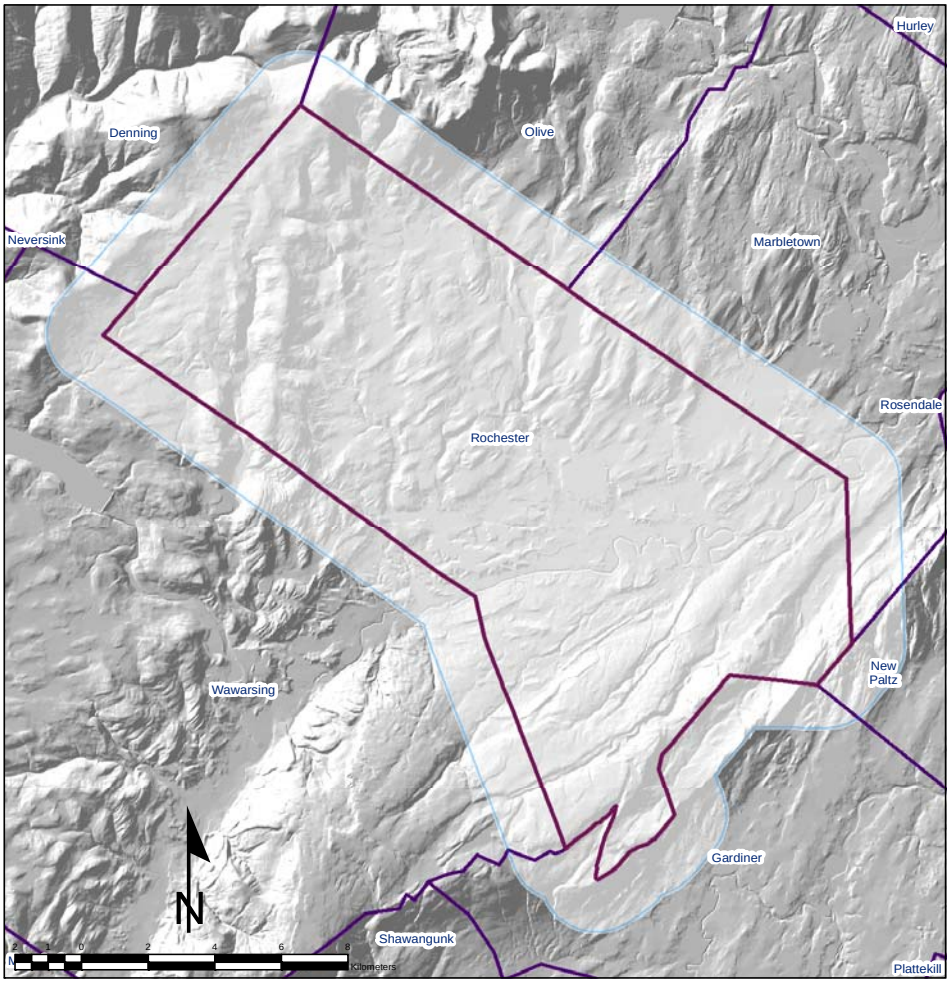
The Ulster County Open Space Plan (2007) and the TOW 2014 OSI suggest consideration of open space as reasonably broad, uniform groups, which, while differing in their composition and arrangement, encompass and include the same fundamental components.

TOW OSI (2014)

- Existing Protected Open Space
- Natural Systems
- Recreation, Scenic, Historic
- Agricultural Landscapes
- Biodiversity & Connectivity
- Land Parcel Sizes

UC Open Space Plan (2007)

- Water Resources
- Working Landscapes (including agriculture)
- Landforms and Natural Features
- Ecological Communities
- Cultural and Historic Resources
- Recreation Resources



Town of Rochester, NY
Open Space Inventory 2015

TOR OSI Study Area

TOR Boundary + 1mi Buffer Zone

Figure 6. TOR OSI Study Area: TOR Boundary + 1mi Buffer

Our project followed a very similar strategy and began by considering the full range of lands, places, cultural and historical assets and natural resources that the TOR might wish to protect for future generations. Context, both local and regional was important, as few natural systems follow political or administrative boundaries. The official study area included the areas within the TOR boundary plus lands falling within a 1 mi. radius from the edge (Image 6), to insure that neighboring and proximal patterns and processes were included.

We began by considering the full range and depth of all potential open space resources and features, starting with the following outline:

1. AGRICULTURE& CULTURAL RESOURCES, including:
    a. Farms & farmlands (active and fallow), orchards, pastures, vineyards, etc…
        i. Important agricultural soils (potentially affecting past\future\potential farmlands)
            1. Prime
            2. Soils of Statewide Importance
        ii. Potential sustainable, private forestry regions (private, forested parcels >50 ac).
        iii. Lands identified within Scenic Hudson's Foodshed Study
        iv. Tax parcels wit Ag\Farm codes
        v. Lands within UC Ag Districts
    b. Historical, cultural and heritage resources
        i. Hamlets
        ii. Stone houses, historical farms and estates
        iii. Areas within Historical Registry Districts
        iv. D&H Canal region
        v. Favorite Places
            1. Hunting, fishing, swimming areas
            2. Farm markets and agro-tourism
            3. Sugar maple farms
            4. Christmas tree farms
            5. Pick-your-own farms
        vi. Rural Character
            1. Fuzzier to define
            2. Components included such as:
                a. Forested\Fields (unbuilt) areas
                b. Green spaces
                c. Scenic vistas of ridges and mountains
                d. Lack of:
                    i. Large, strip-mall, high-impact developments
                        1. Along 209 corridor

2. ECOLOGICAL RESOURCES\HABITAT, includes:
    a. Natural vegetated areas
        i. Forests, fields, post-ag, scrub, unmanaged grass and woodlands
        ii. Wetlands and vernal pools

        iii. Corridors and landscape connectivity features
    b. Important wildlife habitats
        i. Significant biodiversity areas
        ii. Habitats important for species of greatest conservation need (SGCN) as well as important plant communities
        iii. Rare and endangered areas
    c. Biophysical resources critical to ecological functioning
        i. Soils, geology, (surface, bedrock) etc…
        ii. Water (necessary to terrestrial and aquatic life)
3. HYDROLOGICAL RESOURCES, including:
    a. Surface waters: lakes, ponds, streams, wetlands, flood plains, rivers (including the Rondout Creek) etc…, important to human uses
    b. Ground waters and drinking water systems: aquifers, wells, recharge areas, etc…
4. NON-BUILT OPEN SPACE: including:
    a. Governmental or privately owned protected lands
        i. Lands with conservation purposes, other than recreation
            1. Easements
            2. Wildlife preserves
            3. Wilderness, etc…
    b. Misc. Open Space Features
        i. Cemeteries
        ii. Utility right-of-ways
        iii. Green spaces (academic)
        iv. Vacant lots
        v. Brownfields, etc…
    c. Category mostly included as a catch-all for features not fitting in other groups
5. RECREATIONAL RESOURCES, includes:
    a. Parks
        i. State, county, local
        ii. With conservation provisions
    b. Golf courses, play grounds, ball fields, agro-tourism areas
    c. Trails: hiking\biking\ski trails, linear parks,
    d. Picnic areas, agro-tourism sites
    e. Boating, fishing areas, game clubs etc…
6. SCENIC RESOURCES, including:
    a. Scenic character of region
    b. Scenic roads, trails, and by-ways
    c. Ridgelines, ridges, vistas, overlooks
    d. Gateway areas (entry ways to TOR via major road corridors),

The list represents a loosely arranged though reasonably comprehensive survey of most of the features, lands and components that other OSIs have included. The ART agreed the list should legitimately form a starting point of our work. By the time we were through adding items, a total of some 100+ features (including base map and context layers) were included as geospatial layers supporting our efforts.

One of the objectives of this project was to help ensure that these individual layers could be included within the final inventory, but in a manner that made discussing and handling them understandable and

effective. Using the GIS analogy of Overlays and Clustered Groups, the ART discussed ways to condense and arrange the many features into six, and then eventually four main thematic groupings. Some of the groupings were tricky, as many of the features and components maintain clear and apparent overlap among logical categories. For example: state forest lands serve important roles as hiking, hunting and passive recreation areas as well as providing important wildlife and plant habitat and helping to protect water quality for transiting riparian zones. Riparian areas support aquatic habitat and the plants and animals that depend on them as well as providing drinking water assets. Such interconnectedness highlights the importance of protecting future resources in a holistic and relational manner. Our aim was to simplify the names of a series of layers that adequately represented the spatial footprint of the combined individual, inter-related components, while preserving their respective contribution to the group.

As described earlier, the prioritization and ranking exercise that the ART undertook established a sequential order of importance, one relative to another, which the TOR placed on open space components and returned the following:

RANK	GROUP
1	HYDROLOGICAL RESOURCES
2	ECOLOGICAL RESOURCES\HABITAT
3	AGRICULTURE& CULTURAL RESOURCES
4	RECREATIONAL RESOURCES
5	SCENIC RESOURCES
6	NON-BUILT OPEN SPACE

With increased discussion and familiarity of both the groupings and their constituent parts, some re-arranging occurred, eliminating the Non-Built group, which was originally included to provide a catch-all of miscellaneous features that might not fit within other classes.

This returned the four open space resource groups adopted for and used throughout the TOR OSI. The overarching headings, offered also as a foundation of the OSP, include:

- Hydrological Resources and Aquatic Habitat
    - Surface water (rivers, streams, ponds) and aquatic habitats (including riparian zones and wetlands) share a very similar TOR footprint. Protecting one of these components will intrinsically provide immense benefit to the other; hence their clustering.
    - Groundwater layers are addressed largely by the NYRWA 2006 study, and the geospatial data from the project have been included within the OSI Geospatial Data Catalog. A

groundwater recharge protection zone has already been included within the current TOR zoning layer.

- Ecological Resources and Terrestrial Habitat
  - Includes large, contiguous forest tracts, woodlands, post-ag, field and scrub-shrub habitats and other lands containing natural, upland vegetation. This group includes NY State Forest and Park lands as well as regions of privately held conservation lands (Mohonk Preserve, etc…) and lands containing conservation easements. The areas contained provide habitat and resources for both plants and animals, from the rare, endangered, threatened and of special concern to the common and widespread. The rich complexity of TOR terrestrial biodiversity is largely dependent on these areas though they also play important roles in other OSI groups (Recreation, Hydrology, Scenic character, etc…)
- Agricultural Systems and Sustainable Forestry
  - Including all current, actively farmed lands, livestock areas, vineyards, orchards etc…. as well as parcels that fall within the UC Ag Districts and areas containing prime agricultural soils or soils of Statewide agricultural importance.
  - Privately owned forest lands greater than 50 acres, which could represent sites providing sustainably harvested forest products and TOR 480 tax program lands are included.
- Historical, Recreational and Scenic Resources
  - The Historical group contains areas, districts, features and lands that have been identified as of Historical importance by the TOR Historic Preservation Committee and that enjoy recognition by the National Register of Historic Preservation. This project developed draft geospatial depictions of a few, previously listed (tabular) features (10 historic farms, 27 historical stone houses, the D&H Canal region in TOR) though this area still deserves a great deal of effort, both to map and to consider how each might be protected. Cultural features such as Favorite Places and other locations that collectively contribute to rural character or quality of life are also included here (e.g. Farm Stands\Agro-Tourism locations, Sugar Maple farms, etc….
  - Recreation resources here contains both active and passive recreation and again, many maintain considerable overlap with other features such as State Park and other private conservation lands. Recreational trail systems, including extensive regional hiking, biking, skiing and rail-trails are included here, many of which have been mapped and highlighted through the excellent UC Rec-Connect program. (http://ulstercountyny.gov/maps/recreation/). Public and private land parcels are included, representing activities as diverse as golfing and roller skating. The locations of a few privately owned fish and game clubs are included.
  - A Scenic category could rightfully cover the vast amount of the TOR region, due to the towns' abundant green spaces and inspiring array of pastoral vistas. Specifically included within our inventory are three features of importance to open space planning: first the Gateway areas located at the entrances to the TOR, along routes 209 and 44. These areas will be important for the TOR to address, as their aesthetic content help form the first impression that a tourist draws, when visiting the TOR. Secondly, the mountain vistas and remarkable ridgelines within the Catskill and Shawangunk systems are emblematic of the wild spaces and escape that so many travel to the region to find. And lastly are the TOR scenic drive components of the 88 mi. Shawangunk Mountains Scenic Byway (SMSB).

It was the combined, spatial footprint for each of these four broad resource groups which were merged with the TOR tax parcel data, used within the PPF exercise.

Methods: Open Space Inventory

Project Design

The work was performed by the Consultant over a six month period (August 2015- January 2016) utilizing a largely remote, geospatial (GIS) approach. Data forming the framework of the draft Chazen NRI (2006) were reviewed, notated, documented and checked for availability from the originating agencies (Appendix I,Table I) . Available updates or significant changes were acquired and integrated, developing a TOR OSI geospatial database. Several weeks early in the project were spent locating, reviewing and, in many cases, establishing data sharing agreements with agencies such as the NYC DEP (detailed hydrology, land cover), the Hudson River Estuary Program (forest fragmentation layer) and the NY Natural Heritage Program (element occurrences of rare, endangered and threatened animals, plants and habitats). Many layers were added to complete and expand upon the NRI and inform the establishment of an OSI. Data were obtained from a wide range of Federal, State, County, private and NGO agencies, including: the Mohonk Preserve, the Shawangunk Ridge Biodiversity Partnership, The Nature Conservancy, Ulster County Department of Environment, Ulster County Department of the Environment and Information Services\GIS, Hudson River Estuary Program, Open Space Institute, Shawangunk Mountains Scenic Byway, NY Rural Water Association, USGS, USDA-NRCS, FEMA, NYC DEP and the NYS GIS Clearinghouse. All of the data utilized within the OSI has been organized, referenced and cataloged, for use by the TOR and its Committees, within an online Google Drive Geospatial Data Portal.

