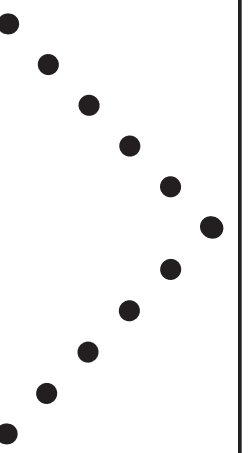
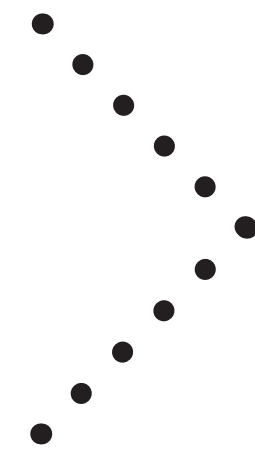


Marcellus by Design



HISTORIC ROUTE 6

SENSE OF PLACE

HABITATS AND CORRIDORS

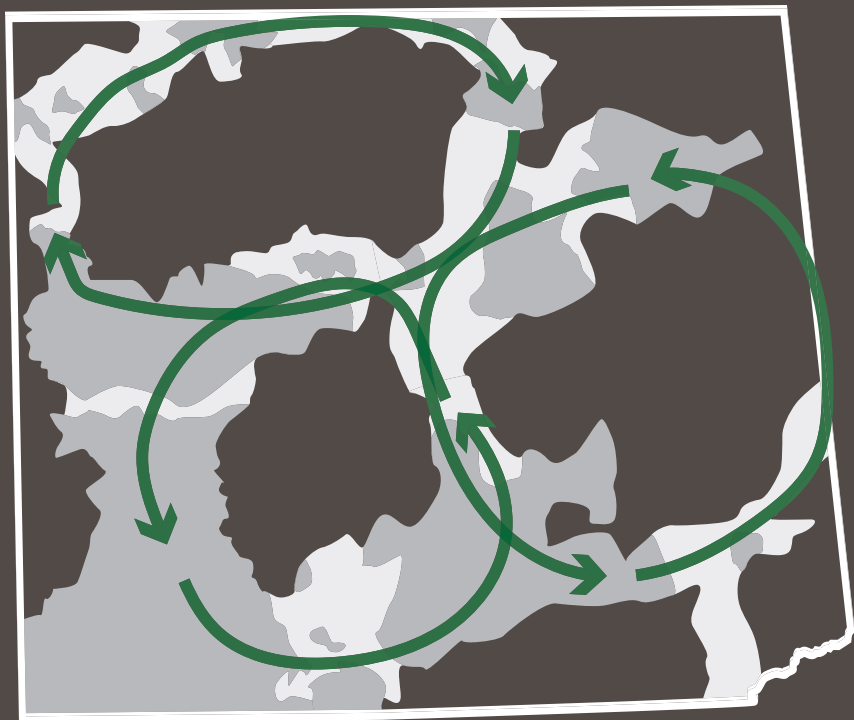
RECREATION

HISTORIC SITES AND LANDSCAPES

WATER

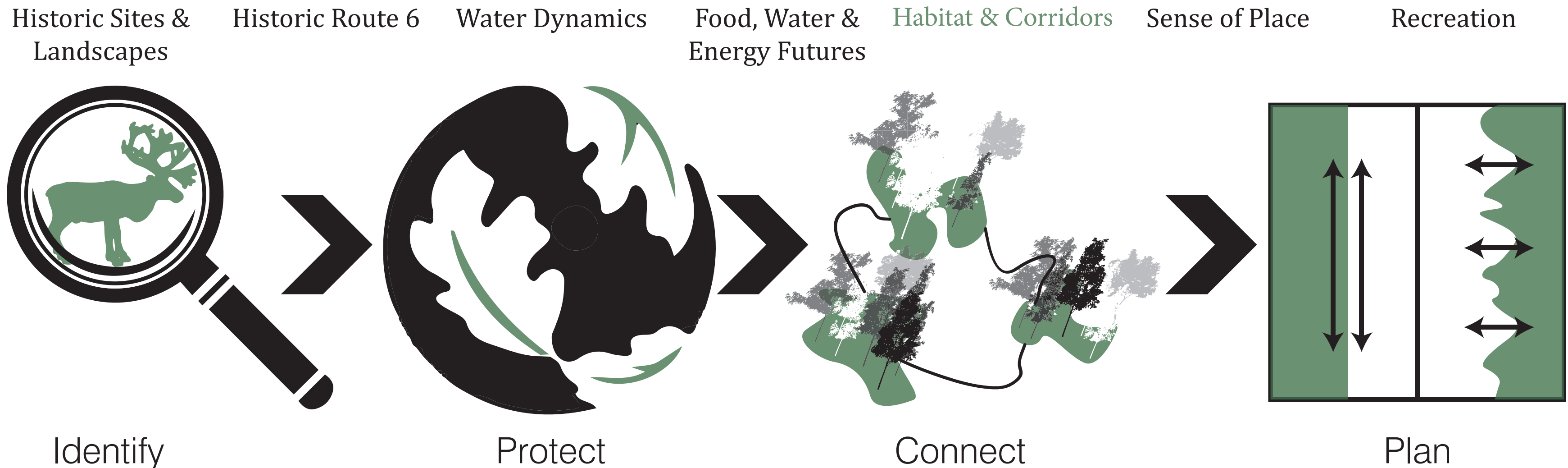
FOOD AND ENERGY FUTURES

Habitat & Corridors

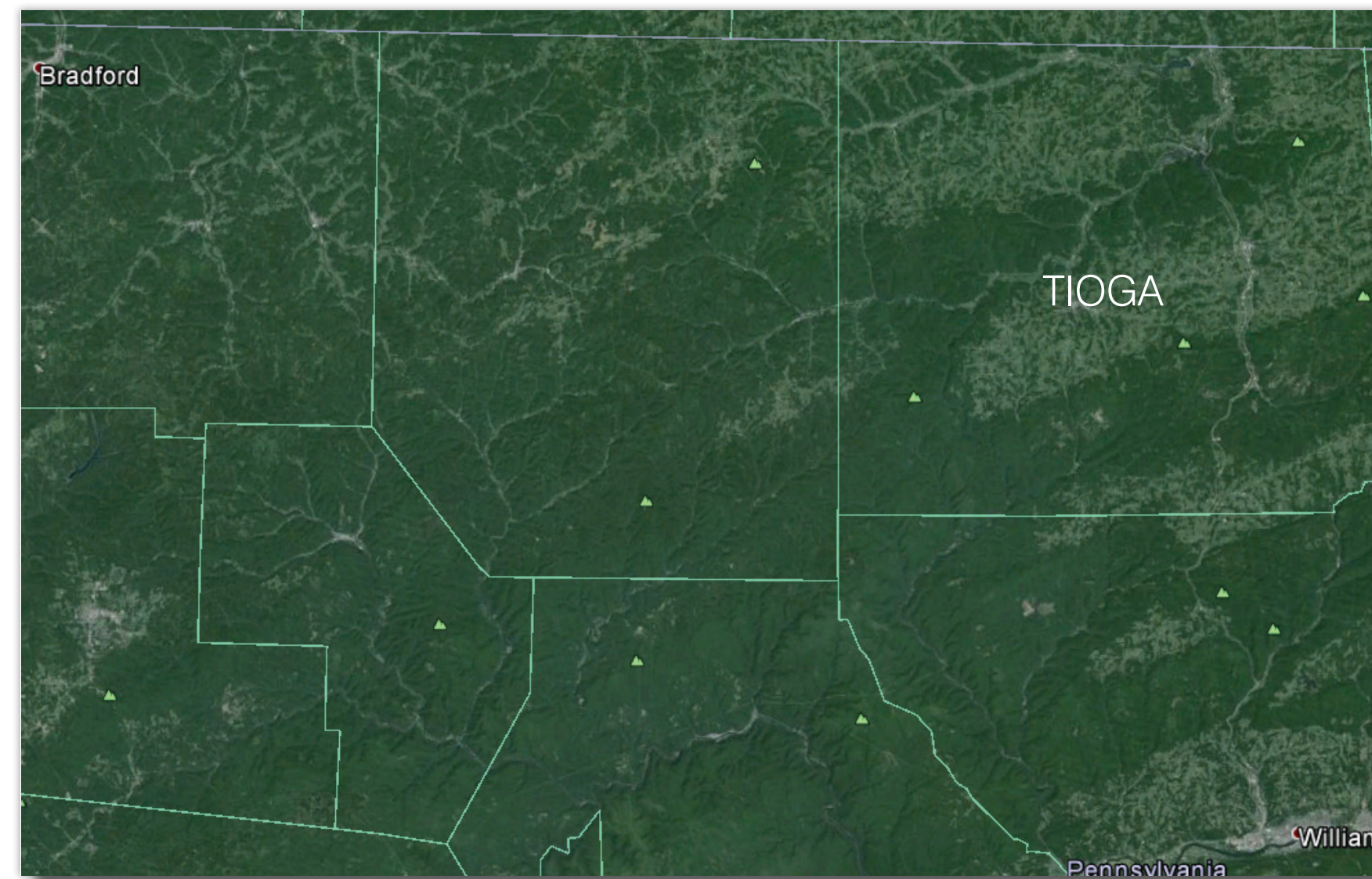


Tioga County is one of the northern tier counties in the state of Pennsylvania making up a part of the state known as “The Pennsylvania Wilds.” The rich natural resources that Tioga County possess makes the outlook of habitats and corridors in the area especially important. The recent discovery of natural gas in the area has brought an even greater amount of attention to the landscape. Tioga County is home to hundreds of wildlife. Their habitat, however, is becoming increasingly fragmented due to human development and sprawl. The presence of infrastructure associated with natural gas including well pads, pipelines, and roads provide yet another threat to these valuable natural resources.

