Fiddler's Green:
A Case Study in Bog Succession

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Acknowledgements:

We would like to thank Harvey and Debbie Kliman along with the entire SMHT board for this opportunity and their support. Our professor Tim McCay for his guidance in this entire process. Chris Lajewski and The Nature Conservancy for their support and information on Fiddler's Green. Myongsong Kong and Adam Burnett of the Colgate Geography Department for their aid in our GIS work. Gary Ward of the Colgate Science Machine Shop for his help in constructing our coring apparatus. Kevin English for price estimates. Carl Spevacek for his previous work and reports on Fiddler's Green. Dianne Keller, Rich April, Amy Leventer and Bruce Selleck of the Geology Department for their help with geology tools and advice.

Executive Summary

Pairing with Southern Madison Heritage Trust (SMHT) we have engaged in the study of a succeeding local bog, the bog at Fiddler’s Green. Fiddler’s Green is owned by The Nature Conservancy and currently under the stewardship of SMHT. We believe that bogs of this nature are unique in this region, and that Fiddler’s Green has future value aesthetically, recreationally and educationally. Our main objectives for this study were to better understand the bog through fieldwork and GIS analysis, as well as to develop an outline for a land management plan outline. Through our research we have been able to identify unique characteristics of the bog at Fiddler’s Green, and understand the consequences of various management options. We have attempted to provide SMHT with information needed to make an decision about the future of the bog.

Introduction

Within North America there are many types of wetlands, one of which is a bog. Bogs are characterized by their most distinctive feature: a mat of sphagnum moss. They are also known for their acidic waters and layers of peat. Most bogs are replenished through the water they receive as a result of precipitation, as opposed to water they may get through groundwater and runoff. As a consequence of being low in nutrients, bogs make a hospitable environment for the growth of things that thrive in acidic environments, like peat mosses and pitcher plants. There are two ways that a bog can develop. Bogs can be formed through terrestrialization, which is when sphagnum moss gradually takes over a body of water, such as a lake or pond. The other way bogs can be formed is through paludification, which is when sphagnum moss slowly starts taking over a dry piece of land and forms a barrier, which prevents water from evaporating. With time, layers of sphagnum moss become compressed and begin to decompose to form layers of acidic peat. Bogs provide a number of environmental services, including climate and atmospheric gas regulation, waste treatment, water supply and regulation, habitat for specific species, disturbance regulation, and raw materials. With their many special features, bogs have evolved to become the home to many plants and animals that have adapted to a harsh environment of low nutrient levels and acidic waterlogged conditions.

Fiddler’s Green is a 78-acre parcel of land owned by The Nature Conservancy and under the stewardship of Southern Madison Heritage Trust. It is located in the Town of Eaton in Madison County, New York. Fiddler’s Green is home to woodlands, a pond and a bog. The bog is at approximately 42.869°N and 75.577°W. In this area a retreating glacier left two similar bodies of water forming the pond and bog. Both the bog and the pond were developed as glacial kettle holes. The difference between the bog and pond demonstrates the difference between rapid versus slow succession.

We propose two options in dealing with succession. The first option lays out a plan that would allow succession to naturally occur, while the second plan is designed in a way that intervenes with succession by proposing to remove encroaching woody species. These species are invasive in the sense that they are spreading into a new habitat. However, they are native to this region. In either case however it is important to note that our end goals of conserving the bog are met.

Methodology

The objective of our research was to gain a better working knowledge of the bog at Fiddler's Green and to provide options for dealing with the succession of the bog. We began fieldwork in early September, and because many of the protected species bloom in the spring, we were unable to incorporate them into our data collection. The notable species in season at this time were: an unidentified variety of fern, pitcher plants, cotton grass, white pine, huckleberry bushes, tamarack, and sphagnum moss. The main portion of the bog is 707 sq. meters and lies 200 meters in from an entrance point on Peck's Road.

In analyzing the bog within Fiddler's Green our group took a two-step approach. We incorporated both field work and research in developing a land management plan outline and were able to analyze literature and case studies to bolster our findings in the field. Kimball (2010) describes five stages in the succession of a pond to a bog. The center of a bog is in the earliest stage of succession, and the outskirts of the bog are in the most advanced stage. The species of plants serve as good indicators of the stage of succession. Kimball lays out the general phases of bog succession and the order in which plant species inhabit the bog: "From the swamp loosestrife and other plants at the waters edge past, sphagnum moss and pitcher plants, then blueberries and poison sumac, followed by black spruce and American larch and, finally, swamp maples and white pines." (Appendix B.1) This pattern of succession is exemplified by the bog at Fiddler's Green. It is noteworthy, however, that the bog does not, as far as we have seen, contain swamp loosestrife. This could be due to the fact that succession has proceeded past this phase, and that other plant species, such as sphagnum moss and pitcher plants have overtaken the swamp loosestrife. Additionally, it seems that black spruce is replaced with tamaracks in Fiddler's Green.

Our fieldwork on the bog centered on coring. We made our own corer with the help of the Colgate Science Machine Shop. The corer was ten feet in length and one inch in diameter. The improved corer enabled us to sample soil at a greater depth and, because of the cylindrical design, the samples kept intact the various soil layers. After procuring samples in the center of the bog, 25 meters from the center, 50 meters from the center and 100 meters strategic locations with the new corer, we analyzed the soil for pH. When analyzing the coring samples for pH we utilized a handheld pH meter and reverse osmosis (RO) water, which is pH neutral. By mixing the various coring samples with 50 mL of RO water we used the handheld pH meter to take the pH of the samples. After each coring sample was analyzed for pH, we cleaned the pH meter with RO water to ensure that coring samples were not cross-contaminated.