One endeavor and associated data source is particularly noteworthy, for the scope and information detail as well as its long-term utility to the region. Funded by the EPAs Healthy Waters Initiative, Karen Firehock, of the Green Infrastructure Center (http://www.gicinc.org/new_york.htm) (GIC) of Virginia, authored a detailed natural resource and open space planning guide for Ulster County. "Evaluating and Conserving Green Infrastructure Across the Landscape: A Practitioner's Guide" uses the term *green infrastructure*, to encompass "… the sum of all our natural resources. It includes all the interconnected natural systems in a landscape, such as intact forests, woodlands, wetlands, parks and rivers, as well as those agricultural soils that provide clean water, air quality, wildlife habitat and food." This 155 page, seven part manual guides municipalities, land-use decision makers and other engaged stakeholders through the process of designing, planning, constructing, evaluating, prioritizing and mapping important natural resource and open space assets. The impressive geospatial database was graciously provided to our project through the auspices of the Ulster County Department of the Environment. It contains an enormous amount of compiled and original data and analysis, useful to virtually any resource agency within UC. The Core Forest area (or Cores Layer) exercise illustrates unfragmented, core-area forest blocks, which have had a wide range of additional metrics added (including variables relating to: contiguity, water quality, habitat value, protection

status and others). This layer alone, if promulgated and utilized wisely, could contribute enormously to a more effective, shared conservation plan and vision for the greater UC region. Many of the geospatial layers were found to be of great utility, in undertaking this OSI project.

A great deal of additional resources can also be found within the excellent and comprehensive guide developed by Ingrid Haeckel and Laura Heady of the NYS-DEC Hudson River Estuary Program: "Creating a Natural Resource Inventory: A Guide for Communities in the Hudson River Estuary Watershed" (http://www.dec.ny.gov/lands/100925.html). This detailed manual will take resource agencies, conservation committees or other environmental volunteers, step-by-step through the process of establishing a NRI, or a parallel OSI.

Five Consultant field days were included in the project, to help provide insight, context and direct experience of the TOR regions remarkable: scenic beauty, abundant green spaces, pastoral farm lands, settlements, habitats and waterways. TOR resident Larry Dewitt provided an expert guide for a circuit around the region; pointing out noteworthy areas, historic hamlets and opportunities for broadening recreational and biking opportunities via scenic throughways. TOR ECC Chair, Laura Finestone provided detailed suggestions as to what TOR "favorite areas" and noteworthy destinations, features and byways should be included within the ventures. Commercial areas, farm markets, popular tourist destinations as well as remote, unpaved roads, pristine woodlands and hidden swimming areas were all included within the surveys.

Open Space Inventory: Additional Study Topic Suggestions

During the data gathering phase of the project, several data gaps arose that the TOR might well want to develop more thorough and detailed information for. Each will likely require a study or effort of its own, but could well be accomplished within the domain of the TOR staff, volunteers or its committees. The topics suggested for data development relate to:

- **Agricultural Systems** have served as a primary industry for nearly as long as the TOR has been settled. They also contribute enormously to the regions character and quality of life. A simple and straight-forward *agricultural census* for the TOR and surrounding regions could easily be accomplished with the aid of a research or project intern. Better understanding just which lands are being farmed, for what kind of products, can add a great deal to the understanding of inter-related: food\water\economic viability cycles.
- **Biodiversity Features** and important TOR ecological areas - While something can be estimated about the species likely occurring within the TOR region from remotely sensed data and habitat models, these cannot compare to the detail, thoroughness and validation of actual field surveys and biodiversity inventories. Site studies both confirm the actual species and communities within a region and also inform planning, development and conservation issues, through the production of detailed occurrence and habitat maps.
- **Climate Impacts** – future climate shifts promise to affect not only the ecological and natural systems within our region, but our shared and inter-connected agricultural, hydrological,

commercial and transportation systems as well. To be adequately prepared, the potential local impacts to the TOR and the region should be considered, and, ideally, included within any open space or comprehensive planning efforts.

- **Economic Development** – While this study focuses primarily on open spaces and natural systems, too often protection of these resources are seen at odds with the financial and economic well-being of a region. If the TOR can consider in some detail, not only the ranges and types of commercial and light-clean-industries that they'd like to see expanded within the municipality, they can also begin to envision *where* said expansions might occur. The Google Earth tools developed with our project should aid such an endeavor. Through the identification and development of commercial expansion and enterprise zones, developers and investors can be given fast-track access to sectors and regions where opposition and legal challenges can be minimized. And the TOR can aid local economies at the same time they are protecting their vital ecological assets.
- **Historical Features, Sites and Districts** – the TOR enjoys and benefits from an immensely rich and interesting historic past; spanning pre-settlement times through 18th century development, arrival of the D&H canal to entrance to the 21th century. The TOR Historic Preservation Commission (http://townofrochester.ny.gov/boards-commissions/historic-preservation-commission/) and other regional historical societies have amassed an impressive online reference literature, documenting and detailing inventories of historic sites and homes. However very little of this material has been mapped or turned into spatial format. The US Park Service distributes Historical Preservation District layers in geospatial format and our OSI project selectively georeferenced scant locations of 10 "historic farms" and 27 historic stone homes. But a great deal more could be done to develop these into resources and to quite literally "put them on the map". Integrating them with features like the historical hamlet centers and the overgrown D&H canal region could form the basis of an historical overlay district or the basis of tour routes along which tourists could re-live some of the regions well preserved past.
- **Scenic Areas and Local Byways** within the TOR, to consider the aesthetic and scenic resources within
    - The Gateway (entrance) areas to the TOR (along roadways)
    - The scenic vistas (mountain areas and ridgelines or "scenic destinations") as well as
        - the areas that these features can be seen *from* ("scenic viewpoints": roadways, trails, etc…) and
        - the regions in-between the *destinations* and the *viewpoints* (frequently agricultural fields and other non-forested areas or scenic corridors that provide unbroken views from a range of locations)
    - The existing SMSB corridor and any local spurs or extensions to this circuit that the TOR might wish to consider (scenic bike or auto routes)
- **Water Quality\Pollution\Flooding-** in the likelihood that global climate patterns affect existing commercial US food production networks, *local agriculture* may very likely take on heightened importance. Increasing our support and investments in local agriculture will also require that we, at the same time, pay close attention to that other critical resource necessary for life; clean water. The more thoroughly the TOR is familiar with local and regional water pollution and flooding patterns, sources and potential remedial options, the better it will be able to ensure a high quality of living for generations to come.

Original Geospatial Data Products and Models: Stream Health\Stream Vulnerability

Riparian (streamside) corridors serve critical functions within interwoven terrestrial and hydrologic systems. They serve as habitat for important floral and faunal populations and minimize stream impacts from neighboring land use and pollutants. They provide food, detritus and shade for aquatic systems as well as scenic and recreational domains for outdoor enthusiasts. Healthy and intact riparian systems can help ensure adequate supplies of high-quality water resources for a region's human and biotic communities and when maintained properly, can provide significant flood retention capacity to flashy systems.

When riparian zones are eliminated, fragmented or are encroached upon by human dominated systems (e.g., development or farming), they tend to lose their ability to protect water resources adequately. Knowing the specific areas where these zones are healthy and intact, or missing and compromised, can aid agencies invested with protecting public water supplies. Their programs and efforts to educate and inform local communities about the critical role riparian buffers play and the impacts our activities can have can be aided. Having timely and accurate information as to the status of a watershed's riparian buffers can allow for effective prioritization of limited resources, aiding restoration and re-vegetation of the systems, as well as informing non-point pollution monitoring.

The Stream Health\Stream Vulnerability (SH\SV) model was originally developed at Cornell University by Dr. Marci Meixler of the NY State Water Resources Institute. Based on regional land cover, terrain and soil patterns, the place-based hydrological model calculates and outputs geospatial layers, indicating which stream reaches and associated upland areas might support Healthy or Unhealthy stream functions and which might be Vulnerable to erosion and\or sedimentation. The model was customized for our project, to run on current software, using the most up-to-date geospatial layers available, as well as to characterize the true riparian zone adjacent to the TORs stream systems. Historically, riparian corridor models use a simple buffered distance (~typically 50-150m) from the centerline of a stream, to estimate the riparian area. The resulting simple linear features have long been recognized as flawed in that they fail to consider the many types of hydric and wetland features that commonly adjoin stream systems. Lakes, ponds, wetlands, flood plains and other hydric soil dominated areas can all encompass the true or functional riparian zone, suggesting that depictions of them be variable in width.

For the TOR SH\SV model, (Figures 7 & 8) the functional riparian zone was calculated according to the following methodology. To begin, the detailed line (arc) hydrological features provided by the Ulster County GIS Department were buffered to a distance of 100 ft. These streams have been custom mapped by the County, to provide detail, accuracy and precision that the widely available National Hydrological Data (NHD), (typically the best and most widely available) don't provide. Next, the features from within the following categories, were selected and spatially merged, based on their adjacency to the 100' stream buffer feature:

- the detailed area (polygon) hydrological features of the UC GIS layer (including lakes and ponds)
- the wetlands and water features of the National Wetland Inventory (NWI)
- FEMA Flood Hazard Layers (FHL) for the 100 or 500 year flood plain
- Regions dominated by hydric soils, from the NRCS SSURGO soils layer

The resulting functional riparian zone layer was then used to clip a 30m raster layer from the 2012 LandFire existing vegetation type (EVT) program. (http://www.landfire.gov/NationalProductDescriptions21.php) The inter-agency LandFire program land cover program develops some 20 layers for the continental United States (as well as Alaska and Hawaii) depicting a wide range of vegetation and forest fire fuel patterns. The EVT layer, which is updated every several years, represents the species composition that is present at a given site (at the 30m pixel level). The reasonably simple model logic used to calculate Stream Health holds that the vegetation and land cover types immediately within and upland from a riparian zone will serve as an indicator of the streams ability to perform the things that it can do, at those locations. So streams flowing through land cover types classified broadly as Forest, Wetland, Shrub and other undisturbed natural areas are ranked Excellent (on a scale of 1-5, with 5 being high) , while those traversing areas dominated by highly human impacted classes (Developed or Agriculture, etc…) are ranked "1" or Poor. Intermediate classes are ranked along the gradient. The underlying assumption is that areas with more intact riparian corridors can better protect local water quality. Appendix A, Table 2. provides a guide as to how each of the 64 possible vegetation class types were rank coded.

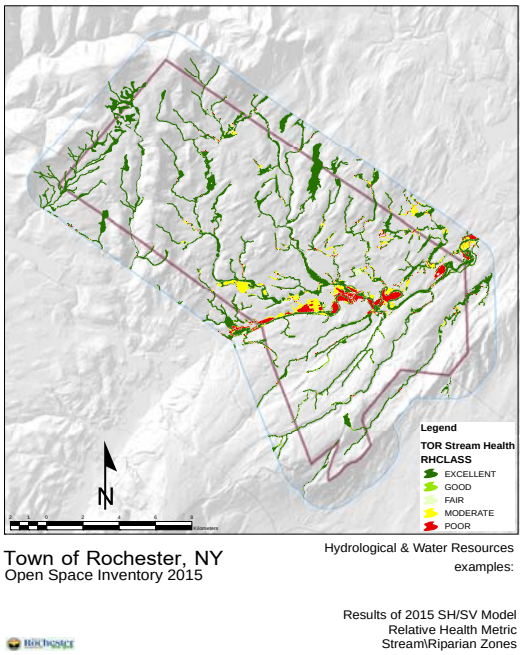


Figure 7. TOR Stream Health Model output

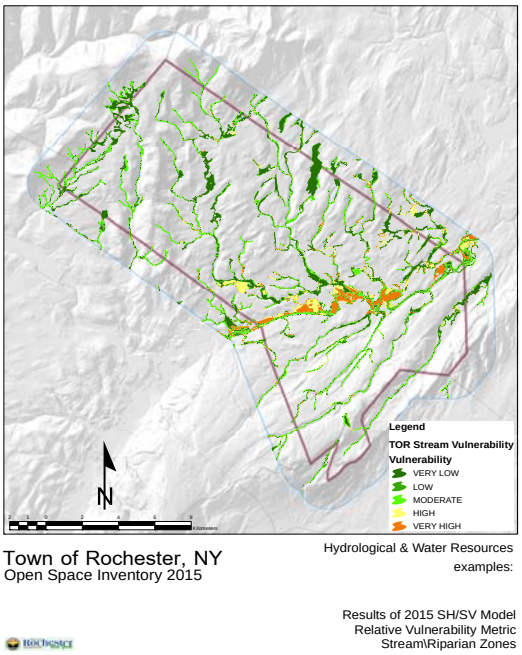


Figure 8. TOR Stream Vulnerability Model output

Stream Vulnerability (SV) is approached similarly, though also considers localized slope and soil permeability class, to calculate an estimate of a stream reach's stability and potential for erosion and run-

off. For this project, the estimated values of Streamside Health and Stream Vulnerability were calculated for each of the major stream systems within the greater TOR study area (Figures 7 & 8). As the results of these models are strictly computer based, they require inspection using high-resolution air photos as well as field surveys to validate. But the data should aid the TOR in better understanding the spatial dimensions of water quality and potential pollution sources within the region. They should provide ample evidence of which particular regions field visits to would most be warranted and in what prioritized reaches restoration measures might aid water quality.