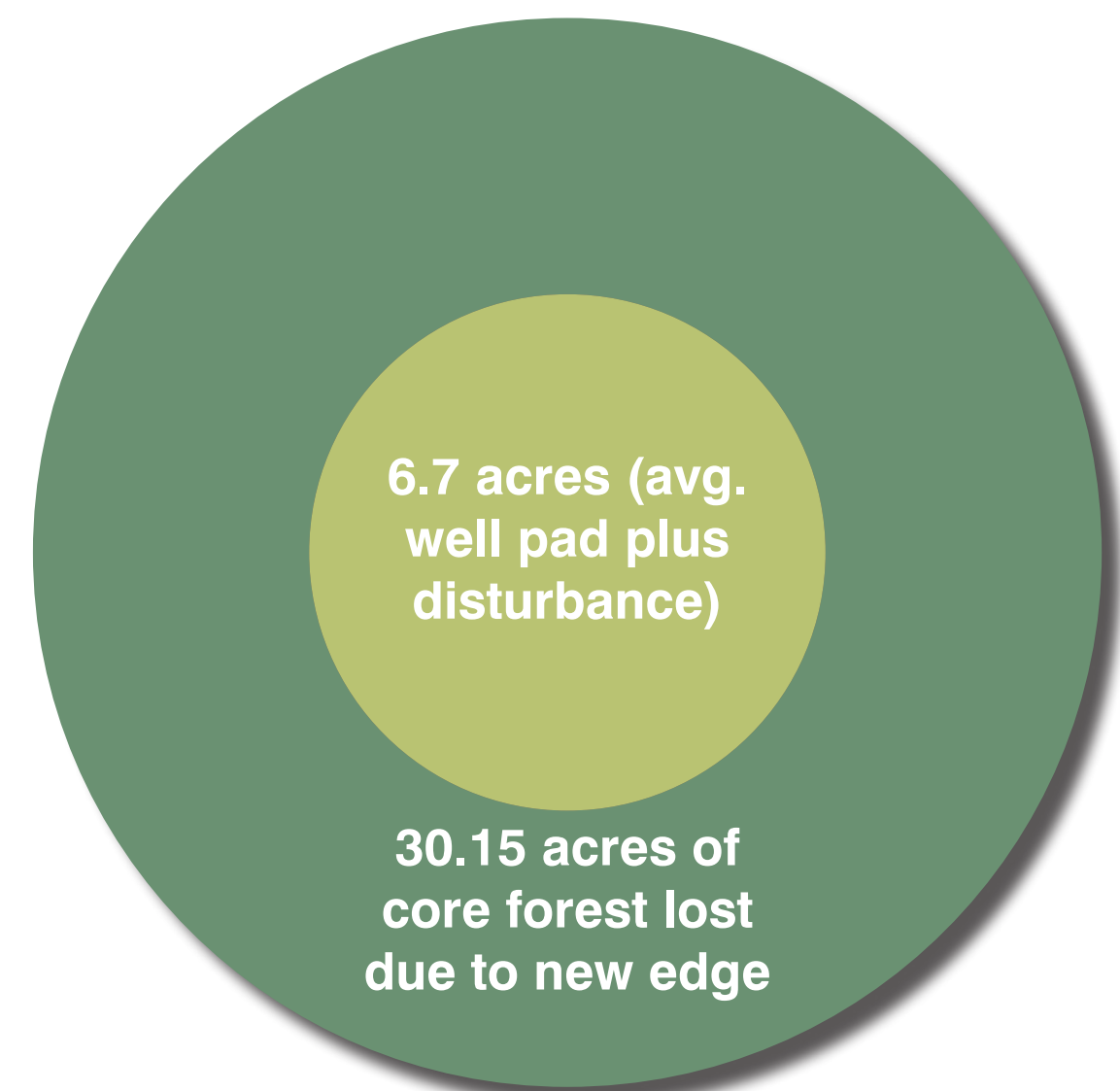
The goal of this project is to identify where the highest quality habitats in Tioga County are located. We will use that information to provide a strategic plan to **protect and connect** these valuable habitats throughout the county. We will then take a look at the impact that natural gas has had and will have on the area, and provide a set of design strategies that will allow natural gas development to co-exist with an improving system of habitat corridors.



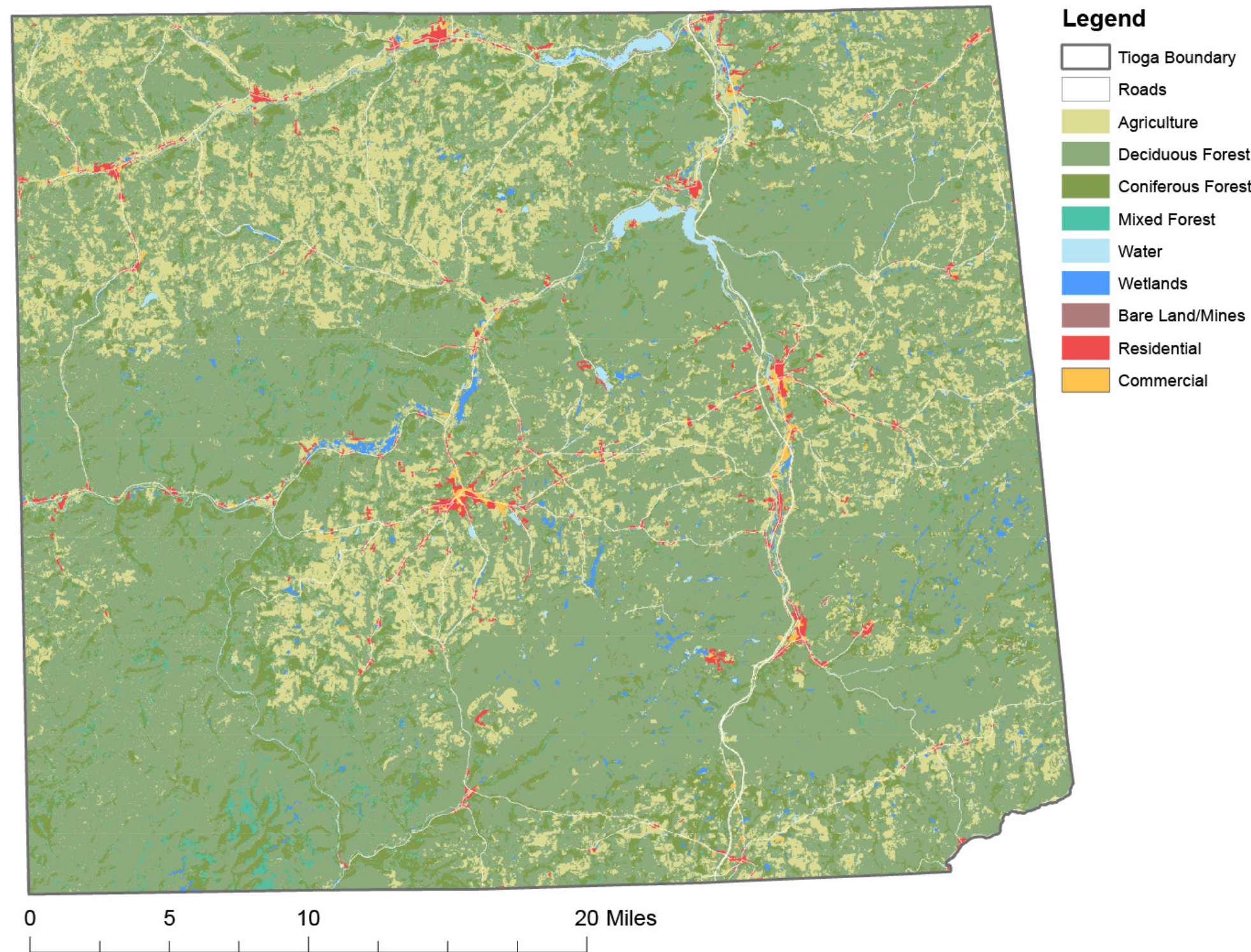
Concept
Using a step-by-step process to achieve our design goals we first identified the highest quality habitat in Tioga County. Then we designated areas for protection according to these habitat values, and also looked at opportunities for connection in lower valued habitats. We then looked at landscape ecology practices and use them to plan for future development in order to limit habitat fragmentation.