Our next step primarily focused on data analysis and work outside of the field. Our main work in this aspect was using Geographic Information Systems (GIS) to analyze physical characteristics of the bog. Using ArcGIS software we were able to use Digital Elevation Models (DEM) to determine the geographical features of the bog. First, we obtained a DEM from the USGS seamless server for the area of study. We then clipped the DEM to the Chenango watershed, as the bog falls within its boundaries. After the DEM was clipped to the Chenango watershed, we used the spillpoint feature to determine where the water collected in the valleys (Appendix B.3). In addition, the spillpoint tool allowed us to determine if the dams near the bog had any effect on water flow into the bog. After performing this analysis it was determined that the dams probably have no significant effect on water flow into the bog. The bog is not being replenished by any of the major water courses in the watershed. Instead, it was determined that the bog is ombrotrophic, meaning it is replenished by local precipitation. This is consistent with our research that shows most bogs are replenished in this way.

After the DEM was clipped to the Chenango watershed, it was imported into ArcScene. Using ArcScene it was possible to give the DEM three-dimensional characteristics (Appendix B.3-5). Manipulating the DEM's base height by increasing the *z* factor from one to nine allowed the actual heights in the DEM to be exported to a visible scale. With a *z* factor of one it was difficult to see the elevation because the elevation was relatively low compared to the horizontal component of the model, therefore the *z* factor was increased to highlight elevation. With the DEM imported to ArcScene and enhanced for visual effect, the different layers of the model were added. The first layer to be added to the DEM was the major water bodies of the Chenango watershed. This layer's base height was also enhanced with a *z*factor of nine to ensure that the DEM and water bodies layer matched appropriately with regard to height. After the hydrology layer the tax parcel layer was added, which shows the actual location of the bog.

Discussion/Results

Bog Characteristics

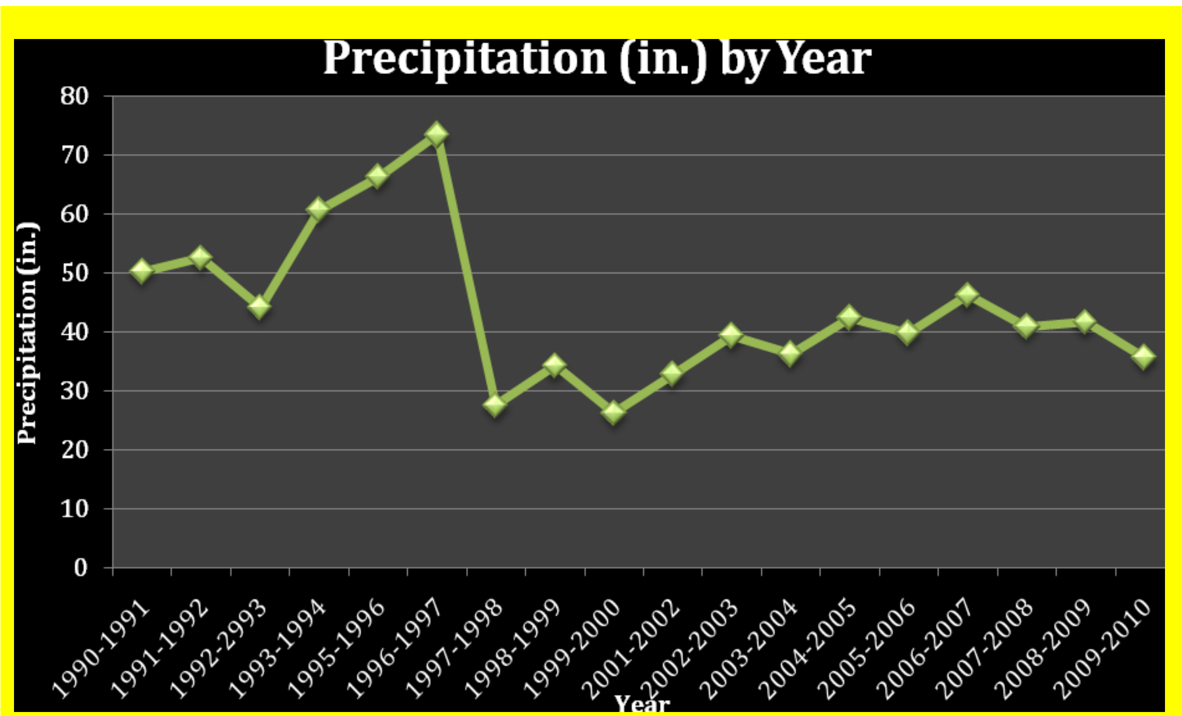
Coring was the focus of our field related work in the bog. Due to logistical problems with the length of our 10' coring apparatus, soil samples were unable to be taken in many areas of the bog. However, we believe this is important to note as it shows the depth of the bog is actually much greater than originally anticipated. The samples that could be taken confirmed previous studies that the pH is around 4.

Location	**pH**	**Depth (cm)**
100m from Center	3.99	132
50m from Center	4.07	187
25m from Center	4.02	235
Closest to bog center	3.98	272
Bog water sample	3.93	-

The pH level is consistently around 4 up to 100 meters away from the main, cleared area of the bog. The fact that the pH is around 4 even out 100 meters away from the center suggests that the main bog area was originally much larger than it is today.

Using GIS software we were able to analyze physical characteristics of the bog and the area surrounding it. This allowed us to classify the bog based on how it is recharged. When we determined that the bog is not replenished by runoff or a tributary water source, we were able to conclude that the bog is ombrotrophic, meaning that it is replenished directly by precipitation. This was further evidenced by observations we made while visiting the bog. When visiting the bog after any significant amount of rainfall it showed substantial increases in water content. In addition, when we visited the bog after just a few days without rain, the bog was significantly drier. The fact that water content is strongly correlated with rainfall suggests that precipitation is the primary source of water.