Original Geospatial Data Products & Models: Parcel Prioritization Framework (PPF)

The second data model developed during the project represents a framework and toolset for assessing and identifying those TOR parcels that relate spatially to the OSI groups. Metrics representing the area (acres) of each OSI group layer as well as the percent composition of each (per parcel), has been fused with the TOR tax parcel data, using a spatial assignment process. This will allow the OSP group to engage stakeholders and the public to consider and, where appropriate, weight those classes of OSI assets that the group considers more important to protect. A detailed logic model reflecting the groups' trial priorities can be scripted and run, reviewed and updated, within the context of a full GIS. For instance, all lands above a certain size (i.e. >10 ac.), that contain more than 2 ac. Ag\Forestry lands, or containing more than 30% of the parcel area for that category, can be queried and quickly displayed. Extended out, should the OSP panel wish to consider the watershed patterns for a sub-drainage section of the town, which might help:

- Protect important forest and park lands
- Improve water quality through reducing sedimentation patterns and
- Prevent and reduce local and downstream flooding

…a logic model could be developed based on a series of spatial and attribute queries, to select parcels that collectively might form an overlay protection zone. Such queries can be based on: parcel side - above or below a certain acreage as well as location and context; parcels next to or within a certain distance of each other or an important feature (say a State Park). The OSP team itself can access and consider the full range of 100+ KML layers created for this project, and suggest criteria which could be assigned "points" for example:

- Parcels containing >30% lands from the Hydrological-Aquatic Habitat group – 1 pt
- Parcels within the 100-year FEMA floodplain that can have their value weighted 2X – 2 pts
- Parcels that intersect a non-forested NWI wetland – 1 pt
- Parcels that intersect and contain >1 acre of Riparian Zone 1 pt
- Parcels that contain POOR Stream Health (SH) – 3 pts
- Parcels that are adjacent to a State Park – 1 pt

The capacity to perform these searches has now been established and, while the more detailed analysis illustrated above will require access to a full GIS (i.e. ArcGIS), the TOR Tax Parcel layer with the Acres and %Composition of each of the major OS groupings is now available within KML (Google Earth) format. This will allow for detailed exploration and visualization of any of the 4,829 TOR parcels, within the context of the ~100+ open space features or groups, created for this or other projects. Additional analyses such as relating parcel sizes relative to development trends can also be easily accomplished using the data provided.

Open Space Inventory: Details of Open Space Groups

This section describes the open space groups used by the project, including details of open space considerations and opportunities within each.

Open Space Inventory: Existing Protected Lands

The TOR enjoys the envious position of having the vast amount of its lands and resources in a fairly intact and largely undeveloped state. Remote sensing data estimates that some 85% of the township is forested and according to the TOR tax records, 900 Class (Protected Conservation\Park Lands) parcels amount to just under 37% (20,381 ac.) of the land area of the municipality (56,034 ac.) (note: this does not include some ~4,000 acres of privately owned, Class 910 lands, that according to the TOR assessor, do not contain any protection devices. It does include 910 parcels that have been identified as having enrolled in the state 480 tax program (17 parcels, ~2,000 ac) or that have been identified as having conservation easements on them, through other reporting agencies. NY State forest and park lands have also been validated using external data sources).

Of the existing ~20,380 ac. of TOR protected lands (Figure 9) , the majority (~14,800 ac., 72%) enjoy reasonably permanent protection, such as those within the NY State Park, State Forest and State Forest Preserve land programs. *Privately held conservation* parcels, which currently enjoy some level of protection, account for another 5,570 acres or 27% of protected lands. These include lands:

- Containing conservation easements
- Those enrolled in the state 480 forest tax program
- Privately owned conservation lands (Mohonk Preserve, Open Space Institute, Palisades Interstate Park Commission, etc..) or
- Owned by Rod and Gun clubs

Collectively, they represent over 20,000 ac., as per:

• State Forest Preserve Lands	8,380 ac.
• State Forest Lands	363 ac.
• State Park Lands	6,026 ac.
• Town Park Lands	42 ac.
• Private Conservation Lands	5,570 ac.
• TOTAL	20,381 ac.

The NYS 480 tax law provides financial relief opportunity to owners of forested parcels greater than 50

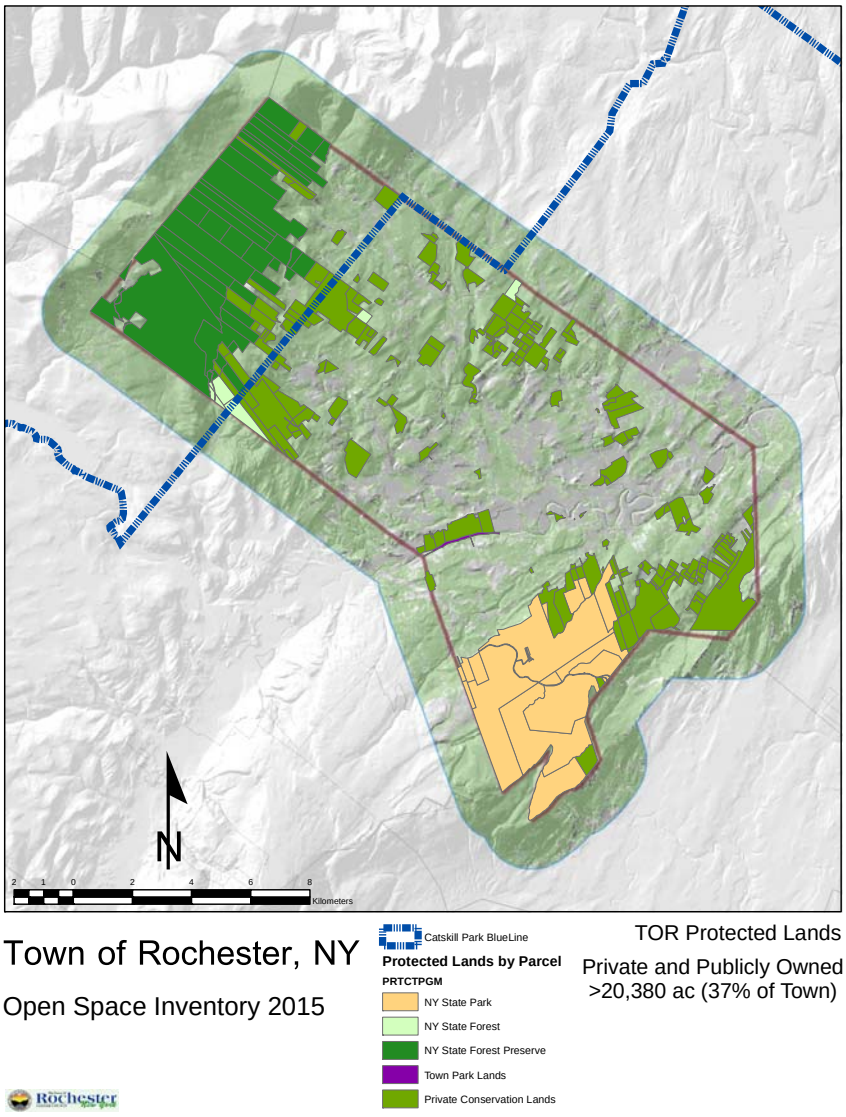


Figure 9. TOR Protected Open Space by Parcel

acres that agree to develop a management plan and sustainably manage those forest lands for a period of not less than 10 years (http://www.dec.ny.gov/lands/5236.html). However after that period, or even during, with some restrictions, those lands can be sold and developed. Even features such as the Mohonk Preserve, which is known throughout the region for promoting conservation awareness and ecological research, is

largely privately owned. Which means that, even though it would seem unlikely, development can legally occur at any time. And while uncommon, lands containing conservation easements can also face some level of development, whether for a home or agricultural uses; depending on the type and restrictions of the easement. So the TOR will do well to pay attention to local development trends and patterns, even within lands that now enjoy some protection.

New York State owns and manages most of the permanently protected lands within the TOR region. The Catskill Park occupies some 13,000 acres within the NW portion of the TOR within the area known as the Blue Line. (Figure 9.). Private land in-holdings within the Catskill Park can be and are freely developed. State-owned lands within the *Catskill State Park Preserve* are protected and include the southern portions of the 30,000 ac. Sundown and Vernooykill Wild Forest sections, (http://www.dec.ny.gov/lands/75346.html) as well as smaller areas of adjacent State forest lands. Within the Shawangunk Mountain region to the south of the TOR, falls the Minnewaska State Park including Lake Minnewaska, one of the few public swimming areas within the TOR. This important recreation area, widely known for excellent hiking, biking, rock climbing and nature exploration, is also very important ecologically, containing several rare and threatened plants and communities such as the dwarf pitch-pine barrens. A broad group of conservation agencies, known collectively as the Shawangunk Ridge Biodiversity Partnership (SRBP) (http://goo.gl/sdOQRu), has been helping to highlight the value and extend protection to the Gunks for more than 20 years. Efforts by the Trust for Public Lands, The Nature Conservancy, the Mohonk Preserve, the Open Space Institute, NYS-DEC, PIPC, NYS-OPRHP, Cragsmoor Association, Friends of the Shawangunks, NY State Museum, have helped form an impressive assemblage of 2,500 acres of addition conservation lands adjoining Minnewaska, extending protection much of the ridge. (Figure 10). Completing the picture of protected parklands within the TOR are the 42 some acres that the TOR itself owns, running in a narrow strip along Berme Road, to the south of the Rondout Creek.

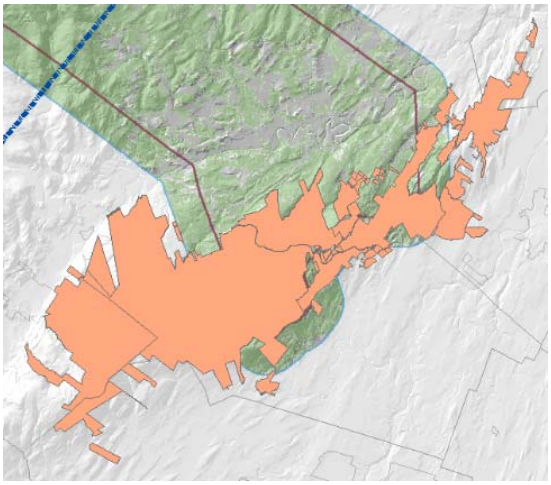


Figure 10. Shawangunk Regional Partnership lands

Open Space Inventory: Hydrological and Aquatic Habitat Group

With the full NYRWA 2006 groundwater study covering the subsurface resources in such detail, our project focused mainly on surficial processes. (The open space consideration of both are included and the NYRWA geospatial data are included within the online Geospatial Data Catalog.) Surficial hydrological features, used by humans, plants and animals alike, include rivers, streams, lakes and ponds as well as wetlands, riparian zones, flood zones and other wet habitat types. Surface waters and aquatic habitats tend to share a very similar footprint. Protecting one of these components will intrinsically provide immense benefit to the other; hence their clustering. Since few aquatic or hydrological features are built upon per se, open space protection of these resources tend to relate to the upland systems that water passes through, as it makes its way to the feature. Though edge encroachment and degradation of streams and wetlands is all too common. For this reason, open space considerations of these systems commonly focus on the upland areas adjacent to them; especially the Riparian Corridors. Patterns of hydrological connectivity, at the watershed scale are becoming increasingly important, especially within the Hudson drainage (https://goo.gl/CBmyuc). The impacts of dams, culverts and other stream blockages can be significant, thereby affecting available fish or wildlife habitat directly or indirectly through modifying nutrient, sediment or macroinvertebrate patterns.

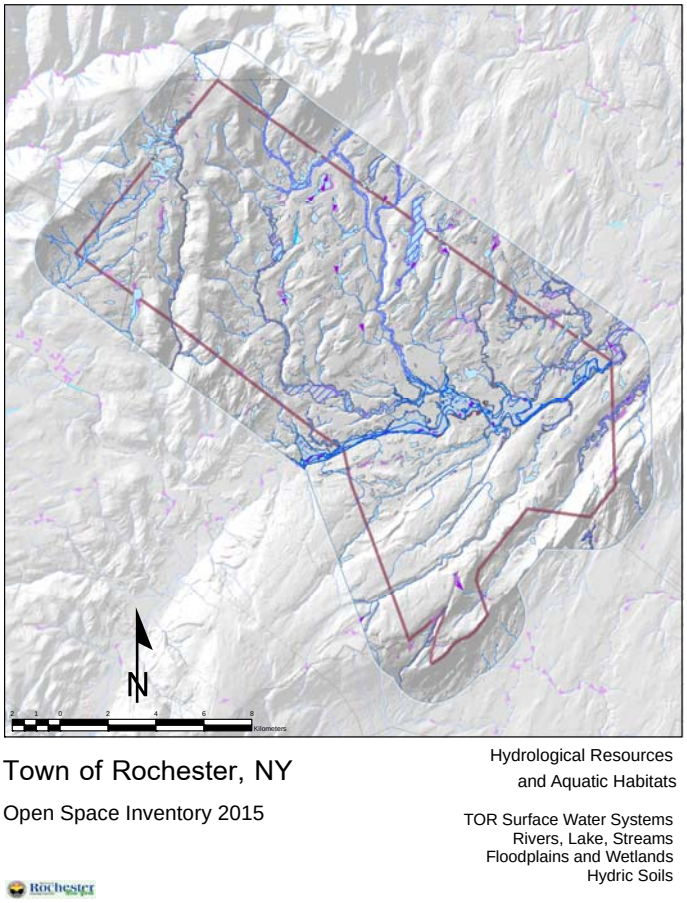


Figure 11 Hydrological Resources & Aquatic Habitats

Since clean, drinkable water is one of the primary requirements for sustaining life on our planet, its regulation, protection, and the maintenance of its supply systems already receive some degree of protection, at the Federal, State and local level. But this is not to say that open space considerations of water supply systems, both for natural and human communities in the TOR can or should be taken for granted. Or that our information systems, for that matter, relating to the current state, location or qualitative trends of water supplies and sources are what they can or should be, to provide the informed citizen with adequate information as to the water resource that they depend upon.

It is hoped that this projects SH\SV model outputs will aid the TOR in both better understanding the location of and processes within the interconnected riparian zones adjoining the towns' stream networks, especially vis a vis water quality patterns. Protecting, maintaining and, where needed, restoring healthy vegetation communities within these as well as the other wetland systems will help stem the introduction of pollutants that commonly attach to sediment or other surficial materials. Minimizing permanent built systems within flood plains will not only save dollars when flooding occurs, but can also help improve drainage patterns downstream. In addition, downstream flows and flooding issues can be significantly impacted through the conservation of vegetation within wetlands and riparian corridors. Plants tend to slow water down, help store it for longer periods and aid local groundwater recharge and at the same time filtering and uptaking nutrients such as nitrogen and phosphorus. This can be especially relevant to stream systems winding though active agricultural areas. Regional programs have shown that even minor improvements to riparian zones adjacent to cropped fields can significantly improve water quality locally and downstream.