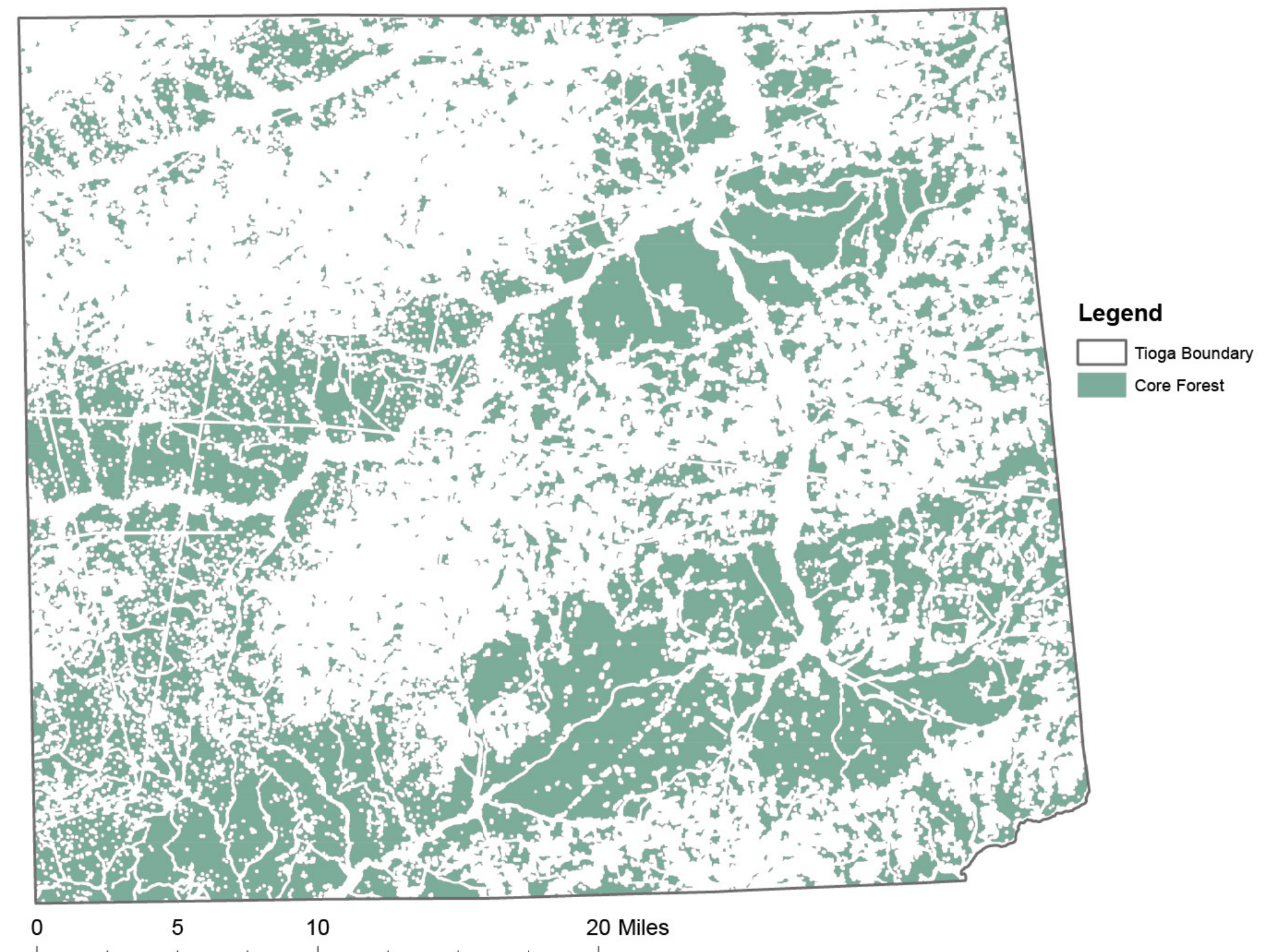
Habitat in Pennsylvania
Tioga County lies within the largest stretch of quality habitat in Pennsylvania. Only about 10% of the entire state is considered quality wildlife habitat, and less than half of Pennsylvania’s forests is considered core forest (any forest greater than 100 meters from a forest edge).



Natural Gas in Pennsylvania
Based on observations that have been made, there is a potential for about 31% of well pads to be placed in core forest. Forest every acre of core forest that is removed, 4.5 acres of core forest are lost due to the creation of new edges. The average well pad site in Pennsylvania removes over 30 acres of core forest.



Data Sources: DCNR PAMAP Program



Data Sources: Eastern Pennsylvania Coalition for Abandoned Mine Reclamation, PENNDOT, DCNR PAMAP Program

Habitat Quality in Tioga County

Compared to the habitat quality of the state as a whole, Tioga County is in much better condition in terms of land use and fragmentation. About 70% of the county is forested, and about 71% of the forest in Tioga are considered core forest. The Tioga State Forest, the Pine Creek Gorge, and other important habitat areas in the county are home to a variety of species. This gives Tioga County an opportunity for tourism that many other places in Pennsylvania do not have. The presence of species such as the Elk, the Bald Eagle, the Pennsylvania River Otter can provide great economic benefits for the surrounding communities. The income from elk tourism alone was estimated at \$147,096 annually for the state of Pennsylvania.

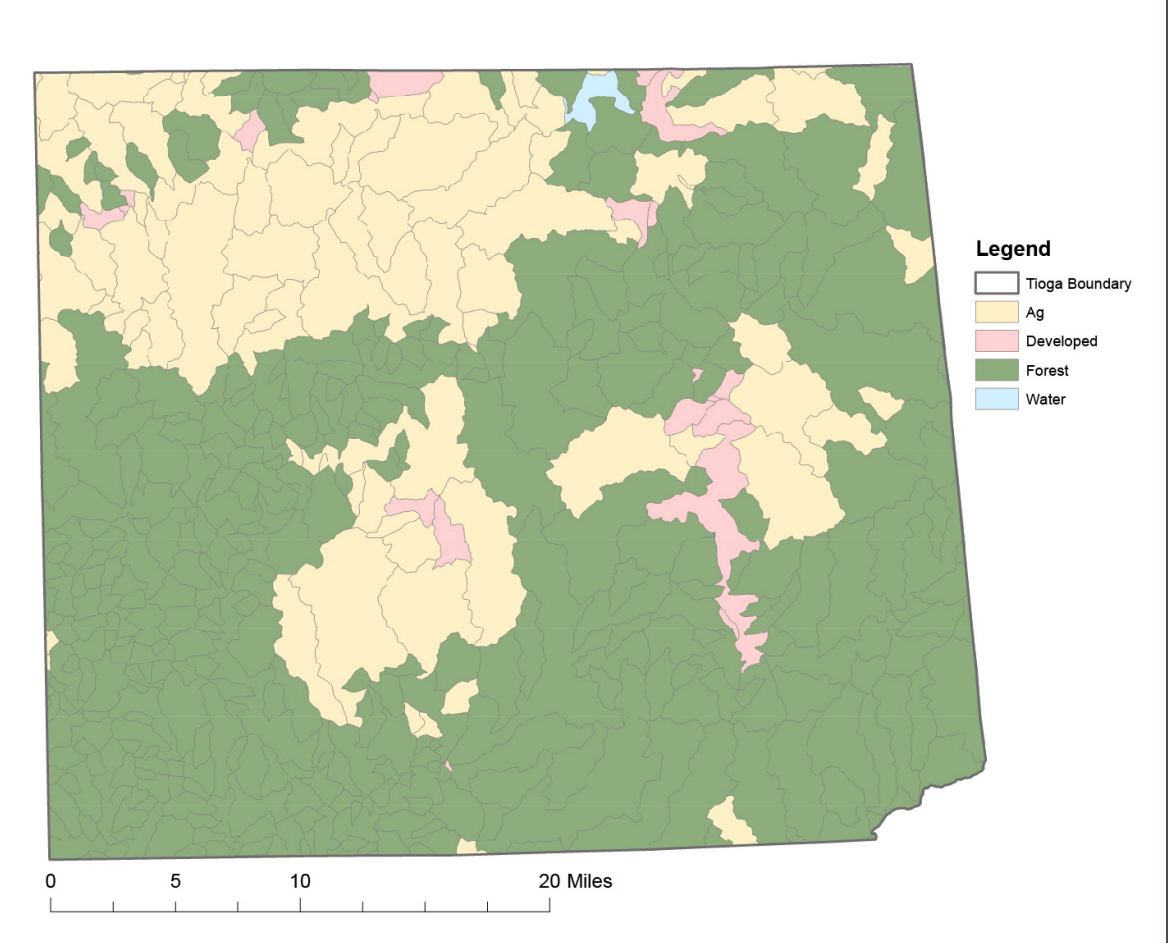
Natural Gas in Tioga

Although the percentage of core forest in Tioga County is very high, the presence of natural gas is threatening these areas. As of 2010, pipeline and road development associated with Marcellus Shale Gas development in Tioga County has created 113 miles of new forest edge. The creation of these edges means that these pipelines and roads have removed more than 8,900 acres of core forest throughout the county. Improved planning of the location of well pads and their infrastructure can help reduce these figures, and simple landscape ecology design principles can help mitigate the effects that the loss of core forest has on habitat quality.