After coming to the conclusion that the bog is ombrotropbic, we thought it would be useful to analyze historical precipitation records to determine if the amount of rainfall in the area could be having an effect on the succession of the bog. We graphed data for Syracuse, NY over a twenty-year period starting in 1990.



While there was a large sustained decrease after 1998, it is important to note that there was unusually high precipitation in the years 1990-1998 as evidenced by the large deviation from the annual average. In the years since 1998 the amount of precipitation has been closer to the average, suggesting that precipitation is not having an effect on the succession of the bog.

Management Plan

For land management, we have identified three main objectives. First is to limit human disturbance to the bog. If the bog will be used as a resource in the future, it is important to maintain its integrity and limit human damage. Second is to promote recreational development. Recreational development would provide another area in which residents in this region could go out to explore the outdoors. Due to this bog's unique characteristics it will allow local residents to experience something that they do not necessarily get to encounter on a daily basis. Along with promoting recreational development, our third objective is to create a unique education spot. Bogs have inherent qualities within them that make them different than most places in this area and could provide a unique learning opportunity for children as well as adults.

To work towards these objectives we have provided plans for two optional infrastructural improvements. The first is a viewing platform. The platform would be placed at the mouth of and into the cleared area of the bog. It would allow people to walk out onto and view the bog without damaging it with footprints. It would be six feet by twelve feet and constructed of pressure treated wood to prevent rotting. It also includes a railing along the outside edge. The total price of the platform project comes out to $3,550, according to Kevin English of English Construction located in Hamilton, NY.

Another improvement that can be made involves the construction of a boardwalk leading up to, and in a semi-circle around the bog. It was measured that the boardwalk would have to be approximately 235 meters. The boardwalk would consist of two, two inch by eight inch by eight-foot boards laid next to each other with a small space in between. This would allow public access to the bog while limiting degradation through footprints. This model has been successfully implemented at the Philbrick-Cricenti Bog in New London, New Hampshire. The prices for this project would be approximately $880, which includes 200 wood boards. This price does not include labor. It was decided to leave this out, as most of the work done at the bog now is through volunteers, and it is believed a similar arrangement could be made.

To increase the size of the bog and to potentially slow succession, we have provided an option for the removal of trees. This removal focuses on the removal of *Pinus strobus*, white pine, from the bog. As a part of actively managing for the bog, removing the *Pinus strobes* would hopefully result in slowing the encroachment of the woody area on the bog. We expect that as the trees are removed there would be less water removed from the bog, this would result in difficulty for new species to take hold because of the increased amount of water. This has also led the group to the assumption that woody area encroachment is accelerating as more trees grow draining the bog of water and making conditions more suitable for a wider array of vegetation.

After talking to English Constriction, we were given a price quote of $750. This would include the removal of thirty to fifty trees with a DBH (diameter at breast height) of no more than ten inches. The estimate of $750 would only include these trees being removed and neatly dropped. It is important to note that this does not including removal of the trees from the area. Getting a price quote for this would require English Construction to further examine the landscape. Actual price could reach up to three times this price (Appendix B.6).

To preserve the bog in its current state, it is recommended that any new white pine seedlings be cut annually in the fall. Research shows this is the best way to limit further expansion of the white pine into the bog. “The Heathland Restoration Project”, which took place over a six year period, investigated the succession of a heathland; the study included the implementation of several management methods and documented the effects of each on the heathland ecosystem. While this heathland is not entirely representative of the bog, this case study did include a detailed account of an invading tree species, and measures that were taken to prevent further encroachment on the ecosystem. According to the study, trees that are cut in spring tend to produce fewer seedlings than those cut in autumn. Thus, with the goal of limiting the regrowth and further intrusion of white pines on the bog ecosystem, the most effective season to annually cut white pines is in spring (“The heathland restoration,” 2004).

Another option for the future of the bog is to let natural succession occur. In almost all previous case studies steps were not taken to prevent succession in bogs. Because of this, and the fact that succession is a natural process, removing the trees could have unforeseen consequences. Soil fertility and structure has already likely been modified during succession, and return of woody plants may be likely. It is also possible that removing native woody plants could promote invasion by exotic woody plants (“The heathland restoration,” 2004).

The boardwalk and viewing platform options are viable with or without management of succession, as the bog can still be used as a recreational and educational resource for many years.

Conclusion

Based on our results we have come to the conclusion that the bog within Fiddler's Green is ombrotrophic, meaning that it is replenished by precipitation rather than runoff or water tributaries. If the area were to begin to see a significant decrease in precipitation the bog could respond by shrinking in size. Vice versa, if annual precipitation were to increase dramatically, there may be a chance that the size of the bog may actually increase. Dramatic increases in precipitation would cause the mesophytic plant species such as the *Pinus strobus,* white pine, to be drowned out. This could create conditions for the hydrophytic plants that are endemic to bogs to become reestablished.

To use the bog for its recreational and educational value, we have provided a management plan that includes optional projects for a boardwalk and viewing platform. These would protect the bog from degradation while allowing access to people. Additionally, we have developed two options for dealing with the succession of the bog (See Appendix A). The first involves the strategic removal of *Pinus strobus,* and could potentially slow the succession and keep the bog in its current state for a long period of time. On the other hand, allowing succession to occur is the common choice when faced with this issue. If this course of action is taken, the bog can still be used recreationally and educationally.

