

GIS Helps Shenandoah Conduct Viewshed Analysis

By Alison Teetor and David Haskell

A primary resource related value of Shenandoah NP is its spectacular views from overlooks along the Skyline Drive from Wilderness mountain peaks. Many of these views are dependent on the continuation of traditional land uses on properties located outside the park. Until recent years, much of the land adjacent to the park has been maintained in forest, agriculture, and pasture.

Development was slow to come to the Shenandoah Valley and the remote hollows of Rappanahock, Green, and Madison counties. With the 1980s came rapidly rising real estate prices in the suburbs of Washington, DC. Completion of Interstate 66 and the shift of populations farther West started a rapid change in land use from rural to an urban style of development. The sudden, unplanned growth of homes, shopping malls, and light industry threatens the integrity of the world famous Shenandoah views.

This alarming new trend prompted initiation of a park management effort, which has become known as the Related Lands Program. Local jurisdictions and private citizens can identify and protect portions of open space that will be mutually beneficial. One objective is to identify adjacent lands that represent or promote park values. Values include, but are not limited to, protecting scenic views, maintaining trail access, providing corridors for wildlife movement, protecting air quality, and assuring the viability of species biodiversity within the region.

One way to describe and evaluate the scenic quality of land outside the park boundary is to create an integral vista/visibility map. The map created for Shenandoah describes the number of times an area can be seen from overlooks along Skyline Drive and highly visited mountain peaks. This paper describes the procedures used in 1990 to create this map.

Methods

In 1978, a visual resource inventory was performed and a visibility map created for the 1980 General Management Plan (GMP) (Stutzman, 1978). In addition, an integral vista report was prepared by the Denver Service Center (DSC) that identified those views integral to visitor enjoyment of the park (Shaver, 1980). These two reports served as the basis for a 1990 update of the viewshed analysis for the park.

The 1980 visibility map was created by VIEW-IT, a computerized mapping program (Stutzman, 1978). Efforts were made to acquire the original data from the DSC, however they no longer were available. Since these data were not available in digital form, a new viewshed analysis was performed, using parameters similar to those used in creation of the first map.

Each of the 76 overlooks along Skyline Drive was visited and compass bearings were established for the maximum angles of the viewing area. The GIS software Geographic Resources Analysis Support System (GRASS) was used for computing which land areas are visible from each overlook based on elevation. The 1:250,000 scale Defence Mapping Agency (DMA) elevation data were used, providing a 50 meter cell resolution.

An outline or pattern of each viewing area was plotted on Potomac Appalachian Trail Conference (PATC) maps (1:62,500) and digitized, using d.digit. Each area was given the value of 1. Glos (a GRASS program) was performed on each overlook. This program calculates which areas can be seen from an overlook based on

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Table 1. Amount of land area visible within 20 kilometers (12 miles) from overlooks and mountain summits in Shenandoah National Park, Virginia, 1990.

Class	Name	Percent	# Hectares	# Acres
0	Areas Not Visible	75.75	2,431,105	983,855
1	Areas Visible from 1	8.48	272,005	100,079
2	Areas Visible from 2	5.21	167,146	67,643
3	Areas Visible from 3	3.82	122,603	49,617
4	Areas Visible from 4	2.36	75,847	30,695
5	Areas Visible from 5	1.80	57,732	23,364
6	Areas Visible from 6	1.30	41,570	16,823
7	Areas Visible from 7	0.89	28,493	11,531
8	Areas Visible from 8	0.36	11,703	4,736
9	Areas Visible from 9	0.03	877	355
10	Areas Visible from 10	0.01	297	120
11	Areas Visible from 11	0.00	47	19
12	Areas Visible from 12	0.00	5	2
	Totals	100.00	3,209,430	1,298,839

Figure 1. Viewshed Analysis of Shenandoah National Park - OV



Table 2. *Percent of land visible from overlooks and mountain summits at various distances from the Park boundary. Shenandoah National Park, Virginia. 1990.*