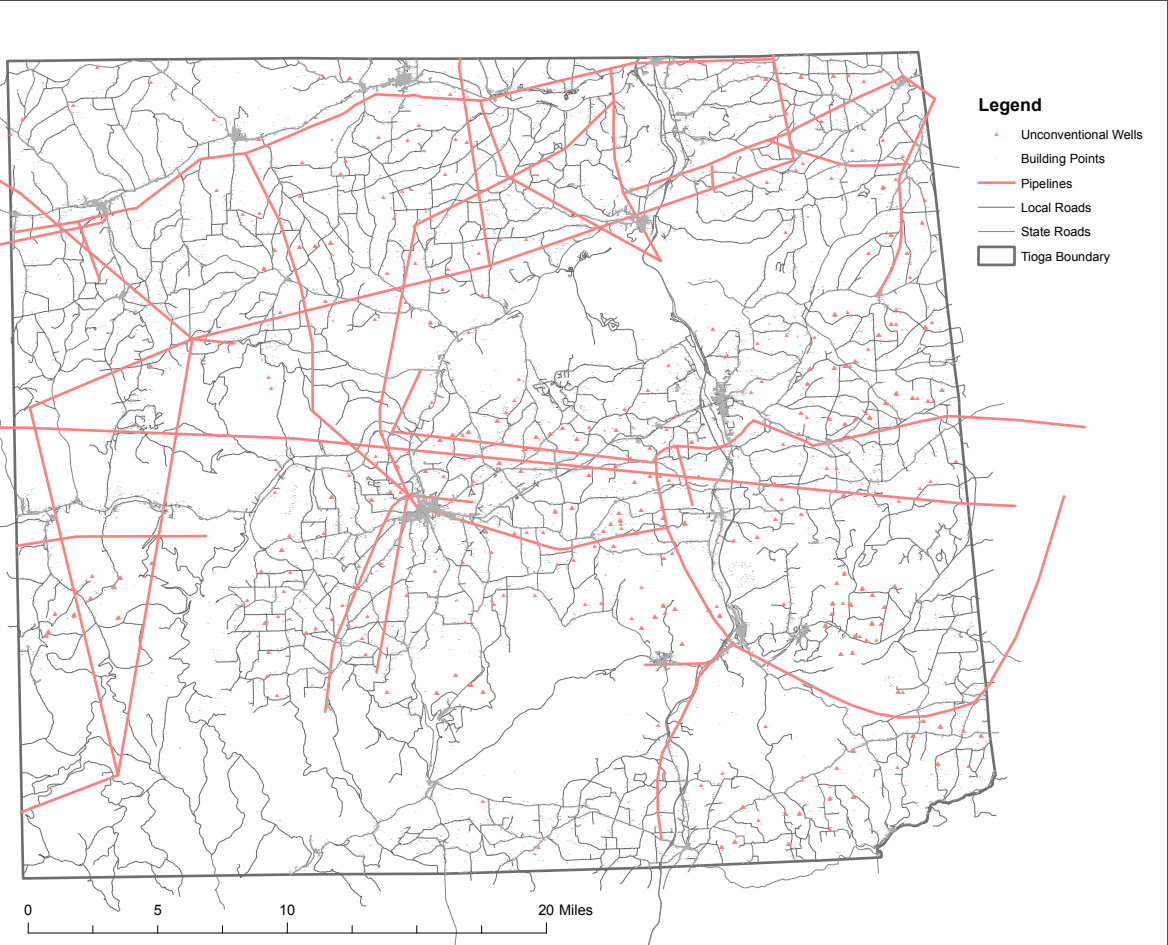
Habitat & Corridors

The Tioga Landscape

Tioga’s swaths of forest are the main form of habittat in the county. The forest dominates the ridgetops of the county and bump up against agriculture and development in the valleys. This pattern is common for a lot of Pennslyvania landscape, however, Tioga’s forest is a unique landscape capable of supporting a extradordinary amount of bio-diversity.



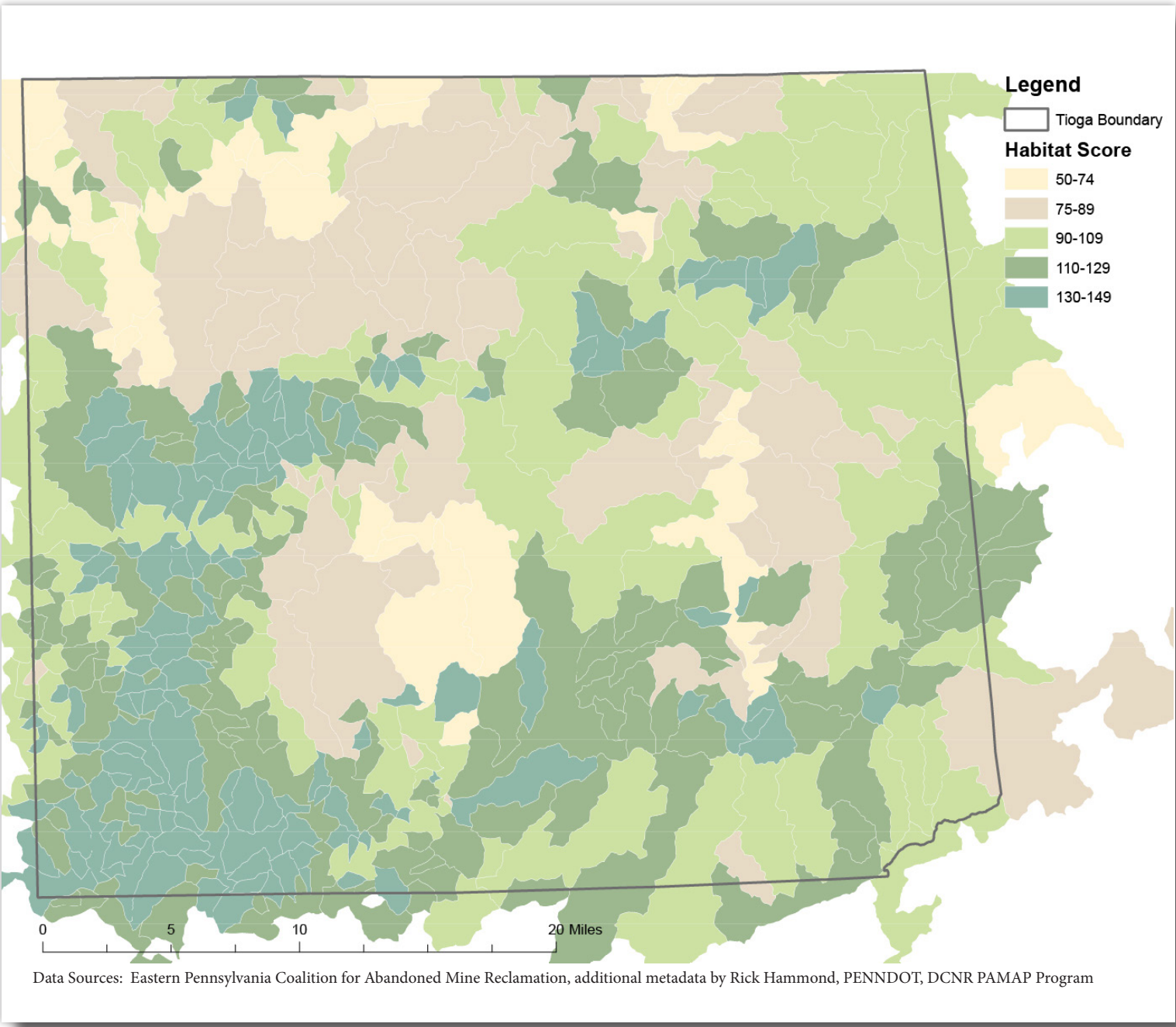
This map shows that tioga has potential for its forest to regrow into a connected system of corridors.



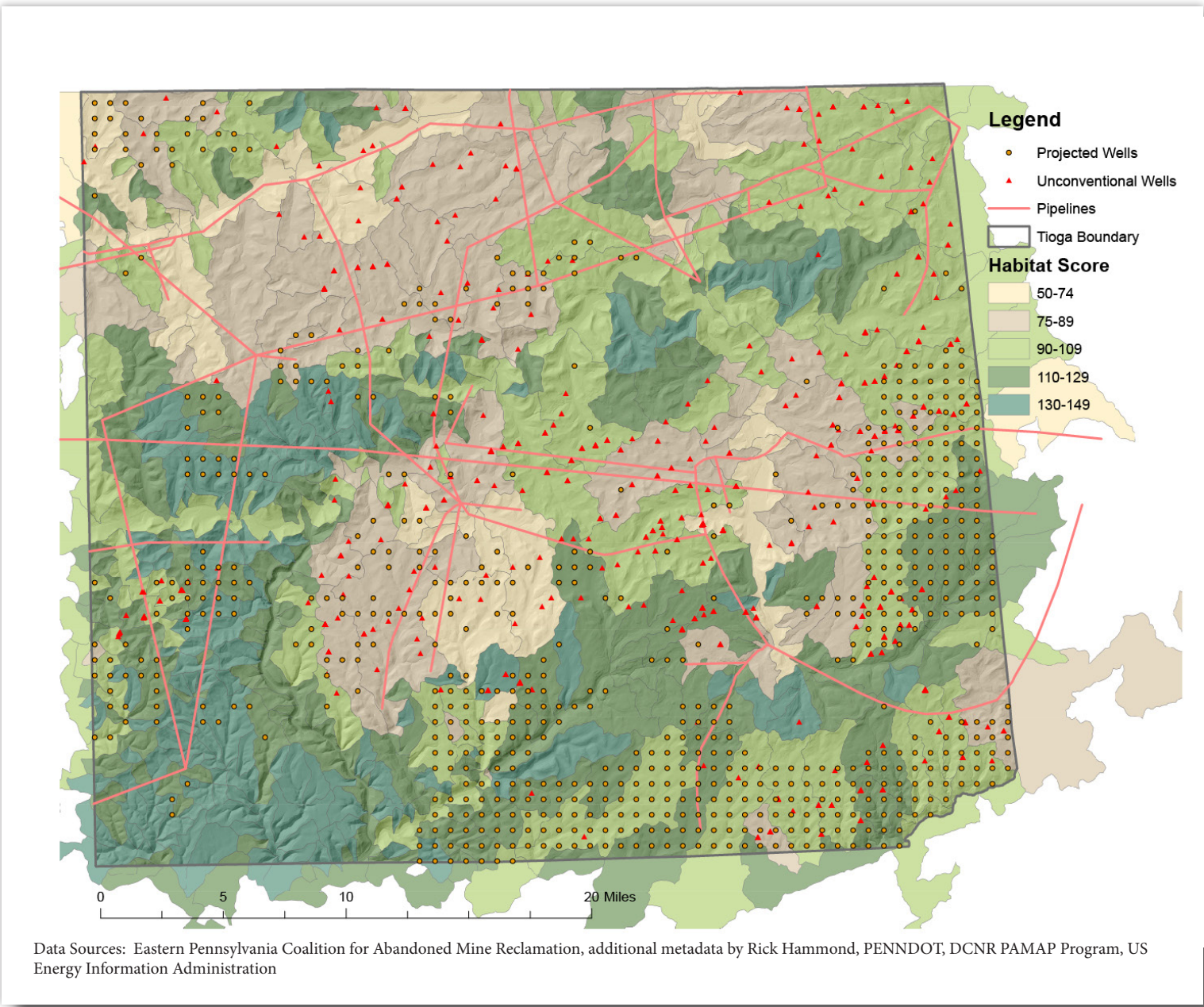
These linear disturbances hold the biggest threat to the protection and connection of Tioga’s natural habitat.