Appendix A

Land Management Plan Outline
Property Name: Fiddler's Green
Name of Writers and Date: Stephen Coscia, Hilary Edmunds, Stephanie Wong, Zack Szabo

I. Introduction

A. Location and Directions
   a. Fiddler's Green is located in the Town of Eaton in Madison County. The coordinates of the bog are approximately 42.869°N and 75.577°W.
   b. Fiddler's Green can be accessed by taking NY 46 to Wendover Road, then turning onto Peck's Road and parking. The bog can be accessed by foot, through the wooded area across the road.
B. Conservation/Ecological Importance
   a. There are a number of interesting species that inhabit Fiddler's Green. These include: slender arrowgrass, grass pink, snake mouth orchis, pink shinleaf, bog twayblade, hooded ladies' tresses, ladies' tresses, southern twayblade, white fringed orchis, pod grass, greater whorled pogonia, and the four-toed, Jefferson's and spotted salamanders.
   b. Bogs provide a number of environmental and other services to the community. These include: climate and atmospheric gas regulation, waste treatment, water supply and regulation, habitat for specific species, disturbance regulations, raw materials, and cultural value.
C. General Description – Fiddler's Green is a 78-acre property in Madison County, New York in the town of Eaton, bog & woodland, soil, hydrology.
D. Surrounding area
   a. Several surrounding properties contain forested area. Parcel 1-18 contains 6.67 acres of vacant, intact woodland. Parcel 1-12 contains 20.69 total acres, 10 of which are tillable and currently used for agricultural purposes. The property also contains 10.69 acres of woodland. Parcel 1-13 contains 1.89 acres of vacant swamp, and parcel 1-3.21 contains 24.85 acres of woodland. (See Appendix B.2)
E. Public use "classification" – Fiddler's Green is technically open for public use although it is not advertised, and heavy use may be detrimental to the bog and the species in it.
F. Brief History
   a. The Nature Conservancy acquired the area now known as Fiddler's Green in several pieces over a period of about 30 years. The manner of acquisition explains the irregular configuration of the property as a whole. The first land was acquired in 1968 through a donation from Frank and Dorothy Selinsky. A number of parcels were acquired in 1984, 1983, and 1988 after property taxes were no longer being paid. County treasurer, Harold C. Landers, took over ownership of the land, buying it on behalf of the county. Snitchler family donated the most recent addition to Fiddler's Green in 1997.
   b. There are no specified wishes from the donors about land use.
G. Site Steward: Southern Madison Heritage Trust

II. Ecology/Natural Features

A. Geology (topography, soil, hydrology, etc).
    a. Approximately 600 million years ago the eastern part of North America sank below sea level, where various sediments, clay, silt, sand and lime muds were swept in layers for about 300 million years and became consolidated into solid rock. The stratum is due to what the Silurian and Devonian Periods of the Paleozoic and what was deposited between 435 and 345 million years ago. A retreating glacier left 2 similar ponds, both formed as glacial kettle holes.
B. Community type(s)
    a. Bog
    b. Woodland
    c. Pond
C. Notable species for conservation or of indicator value
    a. *Triglochinpalustre*, slender arrowgrass
    b. *Calopogonpulchellus*, grass pink
    c. *Pogoniaophigglossoides*, snake mouth orchis
    d. *Pyrolaasarifolia*, pink shinleaf
    e. *LiparisloeseliiI*, bog twayblade
    f. *Spiranthesromanzoffiana*, hooder ladies' tresses
    g. *Spirantheslucida*, ladies' tresses
    h. *Listraaustralis*, southern twayblade
    i. *Habenariablephariglottis*, white fringed orchis
    j. *Scheuchzeriapalustris*, pod grass
    k. *IsotriaverticullatusI*, greater whorled pogonia
    l. Four-toed salamanders
    m. Jefferson's salamanders
    n. Spotted salamanders
D. Connections
    a. Adjacent properties
        i. Residential Areas
        ii. Agricultural Land
    b. Other nearby and comparable or similar preserves
        i. Philbrick-Cricenti Bog (New London, NH)
            1. Implemented a mile-long boarded trail over and around the bog.
        ii. Zurich Bog part of Bergen Swamp Preservation Society
            1. A National Natural Landmark, located in Arcadia, NY. 490 acres of peat land that lies between two drumlins it is 2 ½ miles long and ½ wide. Home to several types of orchids as well as round-leave sundew, highbush blueberry, black huckleberry, small cranberry, and other fauna. Towards the upland the vegetation shifts from mat trees and shrubs.
        iii. Black Pond Bog Nature Preserve
            1. 103 acre piece of land located in Norwell, Massachusetts. Owned by The Nature Conservancy. Primarily conserved for the 4 acre

"quaking" bog located within the preserve. Preserved for ecological preservation, education and research and maintain integrity of current condition.

iv. Hawley Bog

1. A 4 acre bog in the town of Hawley, Massachusetts owned by The Nature Conservancy. Currently under the threat of invasive species namely *phragmitesaustralis*, The Nature Conservancy at the Kampoosa Bog in the Berkshires used rodeo herbicide to some success. Although at the Hawley Bog the herbicide treatments have occurred since 2001, and the *phragmitesaustralis* are still not eliminated.