TOR: Water Quality Trends

Of the five main stream systems within the TOR, the Vernooy Kill, the Mombaccus Creek, the Stony Kill, the Mettacahonts Creek and the Coxing Kill\Kripplebush Creek, the majority exhibit surprisingly high water quality scores. (2015 NYS Water Quality Classification, NYS GIS Clearinghouse http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1118). (Figure 12). "This data set provides the water quality classifications of New York State's lakes, rivers, streams and ponds, collectively referred to as water bodies. All water bodies in the state are provided a water quality classification based on existing, or expected best usage, of each water body or water body segment. Under New York State's Environmental Conservation Law (ECL), Title 5 of Article 15, certain waters of the state are protected on the basis of their classification. Streams and small water bodies located in the course of a stream that are designated as C (T) or higher (i.e., C (TS), B, or A) are collectively referred to as "protected streams."" (from the Clearninghouse metadata.

When viewed from the regional perspective, what stands out is the relative density of A-Class, high-quality stream systems found within many of the TOR dominated watersheds. For these streams "…the best usages of Class A waters are: a source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival. This classification may be given to those waters that, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to reduce naturally present impurities, meet or will meet New York State Department of Health drinking water standards and are or will be considered safe and satisfactory for

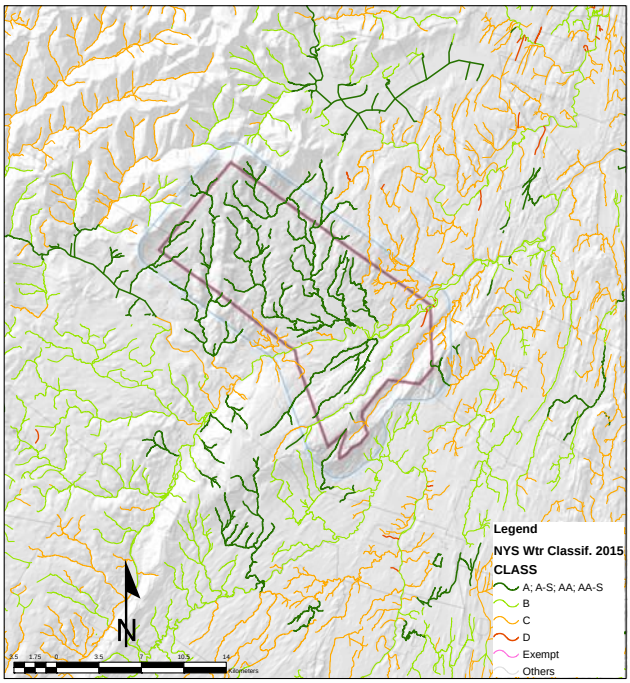


Figure 12. NYS 2015 Water Quality Data (TOR region)

drinking water purposes.". While there are some "B" (Rondout Creek) and "C" rated streams (un-named system along Samsonville road, in the SW corner of TOR), the majority are "A", especially within the higher, forested reaches of the Catskill basins. This pattern matches fairly closely those within the SH\SV model outputs. These data would suggest that the upper reaches of the TOR surface water systems seem to be reasonably intact and functioning as they should be, likely due to low development patterns.

When considering the two water quality indices (NYS and SH\SV), issues tend to appear mostly within the lower, flatter, more highly settled and farmed regions of the TOR central valley, along the Rondout Creek floodplains. It is here that remedial attention may best be focused, in the form of first, closer inspection of the integrity of the riparian zones and later, potentially the restoration or revegetation of any

buffer areas deemed degraded or compromised. Maintaining the health of the upper stream systems through the consideration of riparian buffer legislation might aid the TOR in *staying ahead* of future degradation or development trends. Waiting until problems start to arise are many times futile or cost several times what proactive protection and conservation measures would. Maintaining and enhancing these systems ability to improve water quality and further enhance downstream flooding will remain in the balance.

With the exception of some 16 small, community wells (NYRWA data), the majority of TOR residents depend on their own ground water wells for drinking water. As such, open space protection for these features relates mostly to the above ground areas that might recharge or restore water to the well as well as the groundwater systems, materials or aquifers that affect contributions to the well. Protection can take the form of preventing pollutants, toxins or other unwanted substances from entering the system as well as helping to ensure that neither too much water (flooding) or too little (drought\low-flows) cause problems to those requiring those resources. State and local regulations provide some level of protection to these below-ground systems, though once a well or aquifer has been compromised, remediation can be expensive if not impossible. How we manage areas adjacent to or through which water transits can and does affect opportunities for open space planning.

Which is why we mention, again, the value in the work performed by the NYRWA in their 2006 TOR ground water study. Potential pollution problem areas such as solid waste facilities, surface mines or low-yield well areas have been mapped, and should be monitored on an ongoing basis. This will especially be true should proposed commercial or higher density residential developments be considered within the central Rt. 209 corridor, within the proposed wellhead protection areas. All NYRWA layers should play a vital role in helping the TOR plan for open space protection of water resources, from the site to the watershed scales.

Open Space Inventory: Ecological Resources and Terrestrial Habitat Group

Ecological Resources and Terrestrial Habitat: includes large, contiguous forest tracts, woodlands, post-ag, field and scrub-shrub habitats and other lands containing natural, upland vegetation. This group (Figure 13) includes the collective footprints of the NY State Forest and Park lands as well as regions of privately held conservation lands (Mohonk Preserve, OSI lands, etc…), lands containing conservation easements and lands identified as important by regional conservation agencies (i.e. NY Audubon Important Bird Areas, GIC Cores, NYNHGP and others.). The area provides habitat and resources for both plants and animals, from the *rare*, *endangered*, *threatened* and *of special concern* to the *common* and *widespread*. The rich complexity of TOR terrestrial biodiversity is largely dependent on these areas though they also play important roles in other OSI groups (Recreation, Hydrology, Scenic character, etc…)

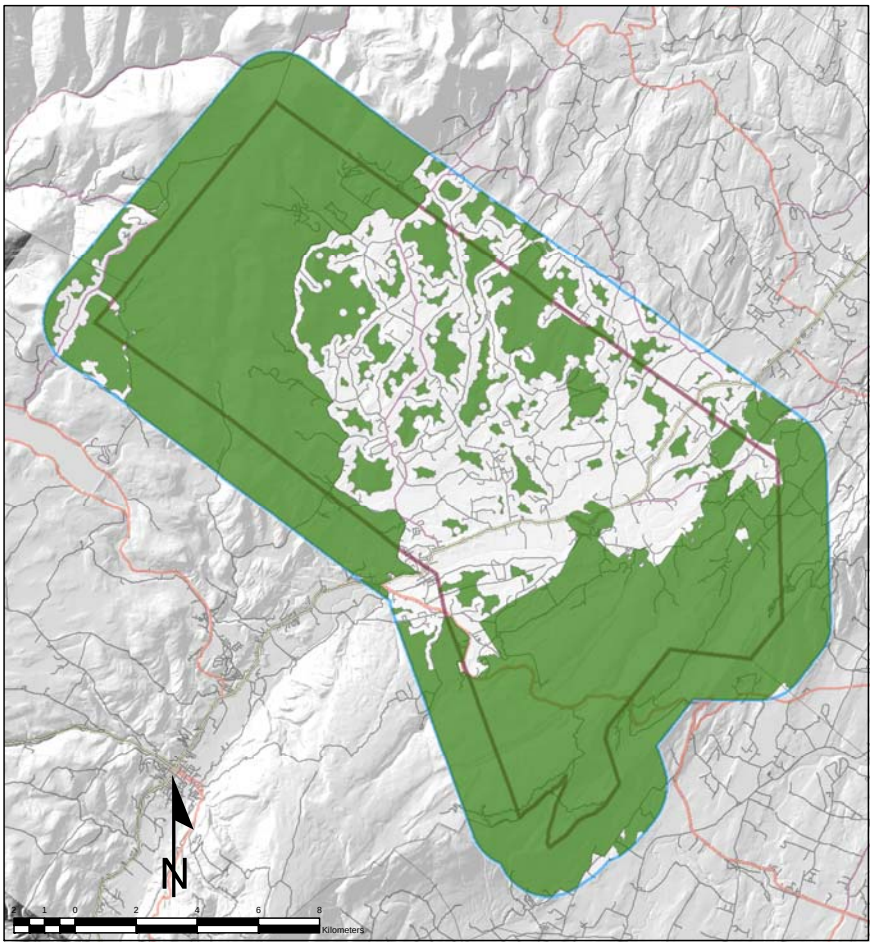


Figure 13 Ecological & Terrestrial Habitat Group

As has been discussed, a great deal of overlap exists among the general open space group categories used for our project. It will not be surprising that many of the TORs high-value biodiversity areas fall within the ~14,700 acres of protected *NYS Forest and Park lands*, also noted for exceptional Recreation and Scenic beauty value. The high biodiversity value of these areas are due in part to the fact that they have been shielded from development and degradation over the years. In addition, the NYS lands support and are part of large, unbroken blocks of regional deciduous forests both deciduous (oak, hickory, maple, northern hardwoods) and coniferous (white pine, hemlock, occasional spruce) that form an ecological corridor between the Catskills and the Shawangunk systems. These important lands, interwoven with streams, fields and wetlands, collectively sustain high-functioning, resilient habitats, sustaining and nourishing both rare and endangered species as well as high-quality examples of representative matrix systems. They provide irreplaceable ecosystem services to humans as well, through purifying and contributing clean air, regulating, stabilizing and filtering soils, providing water and flood mitigation as well as a wide array of forest products directly, including timber, fire wood and maple sugar. The abundant forest cover of the TOR region contributes in untold ways as well to the areas beauty and spiritual dimensions. While existing in multiple, smaller patches, the privately owned conservation lands within the TOR collectively represent over 5,500 additional, largely forested acres. The habitat and biodiversity resources they contain contribute in their own ways to the open space values of the Town. Many of these parcels occur within the SRBP region, along the Shawangunk Ridge (Mohonk Preserve, etc…) and have been strategically acquired through the assistance of the OSI and TLP to help fill in gaps between or buffer core areas adjacent to the larger State land holdings.

NYNHP: Rare, Endangered, Threatened Species

The New York Natural Heritage Program (NYNHP) (http://www.dec.ny.gov/animals/29338.html) is charged with collecting, maintaining and distributing data and expertise regarding the rare, endangered and threatened species and habitats of our state. Nearly all of these threatened plants and animals occurring on the 2015 NYNHP TOR list (Appendix A, Table 3) fall within NYS lands, partly due to the fact that DEC field surveys tend to be centered in and around these public areas. NYNHP ecological expertise and biogeographic research helps conservation stakeholders like the TOR, to better understand and extrapolate distributions of SGCN species, in areas where surveys have not yet been conducted. This model output is one example, depicting the summer distributions of threatened bats (Figure 14) across the TOR region. Understanding each species habitat requirements can help one better understand the potential locations and distributions that those members may be found within. One of the more fundamental biogeographic premises is that: if you find a particular species within a certain habitat type, composition and structure in one place, the likelihood of finding that same species will be heightened, if you can find another occurrence of that same habitat makeup in another location. So the likelihood is that the TOR NYNHP-listed species occur within the broader TOR region, where each plant or animals habitat requirements or habitat

niche may be found. Conducting detailed field studies or biodiversity surveys will help the TO confirm the actual extent, locations and patterns. Additional information can be found through:

- NYS: Endangered, Threatened, and Special Concern species: http://www.dec.ny.gov/animals/7494.html
- NYS: Species of Greatest Conservation Need (SGCN) : http://www.dec.ny.gov/animals/9406.html

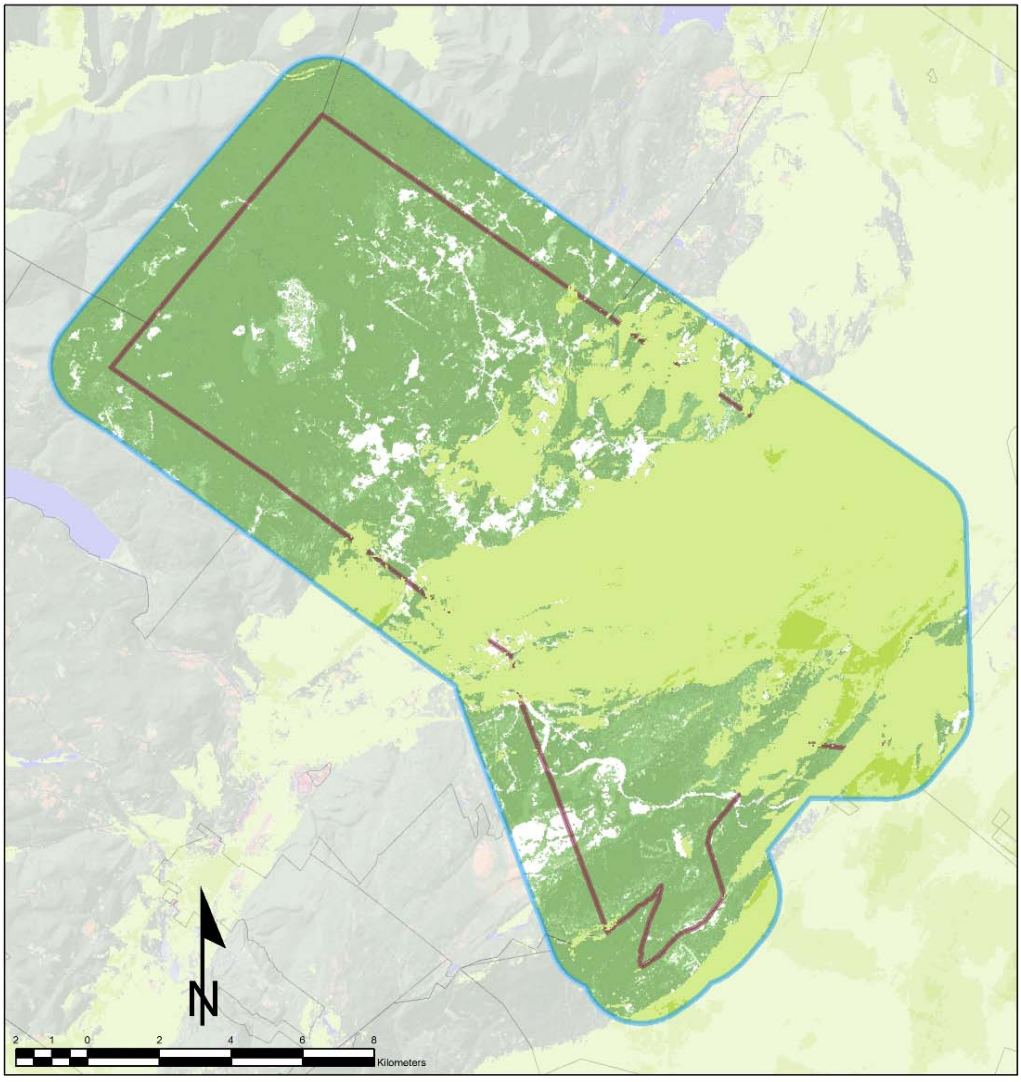


Figure 14. NYNHP Model: Summer Bat Distributions – light green

TOR Region: Biological Importance Recognized by Many Resource Agencies

Over the years, the TOR study area has been identified as being of regional ecological importance by a wide array of state and national conservation agencies and projects. These programs and application areas include:

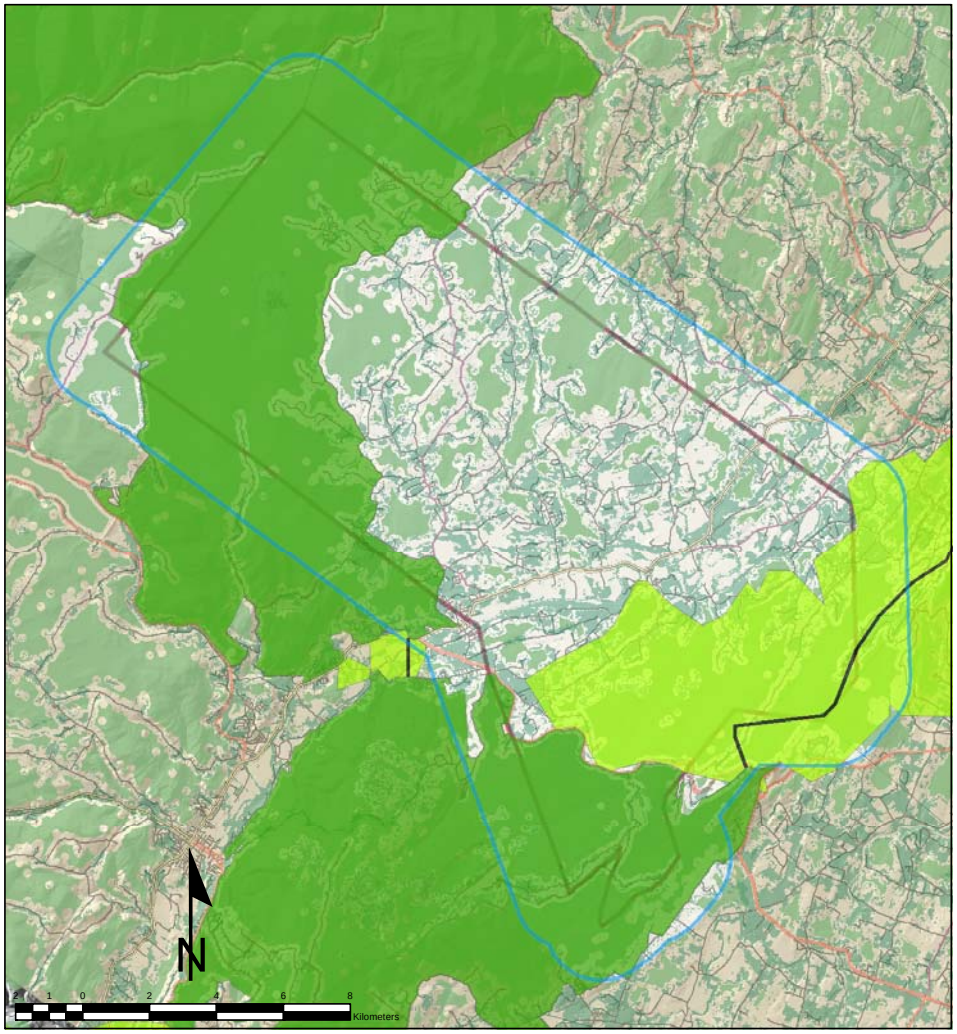
- NY Audubon Important Bird Area (IBA) Program
  - Parts of two important IBAs, the Catskill High Peaks and the Northern Shawangunks, fall within the TOR OSI study area.
  - The IBA initiative is one of the NY Audubon Society's flagship programs, designed to identify and protect habitats critical to the success of important bird populations. The TOR\TOW region is remarkable, for containing 2 of a total of 25 IBAs identified within the Hudson River Estuary region. (http://ny.audubon.org/conservation/hudson-river-valley-conservation).
- NYS-DEC Hudson River Estuary Program – Significant Biodiversity Area (SBA) study.
  - Portions of two SBAs from the HREP study also fall within the TOR study area and also relate to the larger adjoining: Catskill Mountains and Shawangunk Ridge SBAs.
  - The New York State Department of Environmental Conservation (NYSDEC) Hudson River Estuary Program worked with the New York Cooperative Fish and Wildlife Research Unit at Cornell University and the NY Natural Heritage Program to develop Significant Biodiversity Areas (SBAs) for the Hudson River estuary region of New York State. SBAs are 22 landscape areas with a high concentration of biological diversity or value for regional biodiversity.
  - https://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1247
- NYNHP – Important Areas (IA) and Terrestrial Connectivity Initiatives -
  - Important Areas are lands and waters in the Hudson River Valley, delineated with GIS models, which support the continued presence and quality of known populations of rare animals and rare plants, or of documented examples of rare or high-quality ecological communities. Important Areas include the specific locations where the animals, plants, and/or ecological communities have been observed, but go beyond these to also include: additional habitat for the rare animal and plant populations, including areas which may be used by rare animals for breeding, nesting, feeding, roosting, or over-wintering; and areas that support the natural ecological processes critical to maintaining the habitats of these rare animal and plant populations, or critical to maintaining these significant communities.
    - http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1297
  - Terrestrial Connectivity: Priority Large Forest Areas, Block Linkages and Linkage Zones – in partnership with TNC, the Terrestrial Connectivity project This layer depicts the matrix forest blocks selected by The Nature Conservancy as the most viable examples of the dominant forest communities throughout the state. Matrix sites are large contiguous areas whose size and natural condition allow for the maintenance of ecological processes, viable occurrences of matrix forest communities, embedded large and small patch communities, and embedded species populations. The data and approach again tend to illustrate the benefits and potential importance of maintaining landscape connectivity between the Catskills and the Shawangunks.
    - http://nynhp.org/data

- TNC\OSI – NYS and Regional NE Conservation Portfolios and Focal Areas
    - These data illustrates the local inclusion of the greater TOR Catskill and Shawangunk areas, as important and selected components to the central Hudson NY ecosystem management portfolio. The data are designed to provide a vision for conservation success for ecological systems, natural communities and species representative of the ecoregion by showing the boundaries of areas that The Nature Conservancy has prioritized for conservation.
        - http://maps.tnc.org/gis_data.html

Corridors, Linkages and Landscape Connectivity

The undisturbed natural areas of the TOR provide enormous resources and open space benefits directly to the town's residents. But their value is also expressed in manifold ways, given their contribution to *larger, regional corridors and landscape linkages*. The consideration and development of landscape scale linkages and ecological corridors have risen in importance since colonial times, as our shared natural systems have faced wave after wave of fragmentation, degradation and outright destruction. Through maintaining large, intact swaths of connected forest lands, many ecological functions and dynamics of a greater landscape can be aided or preserved. Seasonal migrations, hunts for food, homes or mates or simple escape from predation or disturbances can be significantly sustained. The natural exchange of diversity, including genetic materials that keep populations healthy can be enhanced through the maintenance of such features. Climate impacts are expected to exert strong influences on local natural systems and the life forms that depend on them. Functional landscape linkages can provide irreplaceable opportunities for plants, animals and associated groups to seek for and find their required niches, as resource types and conditions shift.

Virtually all major conservation agencies (TNC, OSI, DEC, TPL, SRBP, etc….) have identified the establishment of ecological corridors as one of the important, centralized conservation issues that NYS stakeholders can collectively address. The Towns of Rochester and Wawarsing collectively occupy one of the major regional proposed corridor routes of the Hudson region; forming important connections between the large Catskill Park to the north with the biodiversity-rich Shawangunks to the south. (Figure 15). Collaborating to support the proposed linkage areas as well as helping to protect and fill in the lands adjacent to them, should form a central component in any TOR\TOW inter-municipal planning efforts. Much can be gained by solidifying and augmenting protection of the private conservation lands within the TOR as well. While many private lands do not directly adjoin the larger NY State parcels, they may containing high-quality examples of important food, water, shelter and habitat resources for a wide range of species. As such, when considered as a networked whole, they may serve important functions as "stepping stone" patches or preserves. They can provide localized sources and sinks for genetic material and biodiversity as well as habitat and sustainably harvested forest products. At the site level, they help buffer against an over-urbanized environment and preserve a high quality of life



Town of Rochester, NY

Open Space Inventory 2015

Ecological & Habitat Resources examples:

TOR Habitat Connectivity
Forest Blocks, Corridors and Linkage Designs

Figure 15. Regional Terrestrial Corridors (TNC, NYNHP)

Habitat Quality & Function

While much has been done to date to help protect critical areas and important resources of the TOR region, vigilance should be maintained and proactive oversight and detailed understanding should continue to be expanded. Few municipalities, now facing near build-out conditions, with the associated air, water, sprawl, quality of life and congestion problems that accompany them, set out or plan to realize such states. Environmental degradation seemingly does occur as a function of 1,000 cuts and few claim to know the critical tipping point at which a natural system will no longer provide the services we expect or require.

The UC-wide geospatial "Cores" overlay, provides valuable insight as to the functional state of the TOR natural systems, in a way that the casual glance at a satellite or air photo image will not. Remote sensing estimates of forest cover commonly fail to take into account the trees overhanging a road, a house or the parking lot of a mall. And while 85% forest cover may be a reasonable index of the functional biomass of the TOR, this GIC Cores map likely suggests a more realistic overlay of effective (terrestrial) habitat areas. Created by the GIC for their 2013 project, they began by taking the extent of predominantly natural and forested lands and then removing or dissolving areas of effective settlement or development, including 100m wide corridors along roadways and\or buildings (Figure 16.). Many species of both plant and animal either require large, undisturbed (core) areas or struggle significantly when exposed to the stresses and threats that edge habitats more and more commonly contain. Increased noise, light, invasive plants and bugs, and dominance by edge species such as skunks, opossums, deer and raccoons are common components of edge habitats. Plus a range of subtler qualitative shifts (nutrient, soil and energy dynamics) all tend to affect biodiversity and habitat use patterns within these areas. Trees and natural features may occur within the edges of settled areas though multiple studies reinforce the fact that their functional use differ considerably from unfragmented core areas, >100m from the edges. Paying attention to these larger Core areas and especially the types of developments that degrade and fragment them (roads, utility right-of-ways, pipe lines, etc…) will help ensure that the TOR can pro-actively plan for the long-term health and resilience of its natural heritage.

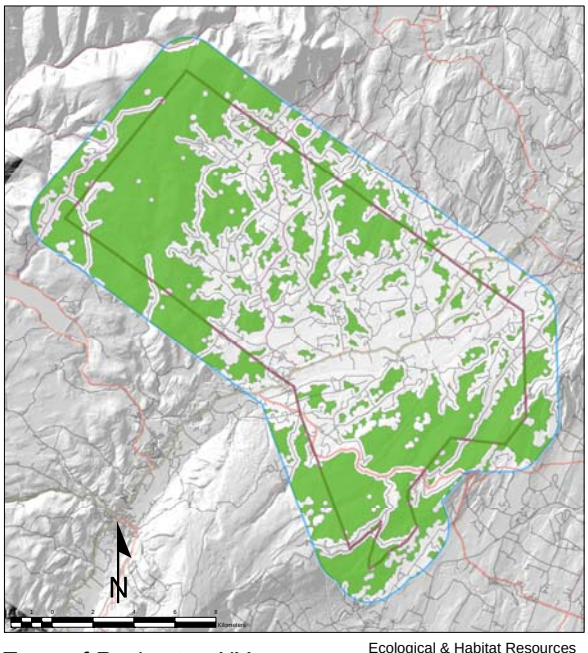


Figure 16. GIC Core Forest Area: Functional Habitat Map

Open Space Inventory: Agricultural Systems and Sustainable Forestry Group

This group includes all current, actively farmed lands, livestock areas, vineyards, orchards etc…. as well as parcels that fall within the UC Ag Districts and areas containing prime agricultural soils or soils of Statewide agricultural importance. In addition privately owned forest lands greater than 50 acres, which could represent sustainably harvested forest product extractions are included.