Data Sources: Eastern Pennsylvania Coalition for Abandoned Mine Reclamation, additional metadata by Rick Hammond, PENNDOT, DCNR PAMAP Program

Comprehensive Habitat Score

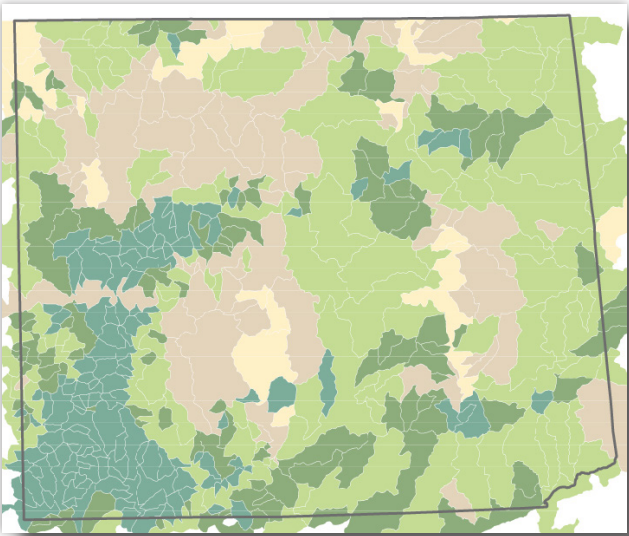


Natural Gas Disturbance

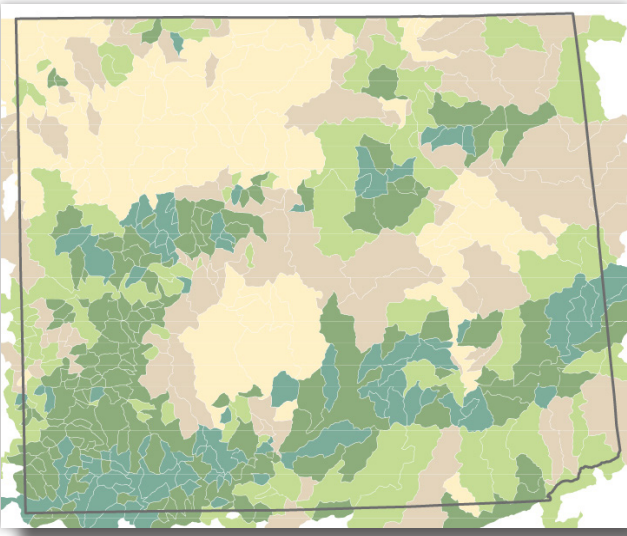


Data Sources: Eastern Pennsylvania Coalition for Abandoned Mine Reclamation, additional metadata by Rick Hammond, PENNDOT, DCNR PAMAP Program, US Energy Information Administration