Class	Name	Percent			
		1.6 km	3.2 km	4.8 km	6.4 km
0	Areas Not Visible	50.10	38.29	31.76	30.15
1	Areas Visible from 1	24.48	21.85	19.96	14.81
2	Areas Visible from 2	11.39	13.10	13.61	14.96
3	Areas Visible from 3	6.01	10.86	11.96	12.35
4	Areas Visible from 4	3.32	5.67	6.79	9.06
5	Areas Visible from 5	1.88	5.06	7.28	6.60
6	Areas Visible from 6	1.55	2.22	5.06	5.27
7	Areas Visible from 7	0.66	1.23	2.73	4.61
8	Areas Visible from 8	0.62	1.69	0.77	2.07
9	Areas Visible from 9	0.00	0.01	0.05	0.04
10	Areas Visible from 10	0.00	0.01	0.04	0.06
11	Areas Visible from 11	0.00	0.00	0.00	0.03
12	Areas Visible from 12	0.00	0.00	0.00	0.00
	Totals	100.00	100.00	100.00	100.00

elevation. Each pattern developed in step one and the UTM coordinates of the center of the overlook were utilized in the equation. A maximum distance of 20 kilometers (12 miles) was used as the furthest point visible. Observer height was defined as 1.5 meters (5 feet).

The information is displayed in cell format. Each cell has a numeric value that describes the angle of view at which the area is visible. The angle of view is defined as the angle from the observer's eye to an area on the ground. For example, the horizon would be at an angle of about 90, a point at the bottom of a steep slope might be 120 degrees. This concept is further described in Stutzman's report. The angle of view can be used to define the relative importance of the view. For this analysis, the angle of view was ignored and all angles were treated as equally important.

Next, each view was reclassified into two classes: a classification of "1" indicating areas visible, and a "0" indicating areas not visible. Appendix A of Stutzman describes the view angles, center point, and GRASS files used to delineate each view. Seventy-six overlooks and four mountain summits or trail destinations were described in this manner.

Thirteen overlooks and four trail destination vistas were defined as integral or encompassing the overall viewing experience of the park. In 1980, photographs showing the panorama of these views were taken to document the scene at that time. These were included in the integral vista report. In an effort to describe changes over time, photos were taken again in 1990, using the parameters outlined in the original report. In addition, these integral views were used in the compilation of the visibility map (Fig. 1).

In order to create a visibility map detailing areas of land seen from multiple views, individual views were combined, using Gmapcalc. Each of the resulting integral vistas was then added, and together they created a composite map showing areas visible from multiple overlooks.

Results and Discussion

Land areas were visible from 1 to 12 overlooks (Table 1). The amount of land within 1.6 (1 mile), 3.2 (2 miles), 4.8 (3 miles), 6.4 (4 miles), and 20 kilometers (12 miles) of the park visible in each class is outlined in Table 2. Ninety-seven percent of the areas were visible from 0 to 7 overlooks. Most of the areas seen from great than 7 overlooks occur further than 6.4 kilometers (4 miles) from the park boundary. Distance from the park can be an important consideration when evaluating the rela-

tive importance of land outside the park.

Another factor to be considered is whether or not an individual view is more "valuable" (scenic, unique) than another. The integral vista assessment was used as a guide to the relative importance of specific views.

Conclusion

The viewshed analysis and production of a visibility map were created to help park managers identify which land areas outside the park are significant in terms of scenic values. The map is intended to be used as a screening tool. Areas of particular interest will be visited to verify the map projections. Information concerning which views overlook a particular parcel can be determined from the pattern files. Photographs of each integral vista will be maintained every 10 years to document changes in scenery and the areas visible over time.

The viewshed map already is being used extensively in the park's Related Lands Program. For example, it was used to determine which of several alternative new land fill sites in an adjoining county would be the least visible from key park viewpoints. The park recommendation was used by the county planner to make the final determination for the site.

Haskell is Chief, Division of Natural Resources and Science at Shenandoah NP; Teetor is a GIS Specialist, formerly with the park.

Literature Cited

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- Stutzman, Susan. 1978. *Using Field Surveys and Computer Techniques: A Visual Resource Inventory for Shenandoah NP*. Denver Service Center. Unpubl. NPS Report. 16 pp.