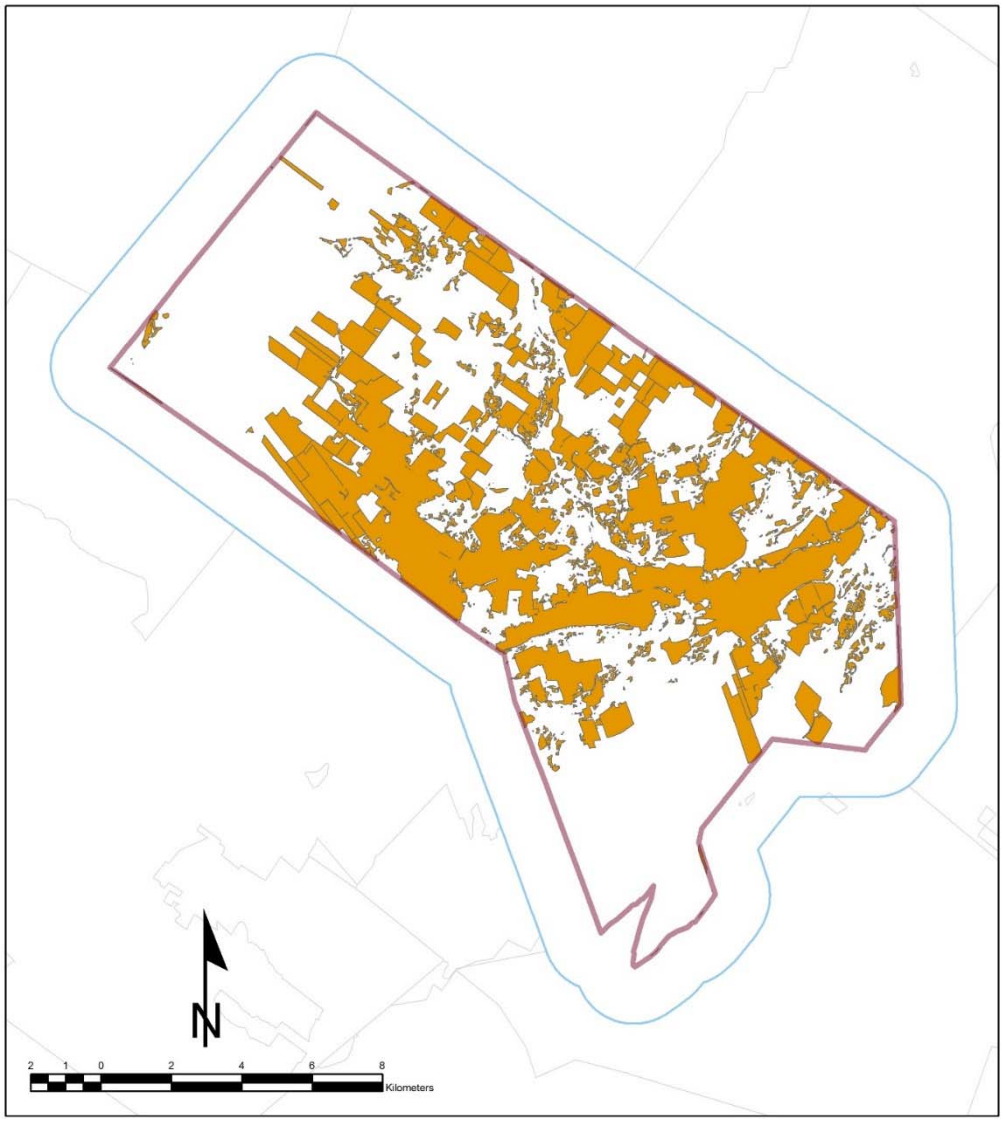


Figure 17. Agricultural Systems and Sustainable Forest Lands

Farming has helped form a core of the TOR identity for much of recorded time. The rich, flat alluvial soils of the Rondout valley have been attracting farmers and farming since the Munsee people practiced rotational habitation\farming, before European settlement began. Agricultural activities helped shape the early TOR landscape, which historians hold was largely cleared for farming, in the early agrarian years (1703-1827). Crops such as corn, oats, buckwheat, rye were early mainstays and small, water-driven mills abounded, supporting the development of small timber, millinery and paper industries. Orchards grew apples for fruit and cider and abundant dairy farms helped make butter a regional export by the late 1800's. Agricultural production has ebbed and flowed over the years, but remains a key and vital component of the fabric, character and soul of the TOR today.

The agricultural components of the TORs open space resources include both current as well as past and future dimensions. Detailed and comprehensive data representing the census of Ulster County Agricultural lands and their actual uses today remain strictly in the hands of the USDA National Agricultural Statistics Service (NASS), which tends not to share them. Scenic Hudson conducted a draft FoodShed survey of the region a few years ago, to try and develop a better shared accounting of regional lands currently in Agricultural production, though the project never really took off. Geospatial data *are* available representing the Agricultural Districts in Ulster County, (https://catalog.data.gov/dataset/ulster-county-agricultural-districts) as of 2013, which will reportedly be updated soon. These Districts represent "… lands that are under the protection of NYS Agricultural District Law, administered by the New York State Department of Agriculture and Markets" (http://agriculture.ny.gov/AP/agservices/agdistricts.html) though, they don't specifically include details as to which lands are currently being farmed. But Ag Districts as well as active farms falling outside of them clearly do comprise critical areas for the TOR to consider as fundamental open space resources, for a number of reasons.

Agriculture represents one of the major industries within the Rondout Valley, both on an employment and a production basis. Access to abundant, fresh, reasonably priced and high-quality produce help support both private consumer as well as restaurant markets from the Hudson Valley to New York City. Tourism and recreation dollars in the TOR region are also very closely tied to Agricultural lands. Farm markets, Agro-Tourism sites and a wide range of pick-your-own produce, orchards and Christmas tree farms have become collectively among the more prominent and iconic income producers locally.

"Local Ag" has become much more than the trendy, cause-du-jour that it once was, and if current global climate trends continue as projected, our ability to feed ourselves from our own backyards will no doubt become increasingly important. Proactively anticipating these trends, it is suggested that the TOR include protection for fertile soils, the foundation of most farms, within any open space plan. Fortunately these features have been well mapped, and many municipalities consider protecting important agricultural soils as fundamental to their future. The USDA classifies farmland and the supporting soil systems based on their location and suitability for agricultural uses. Lists of Prime agricultural soils are compiled for each state, and comprise those units containing the best combination of physical and chemical characteristics for

producing consistently high yields of food, feed, forage and fiber. Soils of Statewide Significance are those soils that are not quite Prime, but that, if drained or managed have a land capability suitable for producing significant yields, some approaching those of Prime.

Of the total 6,500 acres (~12% of TOR land area) of combined Prime\Statewide Significance soils (also called Prime and Productive lands) nearly 3,800 or 59% occur outside of the official Ag Districts, and so, face development. Many of these areas no were doubt sites of historical farmsteads, as can be told by the remaining, stone-wall lined old-field, post-ag communities. Such sites and related scrub-shrub habitats are becoming increasingly important to the overall biodiversity of the region and species such as the grass-land birds that depend on them. But an important topic for the TOR to weigh, is: whether they are willing to allow these precious soil resources to be built upon, removing them in perpetuity from contributing to local foodsheds. The American Farmland Trust reports that in NYS alone, over 125,000 acres of Prime and Product farmlands were lost, between 1987 and 1997 alone. That is enough land to feed over 62,000 families (of 4) with a diet that includes meat, dairy, eggs and vegetables, for a full year (http://www.boston.com/bostonglobe/ideas/brainiac/2013/03/how_much_land_d.html). In addition to an Agricultural Census, it is suggested that the TOR consider allowing such an effort to form the core of a full Agriculture Protection Plan, such as that developed in neighboring Marbletown (2010). (http://goo.gl/87PJYr).

The open space dimensions of the hydrological systems upon which the regions agriculture depends should also be considered here. Food and water are principal requirements in our lives, and with few exceptions, pollutant and toxin-free forms of these necessities seem to provide for healthier people. Unfortunately, Agricultural and Water stakeholder groups too often find themselves at odds, conflicted about apparent trade-offs or expenditures that one suggests the other should be making. The TOR, in its planning efforts, can help foster a more amicable dialog between these groups locally. Helping to track, identify, and offer data and science-based remedial solutions, is something that should be hard-wired into any open space plan or ECC charter. Collaboratively restoring riparian zones, acquiring funds to support better land management BMPs and expand the financing of winter cover-crop planting have been shown to be cost-effective practices that can improve water quality while at the same time supporting farmers and their farms.

Private Sustainable Forestry lands

The majority of large block forest lands within the TOR are owned and maintained by the state. Though there are another 100+ privately owned parcels with greater than 50 acres forest cover, which collectively represent almost 12,000 acres. The 2013 GIC project assessed these type properties across Ulster County as "sustainable silviculture lands", in that they represent potential centers for localized forest product operations that can be sustainably managed over long periods of time. Such an extractive reserve approach

can help land and forest owners realize a financial benefit from active forest management. This will help provide long-term ecosystem services to the town and surrounding environment, since the properties are maintained in an unbuilt state. Of these ~12,000 sum acres, approximately 2,000 are already enrolled in the NYS 480 tax program. This leaves an opportunity within the TOR for nearly another 10,000 acres that could contribute sustainably managed forest products to local sawmills as well income to their owners and the local economy.

Scenic Beauty\Rural Character

And lastly, though no less importantly, we discuss the value that Agricultural lands contribute to the TOR, through the visual and aesthetic channels. It may at first be easy to miss the fact, when driving along Rt. 209 in TOR on a clear summer day, that our ability to enjoy such dramatic vistas and pastoral landscapes is in large-part due to the open farmlands themselves. Without the meadows, fields and croplands, even a single line of trees or buildings would obstruct the mountain tops and astonishing ridgeline views entirely. Which is not to say that the fields and farms themselves, don't add enormously to the peaceful beauty, quiet rural character and extraordinary scenic value of the lands. But these important open space patterns should not be taken for granted and might be considered within a scenic overlay study. They help ensure that visitors and residents alike can better find the things that bring so many: respite from stressed urban existence and a return to a simpler and in some ways better time.

Open Space Inventory: Historical, Recreational and Scenic Resources Group

The Historical open space group contains areas, districts, features and lands that have been identified as of Historical importance by the TOR Historic Preservation Committee and that enjoy recognition by the National Register of Historic Preservation. This project developed draft geospatial depictions of a few, previously listed (tabular) features (10 historic farms, 27 historical stone houses, the D&H Canal region in TOR) though this area still deserves a great deal of effort, both to map and to consider how each might be protected. Cultural features such as Favorite Places and other locations that collectively contribute to rural character or quality of life are also included within the group (e.g. Farm Stands\Agro-Tourism locations, Sugar Maple farms, etc….)

Recreational open space resources here refers to both active and passive recreation and again, many maintain considerable overlap with features such as State Park and other private conservation lands. Recreational trail systems, including extensive regional hiking, biking, skiing and rail-trails are included here, many of which have been mapped and highlighted through the excellent UC Rec-Connect program. (http://ulstercountyny.gov/maps/recreation/). Features found on Public and private lands are included, representing activities as diverse as golfing and roller skating. The locations of a few privately owned fish and game clubs are included.

The Scenic open space resources category could rightfully cover the vast amount of the entire TOR region, due to the towns' abundant green spaces and inspiring array of pastoral vistas. Specifically included within our inventory are two particular features of importance to open space planning: first the Gateway areas located at the entrances to the TOR, along routes 209 and 44. These areas will be important for the TOR to address, as their aesthetic content help form the first important impression that a tourist draws, when visiting the TOR. A commissioned study would be warranted. Secondly, the mountain vistas and breath-taking ridgelines as well as the open lands providing access to the views are included. The SMSB route is included here.

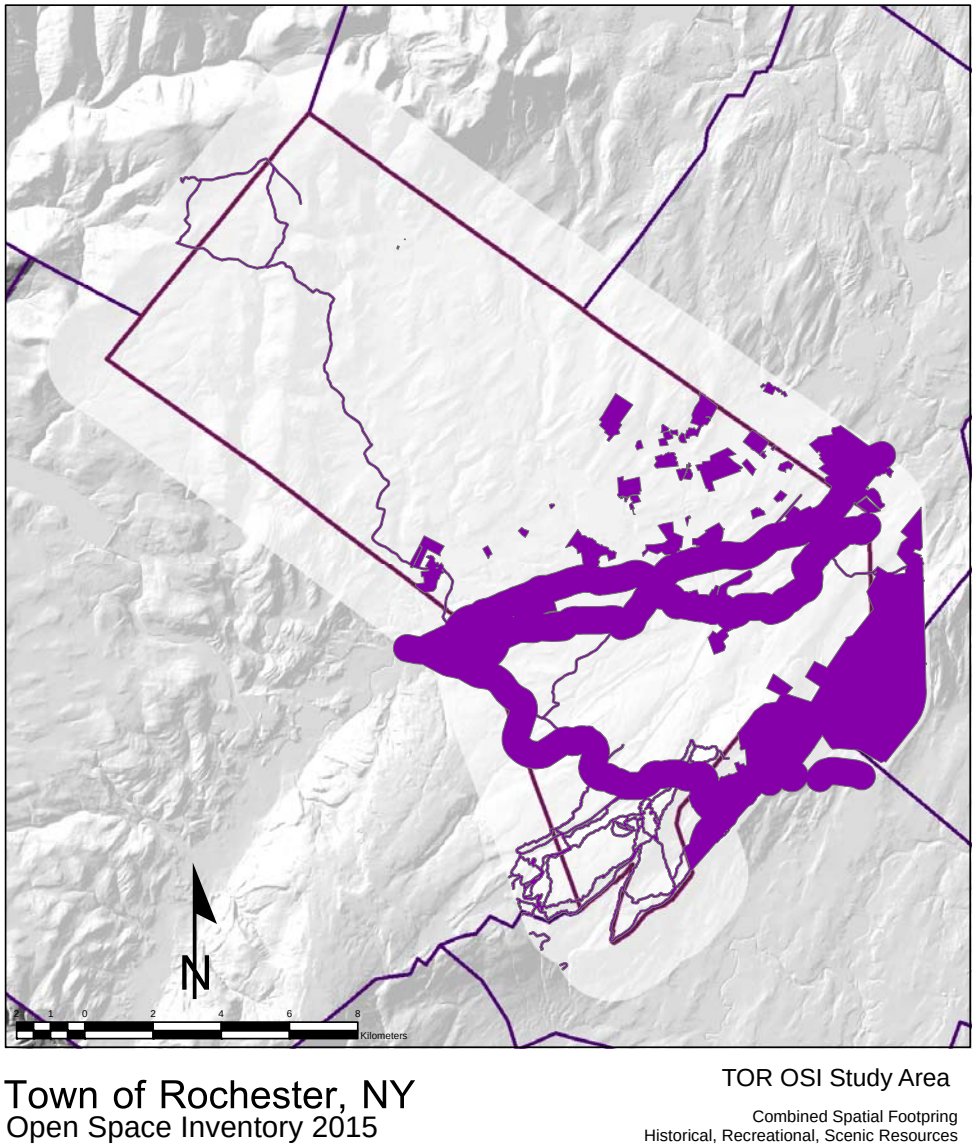


Figure 18. Historical, Recreation & Scenic Resources- Combined spatial footprint

The TOR region enjoys a rich and vital history, which continues to contribute to its character, identity and direction. Understanding and staying connected to our past and where we came from, culturally, ecologically and even economically, can help enrich the bonds that join us as a people. Understanding the land and how those who went before us have cared for and changed it can help us maintain a sense of connectedness and belonging to: a sense of place. The historical details of how the TOR region was settled by Europeans has been well documented by several agencies, including the noteworthy TOR Historical Preservation Commission (HPC) and other regional historical groups, such as:

- http://townofrochester.ny.gov/boards-commissions/historic-preservation-commission/
- http://townofrochester.ny.gov/about-rochester/studiesreports/
- http://www.accord-kerhonkson.com/history.htm

Historical Resources

The remaining historical features, places, hamlets, settlements, farms and homes have been listed with great detail and are certainly worthy of consideration within an open space plan of the TOR. One of the difficulties in including them within an open space context is that the information remains mostly tabular, lacking geospatial (map) dimensions. The National Register of Historic Places provides GIS layer overlays depicting some 31 historical districts within the TOR study area, relating to documented homesteads, farms and other important settlements. We geocoded the locations of some 10 historical farms and 27 stone homes for this project, to demonstrate how the TOR HPC data could be reformatted to allow easy and simple access for planning purposes. The locations and details of the multitude of historical hamlet locations could be added to such a project, as could the location of a potential D&H Canal bike or trail route. Signage could be expanded and bike and scenic auto routes established to aid interested tourists and history buffs to visit and appreciate the remaining components of TOR's formative past.