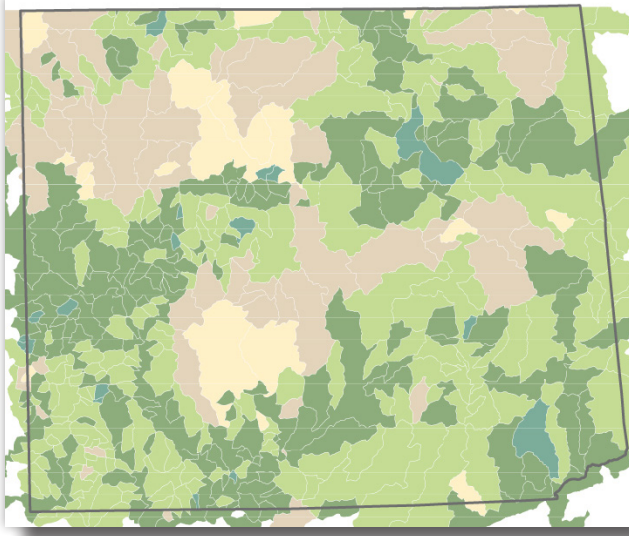
Bald Eagle



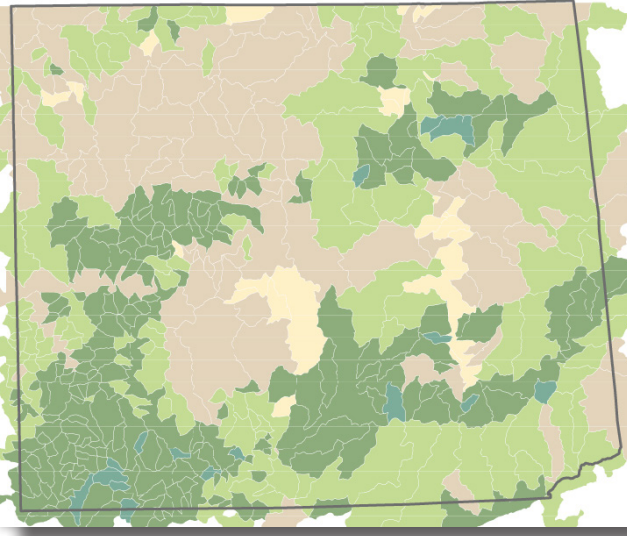
Cerulean Warbler



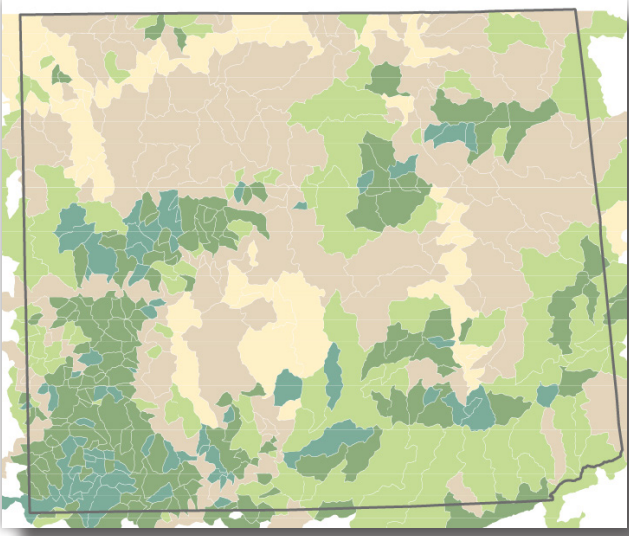
Elk



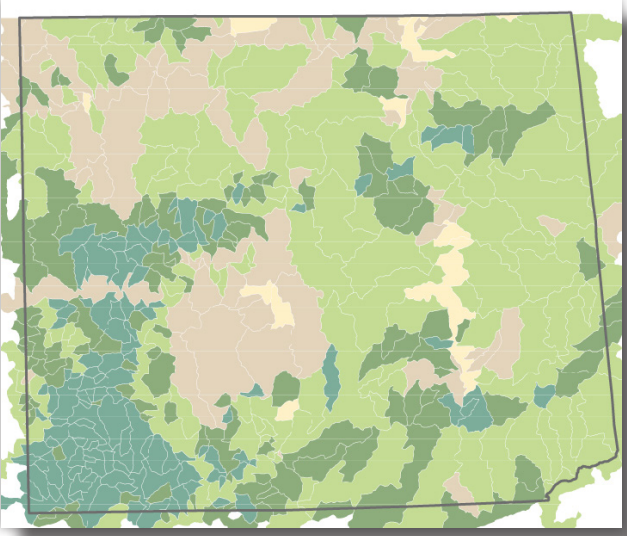
Alleghany Woodrat



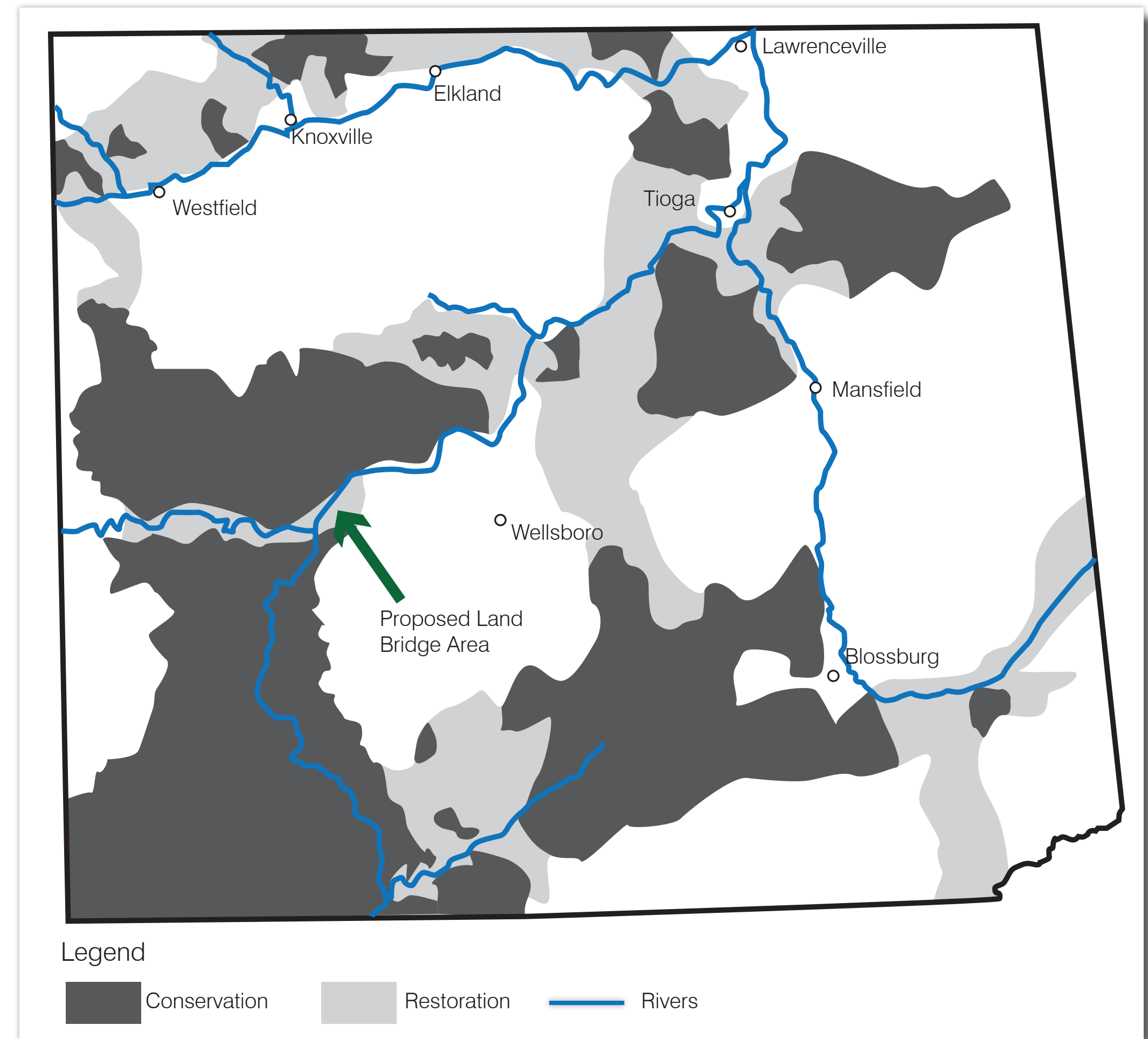
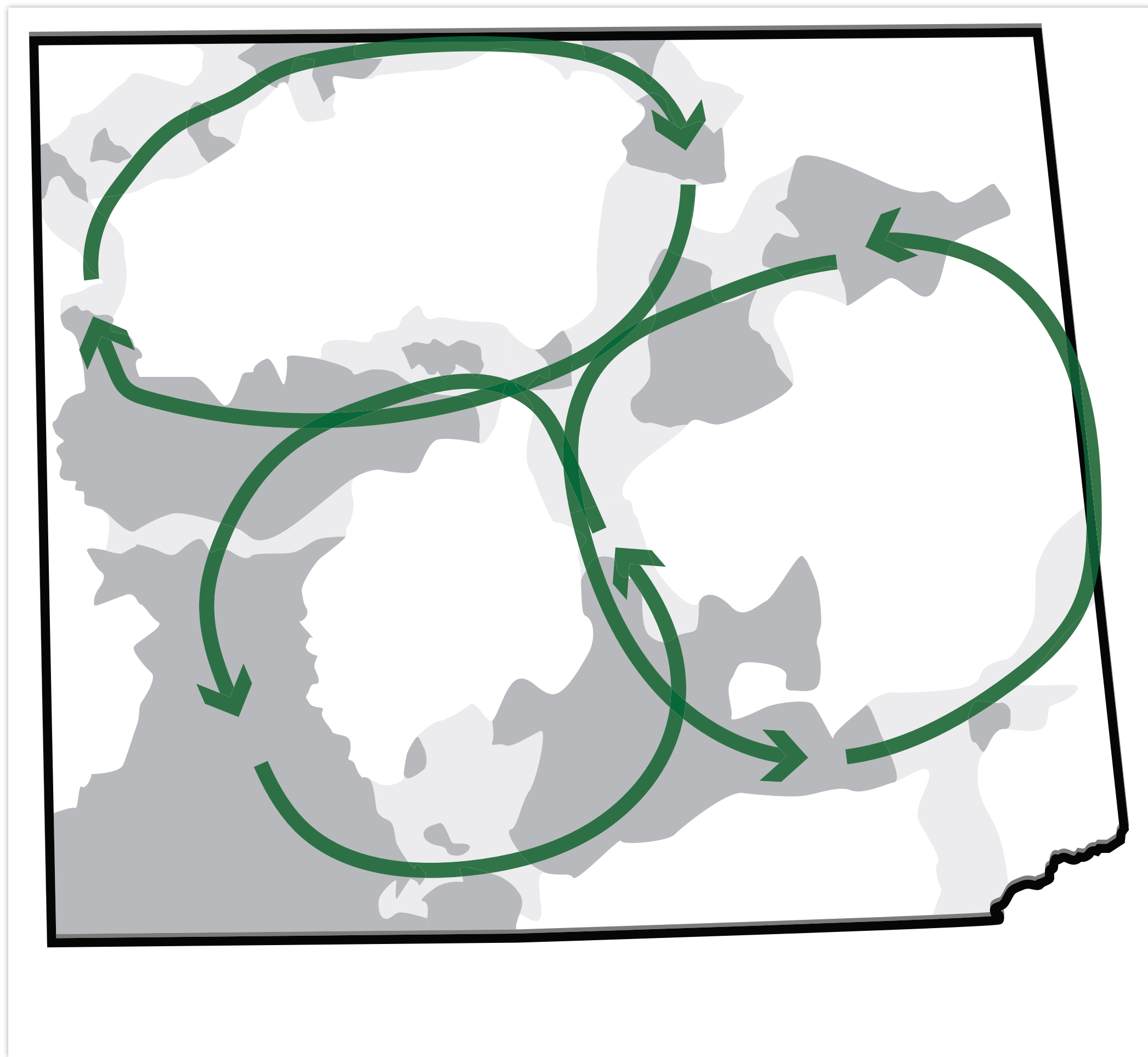
Jefferson Salamander



Wood Turtle



The key species listed above became the benchmark for the design process, allowing us to find out where Tioga’s most viable habitat is for some of its most important indicator species. the map on the top left shows the current habitat in Tioga county that can support the densest amount of wildlife. However, with more gas wells and infratructure coming in the future the viable habitat present will become a point of concern to conserve. The reserach and anylsis of Tioga county guided our design strategies to avoid what seems like the dissecting of one of Pennsylvania’s highest valued habitat.



Protect & Connect Concept

After our site analysis we began to brainstorm ways to conceptually think about connecting the key patches of viable habitat throughout the county. In brainstorming we conceived a concept using three main rings that connect the largest parts of viable habitat to provide corridors of movement for wildlife. The darker blobs on the concept diagram show where there are big areas of natural habitat. The lighter blobs represent areas where the forest has been divided by roads, agriculture, and development. Thus, the darker spots represent areas of conservation while the lighter ones represent the areas of restoration.