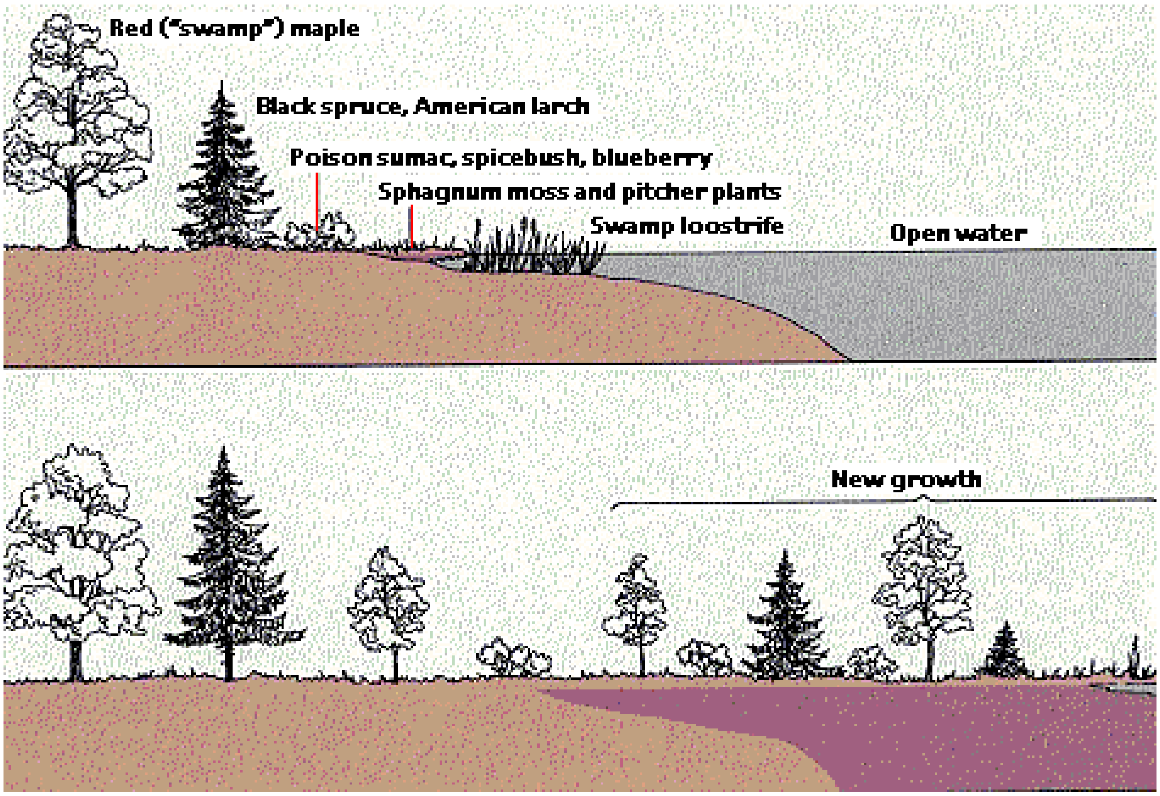
III. Management Issues

A. Objectives
   a. Limit human disturbance to the bog
   b. Promote recreational development: viewing platform, boardwalk
   c. Create a unique education spot
   d. Human impacts - waste, vehicular traffic, berry/fruit picking, foot traffic, disturbance from initial tree removal

B. Improvements and/or infrastructure
   a. Optional construction of boardwalk and viewing platform.
   b. Management Options
      i. Option A: Actively manage bog
         1. Invasive species control.
            - Removal of 30-50 white pines in the area surrounding the bog
            - Annual spring cutting of new seedlings.
      ii. Option B: No intervention
         1. Let succession naturally occur.

Appendix B

Figure 1. This depicts the different phases of succession in a bog.



Kimball, J. (2010, July 25). *Plant Succession*. Retrieved from http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/S/Succession.html

Figure 2: Overlay of the tax parcels on the Chenango watershed. The bog is the dark area in the upper right side of the tax parcel, while the black dot farther up and to the right depicts the dam at Leland Pond.