Recreational Resources

Recreational open space features are important to the TOR region owing to their financial value, since so many people enjoy hiking, biking, cross-country skiing, golfing and even just picnicking within and near the area. Several major resorts and dude-ranches offer well-attended R&R packages and country immersion experiences for urban dwellers wishing to unwind and rejuvenate. Such retreat and vacation industries have made extensive use of the TOR regions tranquility and scenic resources since the early 1800's. Several national and regional athletic alliances maintain road racing, running and biking routes through the region, such as the *Survive the Shawangunks* triathlon (http://sostriathlon.com) and the American Zofingen biathlon (http://www.cm2promotions.com/home#!). The abundant NYS Forest and Park lands provide abundant and widely used opportunities for hiking, rock climbing, picnicking, relaxing, and seasonally for notable fishing and hunting. It is understood that TOR-wide swimming opportunities are somewhat limited, with Lake Minnewaska and a few easily accessed pools in mountain streams serving as cooling stations. The majority of these components are dependent upon resources that enjoy a fair degree of stability: State Forest and Parks will not likely change significantly and roadways will remain accessible for some time. But the nature and scenic character of the supporting and surrounding landscape will continue to play important roles if the TOR is to remain a much sought after recreation destination.

Scenic Resources

The value of the Scenic open space features of the TOR region is as important as it is difficult to define. The emblematic topography, the pastoral fields, the quiet, rolling forestlands and bucolic farmsteads all

contribute in unmeasurable ways to an experience that is both deep and intangible. But these components nonetheless spur the development of programs such as the Shawangunk Mountains Scenic Byway (SMSB), (http://mtnscenicbyway.org) to promote the utilization and wide appreciation of these resources. This 88-mile scenic driving route loops around the Gunks, passes through the TOR along Rt. 209 (shorter route options also include the New Paltz- Kerhonkson "Northern Route", which takes tourists along the spectacular Rt44/55 corridor). All have been designed to leverage the remarkable rural beauty of the region, calling visitors to explore and enjoy the remarkable richness of the region. As has been outlined, the vistas and viewsheds are comprised of the regions topographic and natural features, the vantage points and travel routes *from which* the features can be enjoyed as well as the vast, open farmlands and throughways that *provide* the spectator the view. So any open space consideration should rightfully include all three. Mountain and ridgeline protection should be considered for the high-peaks and mountaintop areas of the Catskills as well as to the Shawangunk ridgeline region. Features such as cell towers or prominent built structures can degrade the available views quickly. As importantly are the maintenance of the view perspectives, especially along important travel corridors such as Rt. 209. The specific lands, travel segments, viewsheds and viewpoints as well as corridor components or recommendations can be tallied with the assistance of a focused Scenic Areas study. The field and farmland owners maintaining the areas can be engaged to help ensure that the resources can continue to be enjoyed. Such a study can include consideration of the visual impression visitors to the region might encounter, when entering the TOR along the Rt. 209 and 44/55 Gateway areas.

Open Space Inventory: Additional Data and Models – PPF

While the PPF exercise was intended to provide data tools for the upcoming open space planning process, the author offered the following suggestions, as an example of how he, as a landscape ecologist, might approach things.

PPF-Hydrological Resources and Aquatic Habitat:

- Riparian Zones
- Potential Flood Mitigation

From the perspective of *Hydrological Resources and Aquatic Habitat*, one of the more important features to consider providing open space protection to may be the lands immediately adjacent to riparian zones of the TOR. Helping to maintain healthy, fully vegetated stream buffer areas can significantly stem the introduction of sediment and accompanying nutrient runoff to a stream system. It can at the same time help slow down the hydrograph or the time frame that it takes for rain falling within the upper reaches of a basin to reach the lowest portion of that system. Maintaining existing and restoring degraded wetlands and floodplains can help control flooding patterns in watersheds where the natural hydrography has been disturbed. Using the PPF developed parcel layer, the parcels adjacent to the riparian zones can easily be identified and when integrated with a vegetation layer or air photos, the local, potential trouble areas can be identified. The parcel size dimensions can be reasonably small in approaching such patterns, as 20-50 linear feet of intact vegetation can provide substantial retention, filtration and uptake capacity. Helping to preserve existing, healthy riparian zones and identifying and restoring those that are degraded could be accomplished, over time with the assistance of a riparian corridor ordinance.

From the perspective of groundwater systems, the NYRWA data may warrant a fresh look, especially regarding any thought of more fully developing the commercial or group housing capacity of the greater central, Rondout Creek floodplain and adjoining areas. The combined agricultural footprint is already great here and multiple indicators (SH\SV and NYS DEC Water Quality data) suggest that water quality might be improved through restoring the buffering capacity of the riparian corridors here.

PPF-Ecological Resources and Terrestrial Habitat:

- Establish Inter-municipal Ecological Corridor Overlay
- Buffer and Fill In Large Protected Areas and Parks

While it may be tempting to think that, with so much NYS Forest and Park lands, that the ecological resources of the TOR will already be protected. But from the Cores perspective, effective habitat areas can

still be degraded, and are often times encroached upon or "nibbled away at the edges". Adding to and protecting the parcels adjacent to the large forest block areas and NYS lands can provide both a significant buffer, adding to the core areas of the habitats. They can also help fill in gaps in protection for the lands, with privately held inholdings.

This same approach should be taken by the TOR and TOW collectively, to identify the parcels, especially larger, undeveloped forest lands, within and abutting the proposed ecological corridor zones suggested by TNC and the NYNHP. Steering development and road construction away from these areas, perhaps with a conservation corridor overlay process or set of incentives, can help ensure that the regions biota can more easily find suitable habitat sites and critical resources, across the broader Catskill\Shawangunk region. It is suggested that supporting the establishment of just such a corridor may be among the more significant achievements that an inter-municipal TOR\TOW open space plan can achieve.

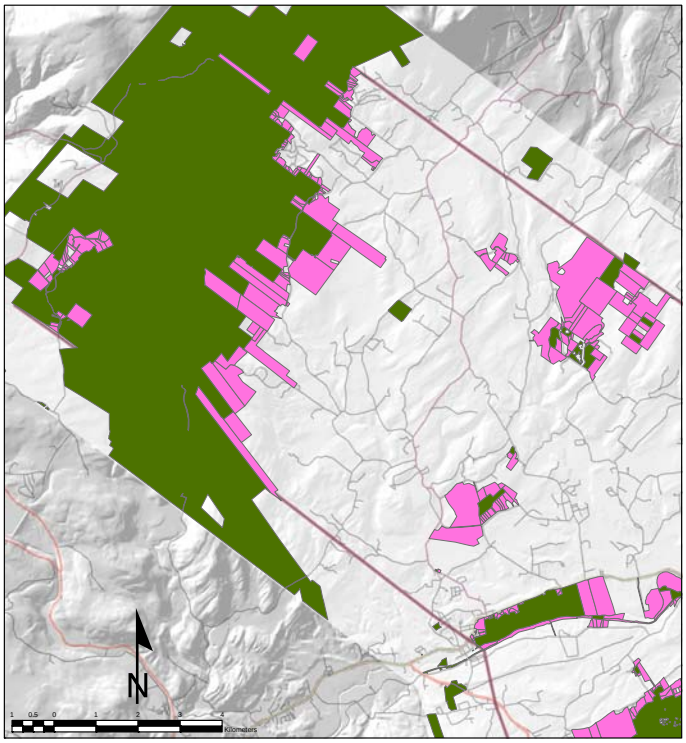


Figure 19.PPF Example: Parcels >50 ac, Adjacent to Park or Protected Lands

PPF-Agricultural Systems \ Sustainable Forestry:

- Ag\Water Patterns
- Prime and Productive Soils
- Sustainable Private Forest Lands

As mentioned above, the interconnected Ag\Water systems within the region may benefit through the utilization of the SH\SV output data. Using geobrowsers (e.g. Google Earth) coupled with field visits, parcels containing opportunities for restoration and replanting can be identified, to help restore effective riparian zone functions. In addition lands containing Prime and Productive agriculturally important soils, which are clustered within a region, may be considered from the spatial perspective. Adjacent blocks of a certain size could represent an opportunity for open space protection. The nearly 12,000 acres of large (>50 ac.) block, privately owned forest lands should be considered for open space action. Whether it be engagement within the NYS 480 tax program as for consideration within a local TOR program, rewarding the owner for not developing the land. Parcels near or adjacent to protected lands or parks should be prioritized and where tightly clustered grouping exist, effort should be made to help consider them as a whole. This clustering and assembling data into larger units should be kept in mind throughout the open space process. Larger conservation areas nearly always provide enhanced function and resilience.

PPF-Historical, Recreational and Scenic Resources:

- Historical District
- Scenic Bike Route
- Scenic Gateways and Byways

Protecting the TOR's interconnected Ecological and Agricultural features will provide, at the same time, a fair measure protection to the town's Recreational and Scenic open spaces that respectively depend upon each of them. Much should be done to better establish the spatial dimensions of TOR's important Historical features, and, again where existing density of the notable places, homes and farmsteads occur, an historic district might be established.

It would seem that many of the Recreational features may enjoy a level of security; i.e. the trails and systems falling within protected lands and NYS properties. But more could be done to help expand and support these valuable resources, such as the development of a scenic bike-way through the TOR and neighboring regions. These would at the same time reinforce broaden access to and the value of the regions Scenic beauty and character.

The geospatial components generated for the PPF coupled with the Google Earth data and trainings should be of significant utility to the TOR when considering Scenic Gateways and internal TOR travel

routes or byway options. Undertaking a study to better understand the locations of the important scenic features, the specific locations and route segments that they can be accessed from will specifically help identify the lands and ownership details that enable the vistas to be enjoyed. Programs to work with these residents and their holdings as well as the preservation of the components and dynamics that currently sustain the viewsheds can more easily be designed and developed.

Open Space Inventory: Next Steps & Suggestions

Using the skills and experience developed within the OSI-sponsored Google Earth trainings, it is suggested that the TOR ART and associated members collectively explore, review and consider the data and information provided by this project. Discussions and assessments of the individual layers and collective groupings should be reviewed to help ensure that a familiarity and understanding will be developed for the upcoming TOR\TOW open space planning exercise. Potential categorical priorities and approaches should be discussed and vetted, especially with an integrated TOR\TOW team. Similarities in data, terminology and ranked preferences should be reviewed and reconciled. Discussions should be held to consider the commission of detailed, site-specific studies to help fill data gaps regarding the following natural resource and open space categories:

- Agricultural Systems:
  - What parcels and total acres are currently farmed, with what crops or livestock
  - What Ag\Water issues exist and where might they most likely occur
  - How can the regional farming community be engaged regarding local water quality patterns
  - What are current farming trends and how best can the TOR support farmers
- Biodiversity Features:
  - What important species and communities actually exist within the TOR
  - Where are they found
  - How can they best be protected
- Climate Impacts:
  - What are the impacts that TOR will most likely face
  - What systems are most likely to be affected (food, shelter, industry, ag… etc…)
  - Where are they located
  - What are the costs and tradeoffs on acting now or later
- Economic Development:
  - What clean economic engines can be most effectively expanded within the region
  - At what cost, tradeoffs
  - Where might they be optimally sited
  - How can environmental\development conflicts best be a minimized
- Historical Features, Sites and Districts:
  - Where are all of the historical features
  - What issues affect their long-term wellbeing
  - What approaches can be taken to help preserve into the future

- Scenic Areas and Local Byways:
    - What areas contain important scenic features?
    - How can they be protected
    - Where can the scenic resources *be seen from*
    - What areas fall between or affect how important scenic features can be enjoyed
    - How can the TOR Gateway entrances be maintained in a way to elicit favorable responses from visitors as they enter
- Water Quality\Pollution\Flooding
    - What are the known pollution problems
    - What are the pollution sources
    - What things can possibly help remediate water quality trends
    - Where are the flooding problems located
    - What are the upstream patterns within the contributing sub-basins
    - What approaches might help stem downstream flooding

The work, information, geospatial data and systems provided through this project are not intended as a blueprint, but as a tool set. The TOR is in the enviable position of having a great deal of its important resources intact and functioning well. The question looms as to how effective it can be in helping to protect and ensure that these assets can be stewarded over time, for the benefits of the next seven generations. It is hoped that the TOR and its agents and partners will be better equipped to visualize, assess, understand and ideally plan for the long-term preservation of the regions precious open spaces. Effective conservation is pro-active, comprehensive and fiercely intentional and must consider the needs of local residents to maintain or enhance their quality of life. As such, any conservation plan or approach must be flexible and adaptive and should be revisited regularly, if not frequently, as time passes.