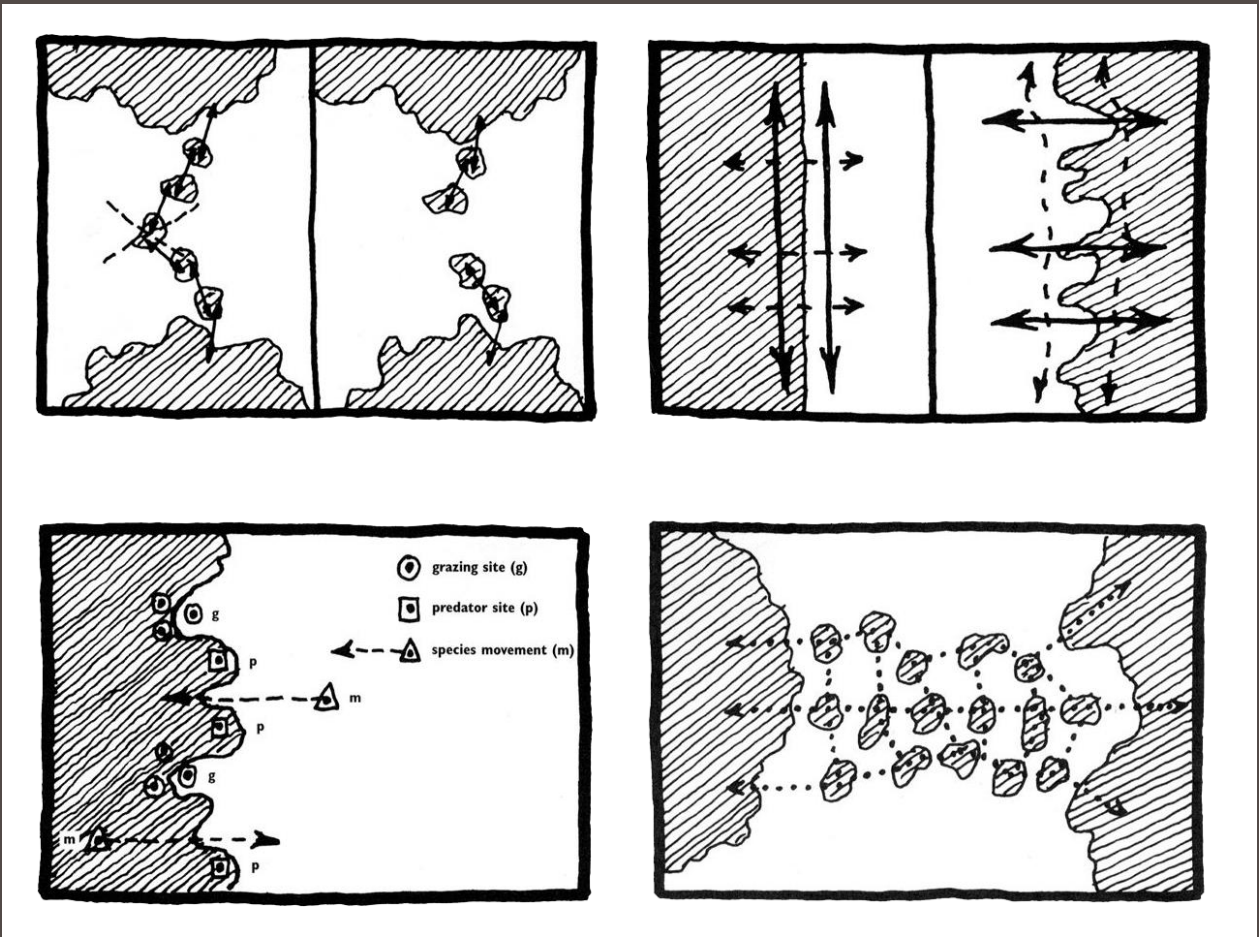
Protection & Connection Priorities

Once connection and protection areas are in place, design can begin to get implemented. Seeing these two diagrams side by side you begin to see the patterns in the landscape. Such patterns include the correlation between the rivers and our areas of connection. The water bodies represent the paths of least resistance to connecting the areas of conservation. Another pattern shown in this diagram is the dissection of the two largest areas of conservation. The space between the two became our highest priority area for design. The connection of the above area to the larger area would expand on the highly valued natural area of the Pennsylvania Grand Canyon. This connect would also protect Pine Creek, the water body that runs through the highly valued natural area.

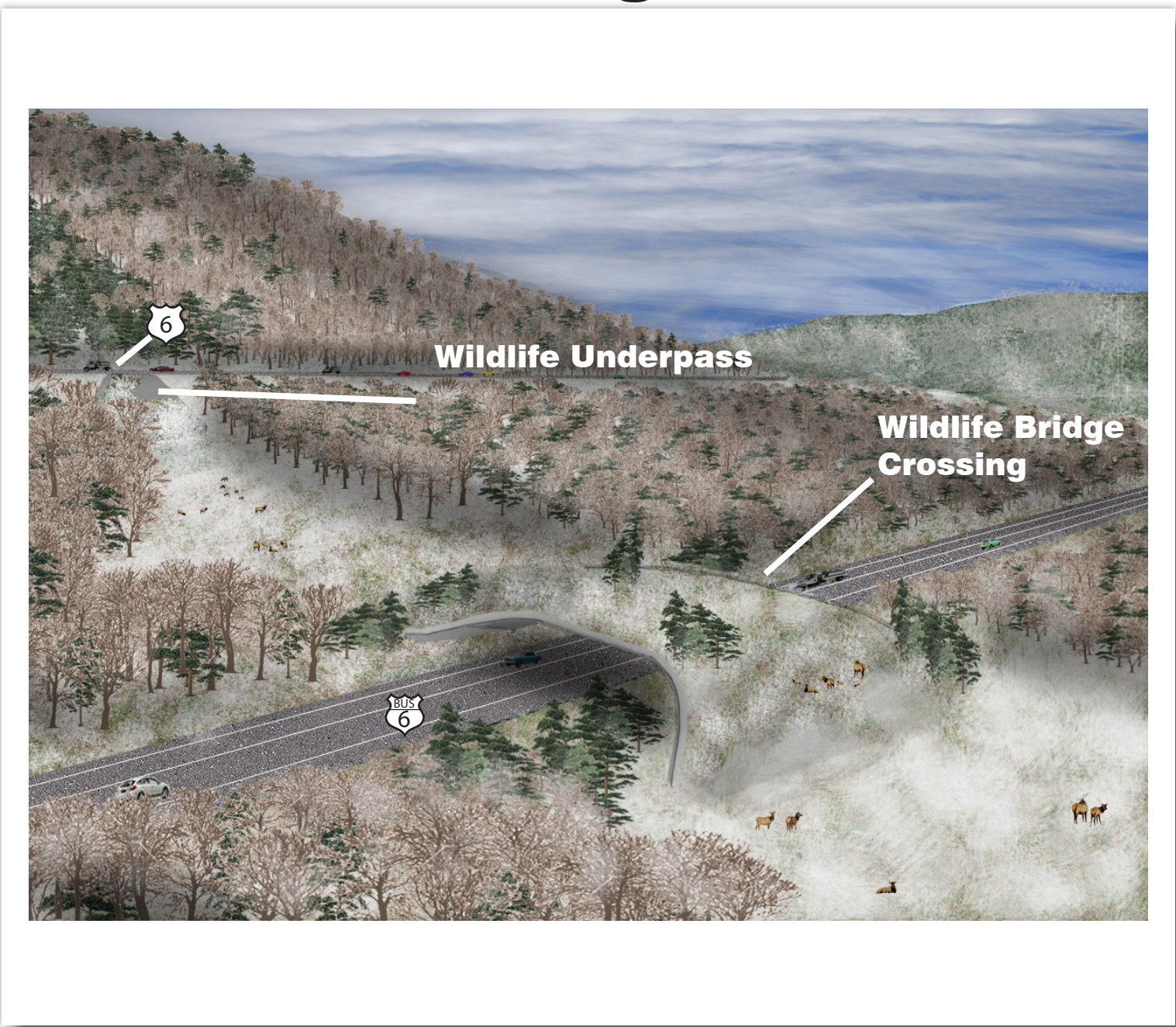
Habitat & Corridors

Design Strategies

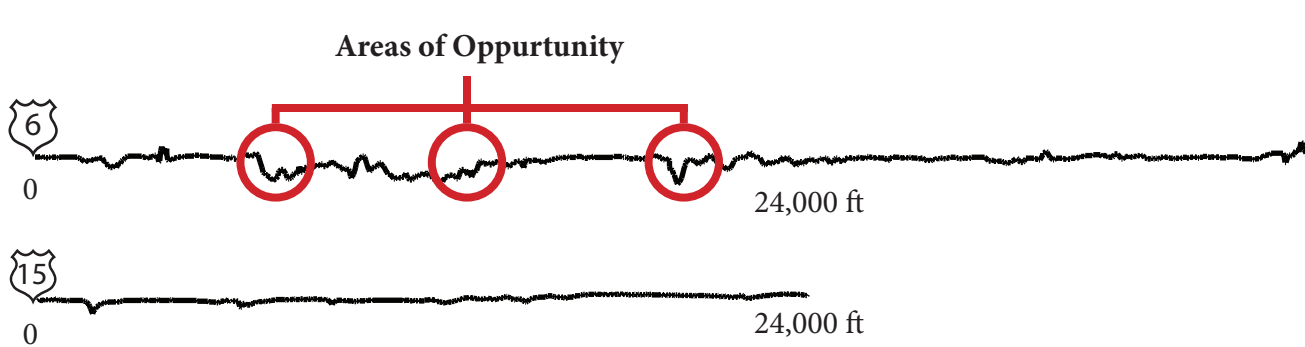
When implementing our design strategies we adopted many ecological principals, that you can see below, to increase movement, patch sizes, and decrease fragmentation. These basic strategies are steps in the right direction for restoring and conserving the areas of high priority in the county. These strategies were then adopted in to our design implementation.