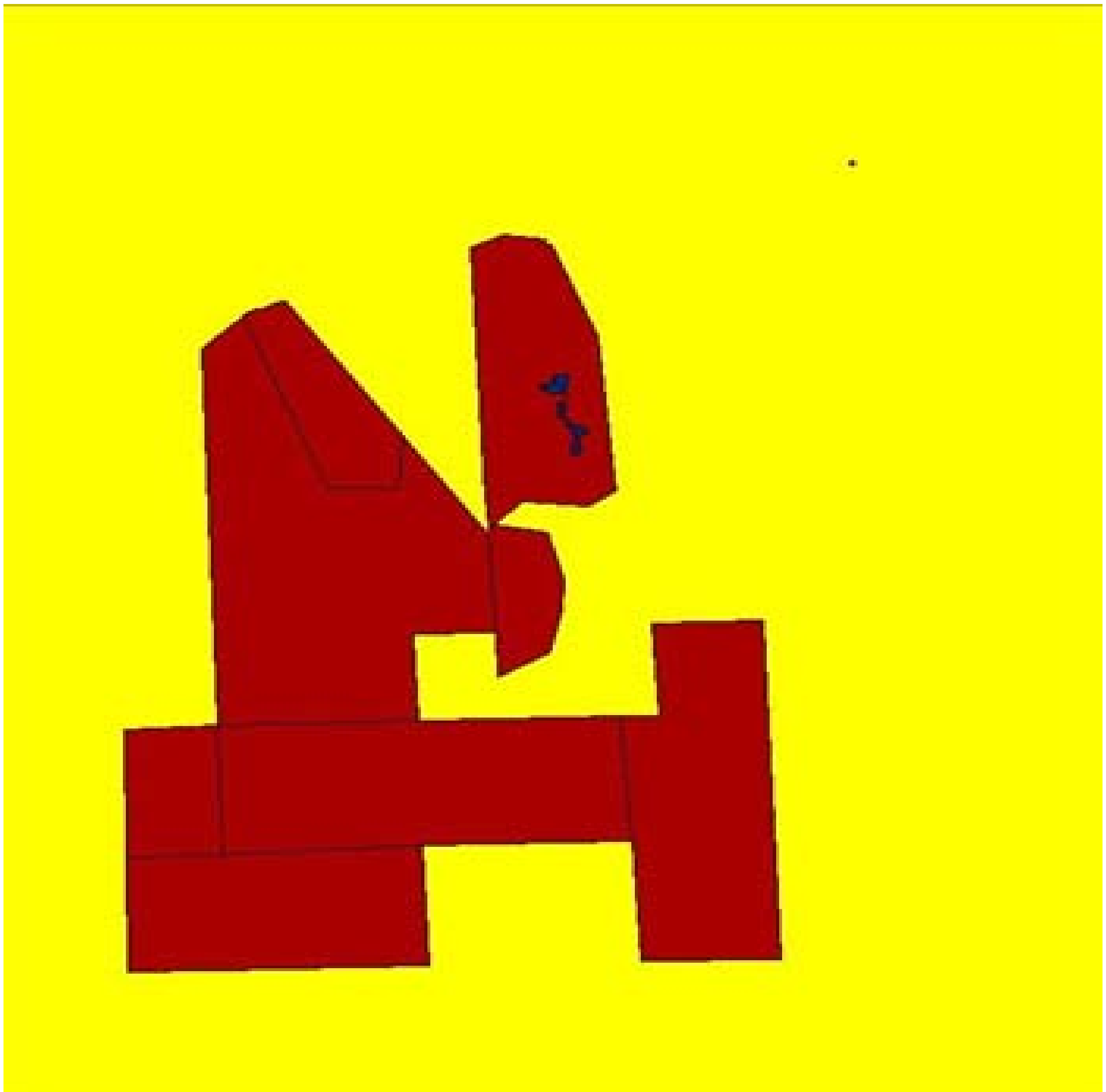


Figure 3: Digital Elevation Model (DEM): Overlays the major rivers and streams and tax parcel (seen as a black dot on the right side highlighted by the yellow circle)

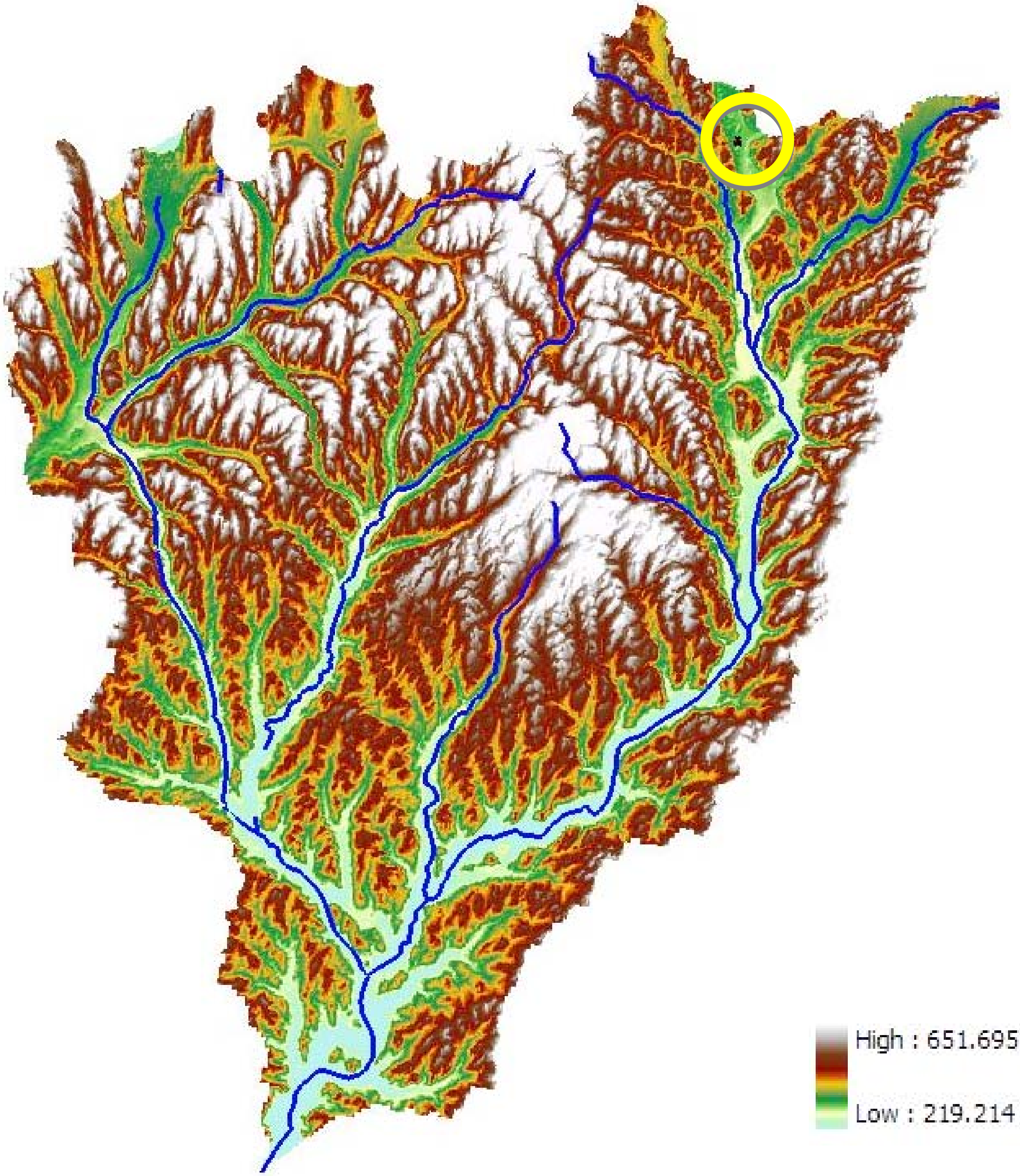


Figure 4: Another view of the DEM: here the relief of the map is easier to see, tax parcel is again highlighted in yellow