Caveats: as the TOR enters the realm of a fuller utilization of geospatial data and regional mapping information, a few cautions should be highlighted. All spatial information is wrong in some ways; whether they be regarding accuracy, precision, scale, direction or a range of other factors. Part of this is due to our attempts to render features from a curved surface (the earth) onto a flat, 2D surface (a map or our computer screens). Others relate to the scales and intended purposes of the data involved. Data from the 100+ layers provided for this project come from various sources, and were designed to be used at various scales and purposes; from the regional watershed to the backyard site\parcel. When exploring data that have been converted for use within Google Earth, the user should know that not all features will appear to "line up", which can be confusing for the beginner (e.g. tax parcels or administrative boundaries with wetlands and floodplains). It is imperative to keep in mind the term "appropriate" when loading data into Google Earth to explore a site, pattern or region. Expecting a watershed layer intended for use at a scale of 1:1,000,000 to match the spatial dimensions and exact detail, say of a tax parcel, which was intended for use of ~1:1,500, is inappropriate. All of the data for this project have been obtained, provided and intended for general planning purposes, and none should be deemed appropriate for use within any legal, regulatory or litigious framework. No claim as to the accuracy, precision, completeness is made and no data should be thought to replace in-situ field studies by licensed professionals.

Appendix A, Table 1. List of Data Layers Referenced within 2006 Chazen NRI

Geospatial Data and Layers Referenced in 2006 Draft NRI (Chazen)		
Layer	**Source**	**Description**
Biotic		
NYS Natural Heritage Element Occurrences: Plants, Animals, Communities	NYS Natural Heritage Program	Rare, endangered, threatened, and species of greatest conservation need and significant natural communities
Wetlands	NYSDEC and USFWS Natl. Wetland Inventory	NYS regulated wetlands (>12.4 ac) and NWI wetlands (USACE regulated)
Vegetation	NYSNHP	Not mapped
Wildlife	NYSNHP	Not mapped
Protected Lands	Ulster County (easements)	Parks, preserves, conservation easements, contiguous forest blocks
Conservation Targets	SRBP (TNC)	Shawangunk ridge and surrounding areas
Layer	**Source**	**Description**
Biophysical		
Soils	NRCS\USDA	Soil units, catenas, drainage, depth, texture patterns
Elevation\Topography	Unknown	Digital elevation derived: topography, slope
Geology (surficial, detailed)	NY Rural Water Association	Detailed surficial materials, layer apparently developed for a 2006 demonstration (groundwater protection) project for the Agency, by S. Winkley of the NYRWA
Geology (surficial, general)	USGS\NYSGS	Coarse scale surficial materials
Geology (bedrock, detailed)	NY Rural Water Association	Focus on water bearing materials and aquifer patterns
Geology (bedrock, general)	USGS\NYSGS	Coarse scale bedrock materials
Layer	**Source**	**Description**
Aquifers (including karst regions & unconsolidated aquifers)	NY Rural Water Association	Developed by NYRWA for the Agency by integrating data from NYSGS, USGS and field surveys (wells) (2006)
Surficial Water: streams, rivers, lakes, ponds (detailed)	Ulster County GIS	Developed by UCGIS in collaboration with NYCDEP
Water quality classification (surface waters)	NYS DEC	Updated regularly by NYS
FEMA Flood Zones	FEMA (1996)	100 and 500 year flood plains
Layer	**Source**	**Description**
Developed\Human Impacted		
Agricultural Lands	Ulster County, Cornell IRIS Lab	Agricultural Districts (2003), Agricultural Land Use (2006)
Land Use and Parcels	Ulster County GIS	2006
Cultural Resources	1993 Rochester Historic Preservation Commission, State\National Registry of Historic Places	Also some potential archeological resources (NYS OPRHP interest).
Wells and well head locations	Ulster County GIS	Provided by NYRWA as part of their 2006 study

Appendix A. Table 2

CLASSNAME	Count	Health Class	Life Form	# of Acres	Pct of RZ
Acadian-Appalachian Montane Spruce-Fir Forest	12	E	Tree	2.7	0.1
Appalachian Hemlock-Northern Hardwood Forest	1035	E	Tree	230.2	**7.9**
Appalachian Hemlock Forest	1031	E	Tree	229.3	**7.9**
Appalachian Northern Hardwood Forest	454	E	Tree	101.0	3.5
Central Appalachian Dry Oak-Pine Forest	676	E	Tree	150.3	5.2
Central Appalachian Dry Oak Forest	913	E	Tree	203.0	7.0
Central Appalachian Dry Pine Forest	381	E	Tree	84.7	2.9
Central Appalachian Rocky Oak Woodland	404	G	Tree	89.8	3.1
Central Appalachian Rocky Pine-Oak Woodland	234	G	Tree	52.0	1.8
Central Appalachian Rocky Pine Woodland	134	G	Tree	29.8	1.0
Central Appalachian Rocky Shrubland	8	G	Shrub	1.8	0.1
Central Interior and Appalachian Floodplain Forest	480	E	Tree	106.7	3.7
Central Interior and Appalachian Floodplain Herbaceous	24	E	Herb	5.3	0.2
Central Interior and Appalachian Floodplain Shrubland	100	E	Shrub	22.2	0.8
Central Interior and Appalachian Riparian Forest	829	E	Tree	184.4	**6.3**
Central Interior and Appalachian Riparian Herbaceous	29	E	Herb	6.4	0.2
Central Interior and Appalachian Riparian Shrubland	19	E	Shrub	4.2	0.1
Central Interior and Appalachian Swamp Forest	746	E	Tree	165.9	5.7
Central Interior and Appalachian Swamp Shrubland	108	E	Shrub	24.0	0.8
Developed-Low Intensity	59	P	Developed	13.1	0.5
Developed-Medium Intensity	19	P	Developed	4.2	0.1
Developed-Roads	361	P	Developed	80.3	2.8
Eastern Cool Temperate Close Grown Crop	49	P	Agriculture	10.9	0.4
Eastern Cool Temperate Developed Ruderal Deciduous Forest	368	F	Tree	81.8	2.8
Eastern Cool Temperate Developed Ruderal Evergreen Forest	3	F	Tree	0.7	0.0
Eastern Cool Temperate Developed Ruderal Grassland	38	F	Herb	8.5	0.3
Eastern Cool Temperate Developed Ruderal Mixed Forest	20	F	Tree	4.4	0.2
Eastern Cool Temperate Developed Ruderal Shrubland	508	F	Shrub	113.0	3.9
Eastern Cool Temperate Fallow/Idle Cropland	120	M	Herb	26.7	0.9
Eastern Cool Temperate Orchard	26	M	Tree	5.8	0.2
Eastern Cool Temperate Pasture and Hayland	477	M	Herb	106.1	3.6
Eastern Cool Temperate Row Crop	86	P	Agriculture	19.1	0.7
Eastern Cool Temperate Row Crop - Close Grown Crop	18	P	Agriculture	4.0	0.1
Eastern Cool Temperate Undeveloped Ruderal Deciduous Forest	25	G	Tree	5.6	0.2
Eastern Cool Temperate Undeveloped Ruderal Shrubland	55	G	Shrub	12.2	0.4
Eastern Cool Temperate Urban Deciduous Forest	111	G	Tree	24.7	0.8
Eastern Cool Temperate Urban Evergreen Forest	60	G	Tree	13.3	0.5
Eastern Cool Temperate Urban Herbaceous	102	F	Herb	22.7	0.8
Eastern Cool Temperate Urban Mixed Forest	169	G	Tree	37.6	1.3
Eastern Cool Temperate Urban Shrubland	47	P	Shrub	10.5	0.4
Introduced Forest Wetland	46	G	Tree	10.2	0.4

Introduced Herbaceous Wetland	7	G	Herb	1.6	0.1
Introduced Shrub Wetland	11	G	Shrub	2.4	0.1
Introduced Upland Vegetation-Treed	64	G	Tree	14.2	0.5
Laurentian-Acadian Floodplain Forest	29	E	Tree	6.4	0.2
Laurentian-Acadian Floodplain Herbaceous	7	E	Herb	1.6	0.1
Laurentian-Acadian Forested Wetlands	33	E	Tree	7.3	0.3
Laurentian-Acadian Herbaceous Wetlands	56	E	Herb	12.5	0.4
Laurentian-Acadian Northern Hardwoods Forest	729	E	Tree	162.1	**5.6**
Laurentian-Acadian Northern Pine Forest	11	E	Tree	2.4	0.1
Laurentian-Acadian Pine-Hemlock Forest	272	E	Tree	60.5	2.1
Laurentian-Acadian Shrub Wetlands	158	E	Shrub	35.1	1.2
Laurentian-Acadian Swamp Shrubland	20	E	Shrub	4.4	0.2
Laurentian-Acadian Swamp Woodland	312	E	Tree	69.4	2.4
Managed Tree Plantation-Northern and Central Hardwood and Conifer Plantation Group	5	M	Tree	1.1	0.0
North-Central Interior Wet Flatwoods	16	E	Tree	3.6	0.1
Northeastern Interior Dry-Mesic Oak Forest	814	E	Tree	181.0	**6.2**
Open Water	94	E	Water	20.9	0.7
CLASSNAME	**Count**	**Health Class**	**Life Form**	**# of Acres**	**Pct of RZ**
Recently Burned-Herb and Grass Cover	12	F	Herb	2.7	0.1
Recently Logged-Herb and Grass Cover	8	F	Herb	1.8	0.1
Recently Logged-Shrub Cover	62	F	Shrub	13.8	0.5
Recently Logged-Tree Cover	5	F	Tree	1.1	0.0
Ruderal Forest-Northern and Central Hardwood and Conifer	2	E	Tree	0.4	0.0
# of Pixels	**13111**		**# of Acres**	**2915.8**	**100.0**

Appendix A. Table 3. NYSNHP Species List 2015: TOR

New York Natural Heritage Program

625 Broadway, Albany, NY 12233-4757
(518) 402-8944 NaturalHeritage@dec.ny.gov

Report on Rare Plants and Rare Animals

as documented in the Natural Heritage database from the

Minnewaska State Park, Mohonk Preserve, and NYS Forest Preserve

September, 2015

	COMMON NAME	SCIENTIFIC NAME	NY STATE LISTING	NY STATE RANK**
++ ***Historical record only***				
Minnewaska State Park				
Mammals	Eastern Small-footed Myotis	*Myotis leibii*	Special Concern	S2
Birds	Peregrine Falcon	*Falco peregrinus*	Endangered	S3
	Whip-poor-will	*Antrostomus vociferus*	Special Concern	S3
Dragonflies and Damselflies	Arrowhead Spiketail	*Cordulegaster obliqua*		S3
Moths	Black-eyed Zale	*Zale curema*		SU
	Blueberry Gray	*Glena cognataria*		S1S3
	Pine Barrens Zanclognatha	*Zanclognatha martha*		S1S2
	Toothed Apharetra	*Sympistis dentata*		S2S4
Vascular Plants	Appalachian Sandwort	*Minuartia glabra*	Rare	S3
	Broom Crowberry	*Corema conradii*	Endangered	S1
	Carey's Smartweed	*Persicaria careyi*	Endangered	S1S2
	Clustered Sedge	*Carex cumulata*	Threatened	S2S3
	Mountain Spleenwort	*Asplenium montanum*	Threatened	S2S3
	++ Northern Running-pine	*Diphasiastrum complanatum*	Endangered	S1
	++ Primrose-leaf Violet	*Viola primulifolia*	Threatened	S2
	Rhodora	*Rhododendron canadense*	Threatened	S2
Mosses	Anderson's Peat Moss	*Sphagnum andersonianum*		S1
	Angerman's peat moss	*Sphagnum angermanicum*		S1
	Soft-leaved peat moss	*Sphagnum tenellum*		S2
	Trinidad peat moss	*Sphagnum trinitense*		S1

	COMMON NAME	SCIENTIFIC NAME	NY STATE LISTING	NY STATE RANK**
Mohonk Preserve/Mohonk Mountain House				
Birds	Peregrine Falcon	*Falco peregrinus*	Endangered	S3B
Vascular Plants	Mountain Spleenwort	*Asplenium montanum*	Threatened	S2S3
	Arctic Rush	*Juncus trifidus*	Threatened	S2
	++ Large Twayblade	*Liparis liliifolia*	Endangered	S1
	++ Riverbank Quillwort	*Isoetes riparia*	Endangered	S1
NYS Forest Preserve (Sundown Wild Forest)				
Reptiles	Timber Rattlesnake	*Crotalus horridus*	Threatened	S3

** Conservation status in NYS as ranked by NY Natural Heritage Program on a 1 to 5 scale: S1 = Critically imperiled
S2 = Imperiled
S3 = Rare or uncommon
S4 = Abundant and apparently secure S5 = Demonstrably abundant and secure
SH = Historical records only; no recent observations known; may or may not still be present in New York.
SU = Conservation status not assigned

B after one of the above ranks indicates the status rank is for breeding populations only.
N after one of the above ranks indicates the status rank is for nonbreeding wintering populations only.

Information about many of the rare animals, rare plants, and natural communities in New York, including habitat, biology, identification, conservation, and management, are available online in Natural Heritage's Conservation Guides at www.guides.nynhp.org.

This report only includes records from the NY Natural Heritage databases. For most sites, comprehensive field surveys have not been conducted, and we cannot provide a definitive statement as to the presence or absence of all rare or state-listed species. This information should not be substituted for on-site surveys that may be required for environmental impact assessment.