Route 6 Land Bridge



Design Opportunity

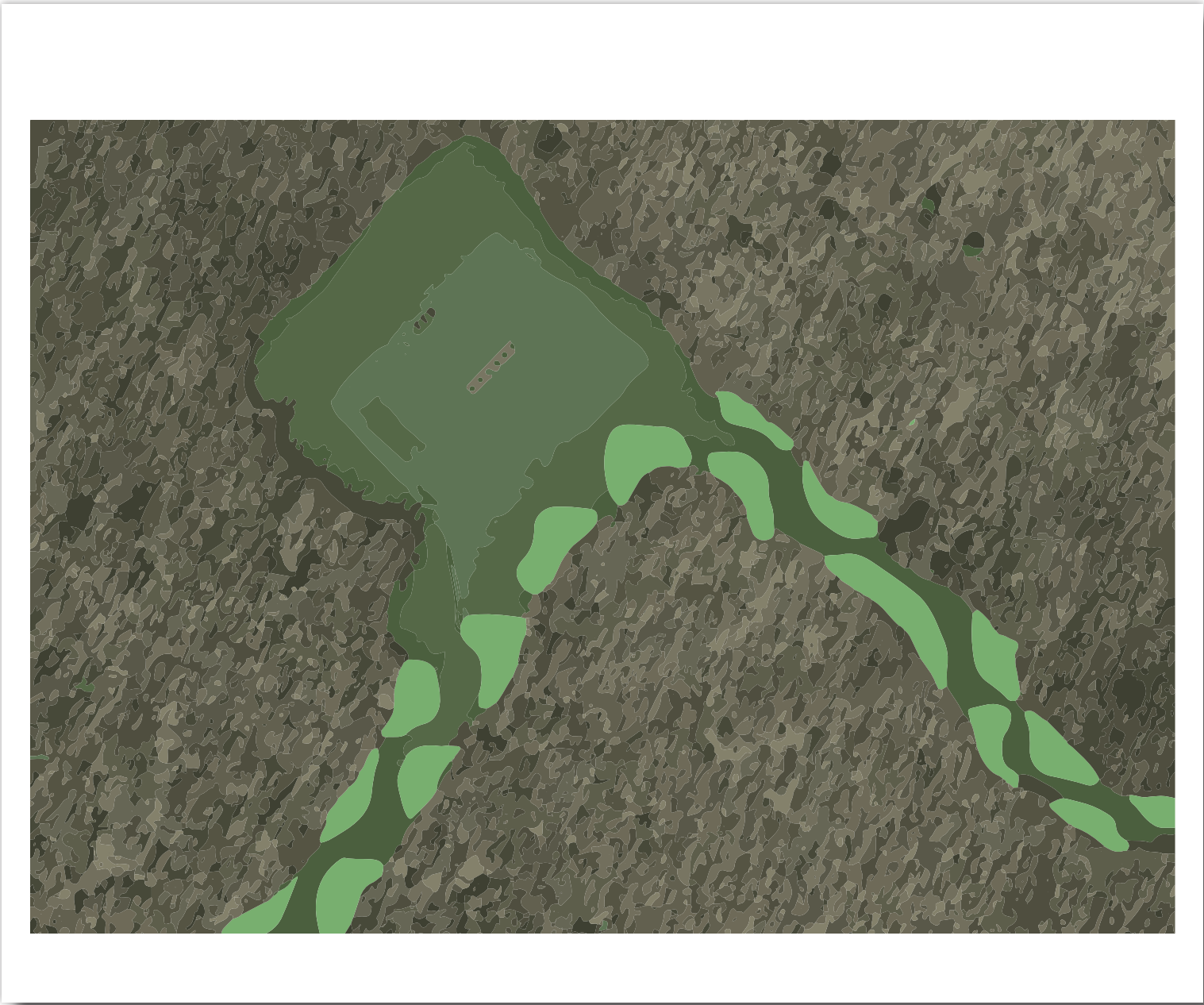


Concept Diagram

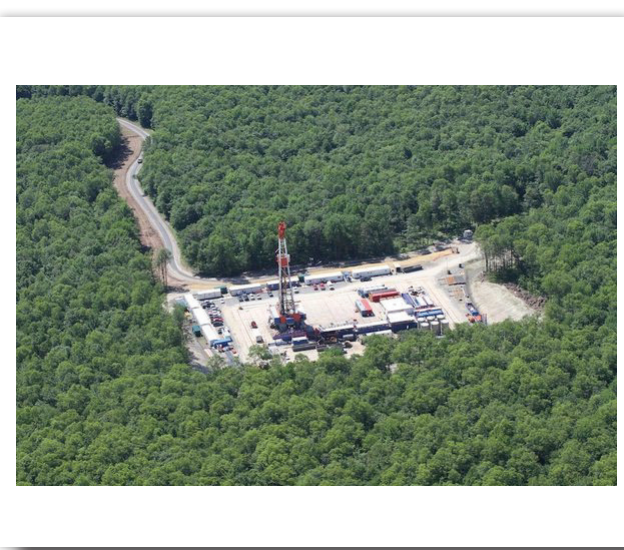


This design will allow for circulation of wildlife through the corridors in Tioga County while providing the population with an iconic landmark adding to the already rich history of Historic route 6.

Well Pad Restoration



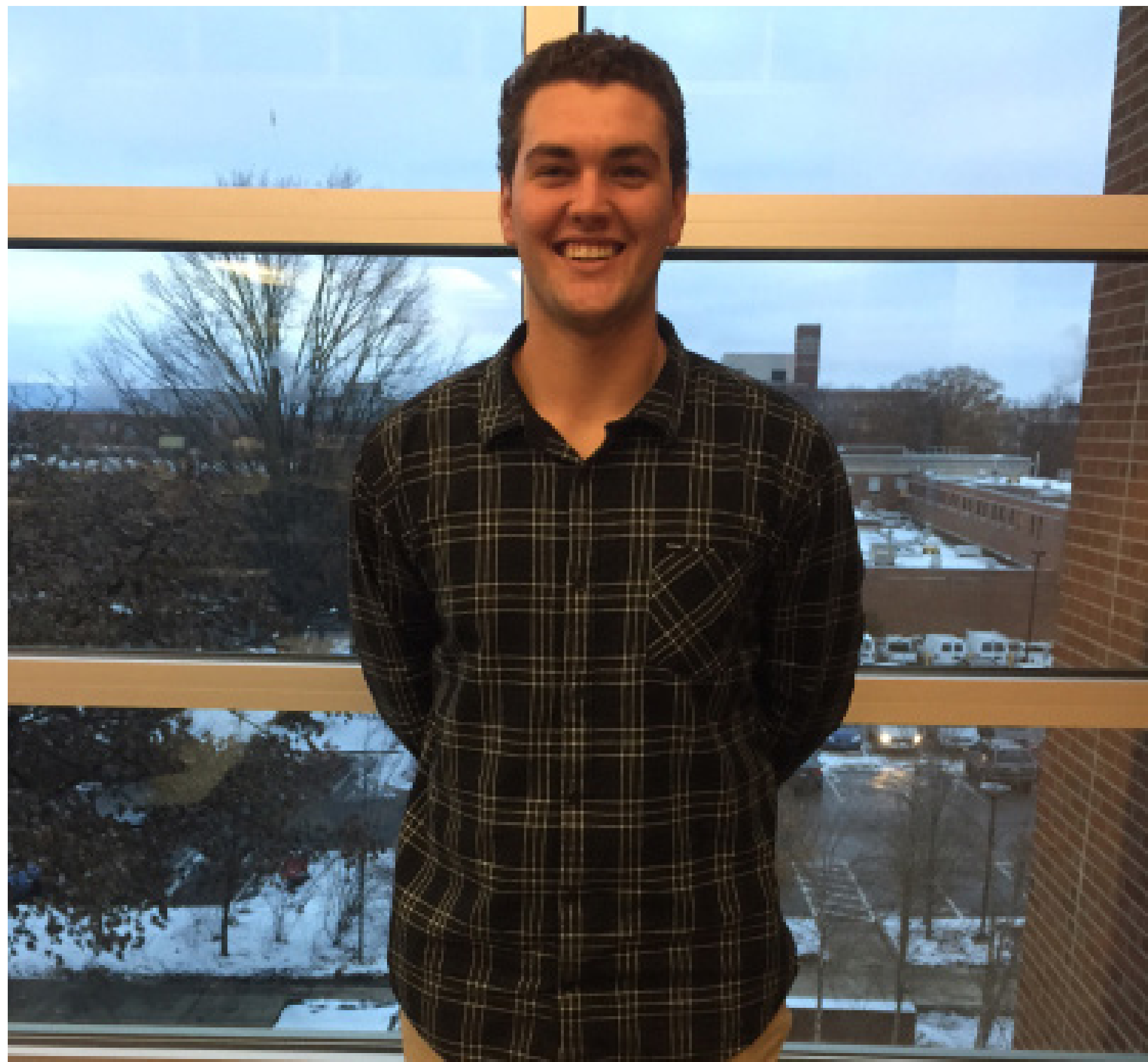
Before



After



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Austin Thomas

Austin is a 4th year Landscape Architecture student at the Pennsylvania State University in University Park, PA. He is a out of state student from central New Jersey whose interest in hiking and the outdoors drew him to this project. Throughout his years in school he has adopted a love for the field and its capabilities to have a positive impact on the communities he works within.



Shane Brown

Shane is completing his 4th year at the Pennsylvania State University's Landscape Architecture Department. Shane's father is in the U.S. Army so he has spent most of his young life traveling, living in 11 different states as well as Germany and South Korea. Shane enjoys hunting, fishing, hiking, riding his mountain bike, and other outdoor activities. While his studies at Penn State have been focused on Landscape Architecture, he also has minor focuses in Environmental Inquiry and Geography.

Habitat & Corridors