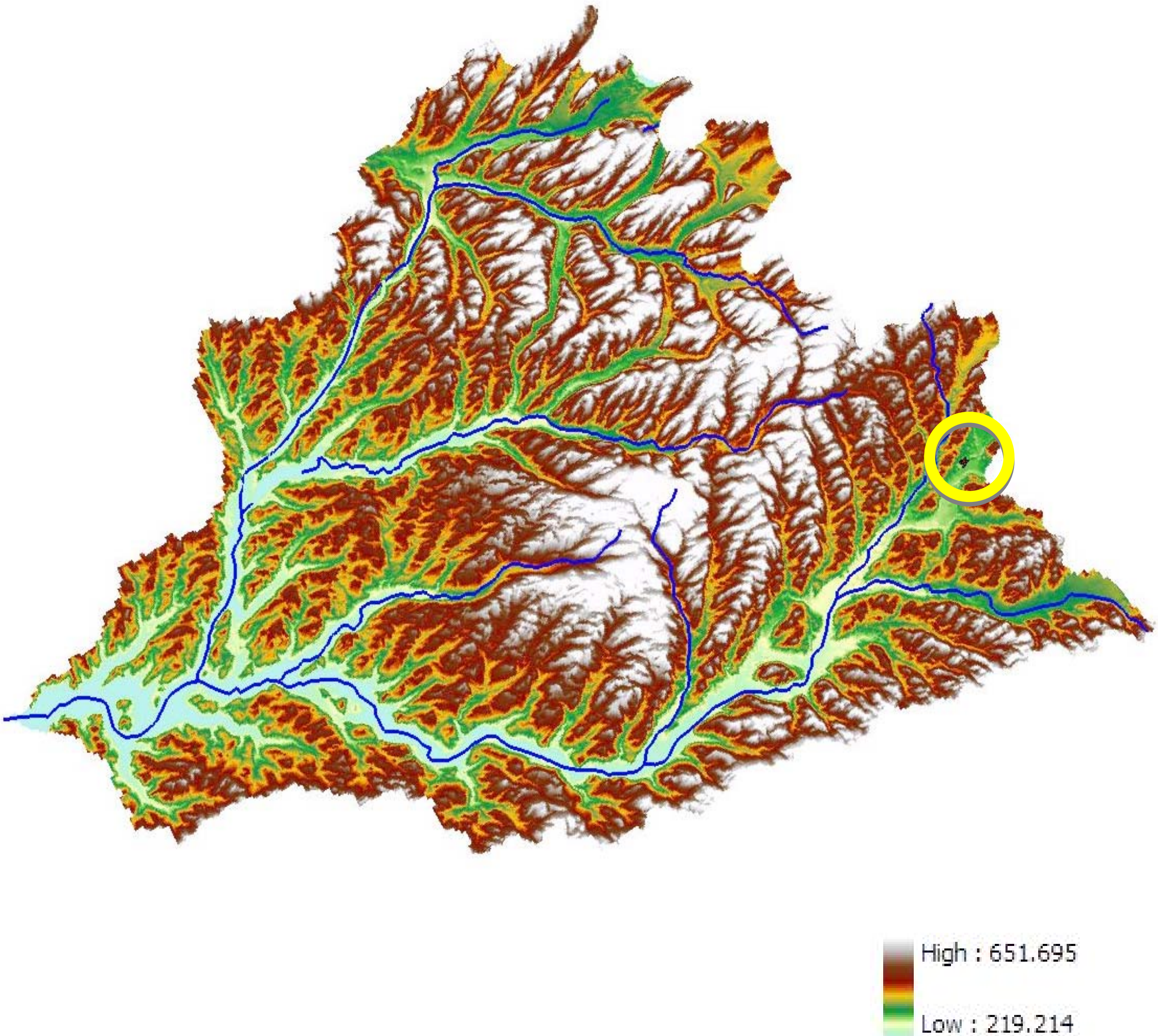


Figure 5: Zoomed in perspective of the DEM: again tax parcel highlighted in yellow

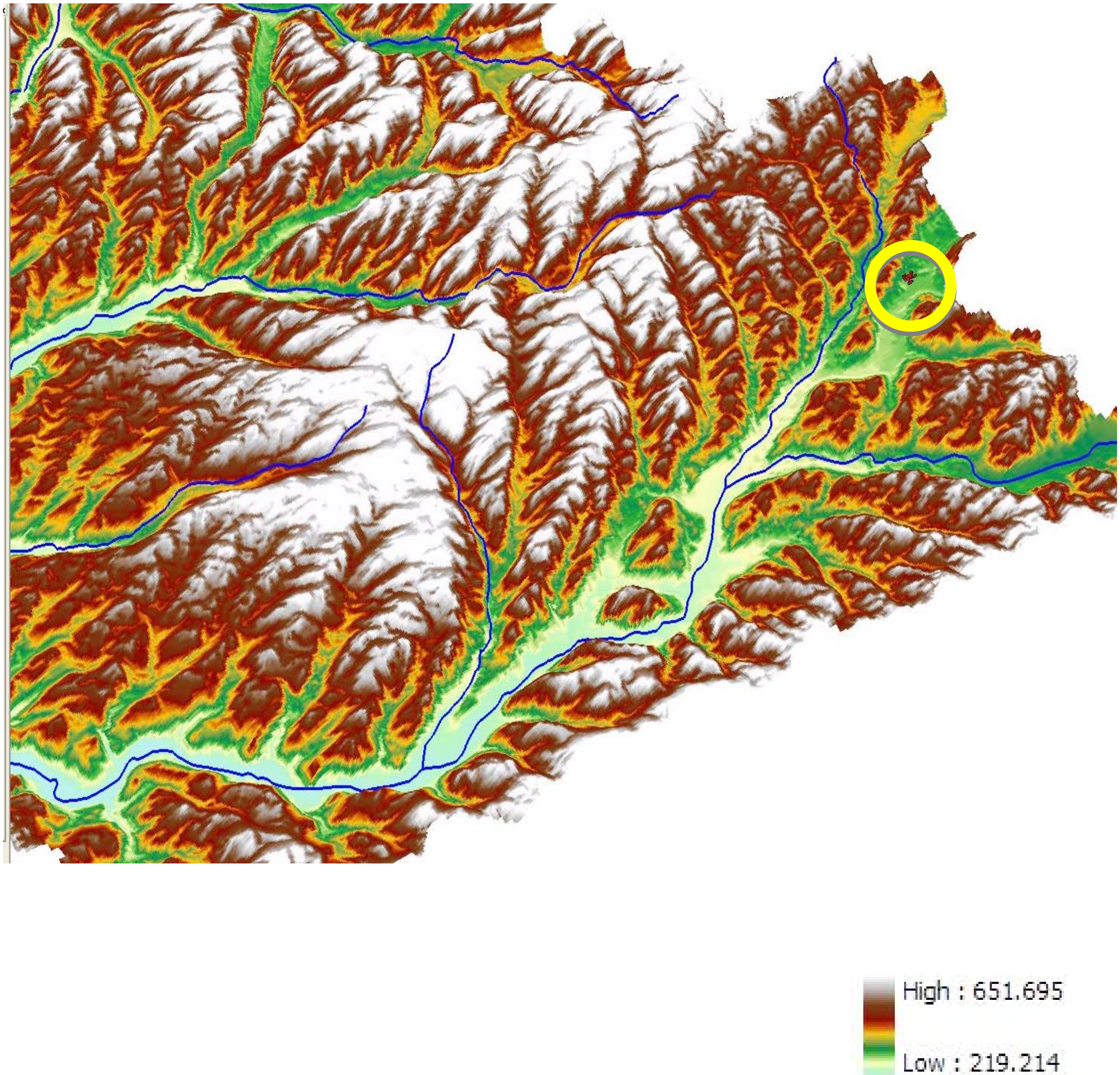


Figure 6: Price Estimates of construction of boardwalk, viewing platform and tree removal

Price Estimates

Description	AMOUNT
Viewing Platform[1]	
Labor	2,460.00
6‘x12' pressure treated platform	1,090.00
Viewing Platform Total	3,550.00
Tree Removal[1]	
Removal of 30-50 trees (DBH no more than 10) in area immediately surrounding the bog, neatly dropped	750
Boardwalk[2]	
200 2"x8"x8' boards leading up to and in a semi-circle around the bog	880
TOTAL	$5,180.00

1. English Construction (Hamilton, NY)
2. Home Depot

Bibliography

Bog. (2007, Feburary 23). Retrieved from http://www.eoearth.org/article/Bog

Freléchoux, F, Butller, A, &Gillet, F. (2000). Dynamics of bog-pine-dominated mires in the jura mountains, switzerland: a tentative scheme based on synusialphytosociology. *Folia Geobotanica*, *35*(3), Retrieved from http://www.jstor.org/stable/25133789

Hughes, P, &Dumayne-Peaty, L. (2002). Testing theories of mire development using multiple successions at crymlyn bog, west glamorgan, south wales, uk. *Journal of Ecology*, *90*(3), Retrieved from http://www.jstor.org/stable/3072230

Johnson , CW. (1985). *Bogs of the Northeast*. Hanover, NH: University Press of New England.

Klinger, L. (1996). The myth of the classic hydrosere model of bog succession.*Arctic and Alpine Research*, *28*(1), Retrieved from http://www.jstor.org/stable/1552080

Large, A. (2001). Reversing spontaneous succession to protect high-value vegetation: assessment of two scottish mires using rapid survey techniques. *Applied Vegetation Science*, *4*(1), Retrieved from http://www.jstor.org/stable/1479042

McMullen, J, Barber, K, & Johnson, B. (2004). A paleoecological perspective of vegetation succession on raised bog microforms. *Ecological Monographs*, *74*(1), Retrieved from http://www.jstor.org/stable/4539045

Kimball, J. (2010, July 25). *Plant Succession*. Retrieved from http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/S/Succession.html

Smith, A, & Morgan, L. (1989). A succession to ombrotrophic bog in the gwent levels, and its demise: a welsh parallel to the peats of the somerset levels. *New Phytologist*, *112*(1), Retrieved from http://www.jstor.org/stable/2556766

Strategic land protection plan for the southern madison heritage trust. (2005). Unpublished manuscript, Cornell Universoty, Ithica, New York.

The heathland restoration project. (2004). Retrieved fromhttp://www.countrysideinfo.co.uk/hpr_survey_01/conclsns.htm

Weather underground. (2010). Retrieved from http://www.wunderground.com/history/airport/KSYR/2009/1/1/CustomHistory.html?dayend=1&monthend=1&yearend=2010&req_city=NA&req_state=NA&req_statename=NA&MR=1