National Park Service
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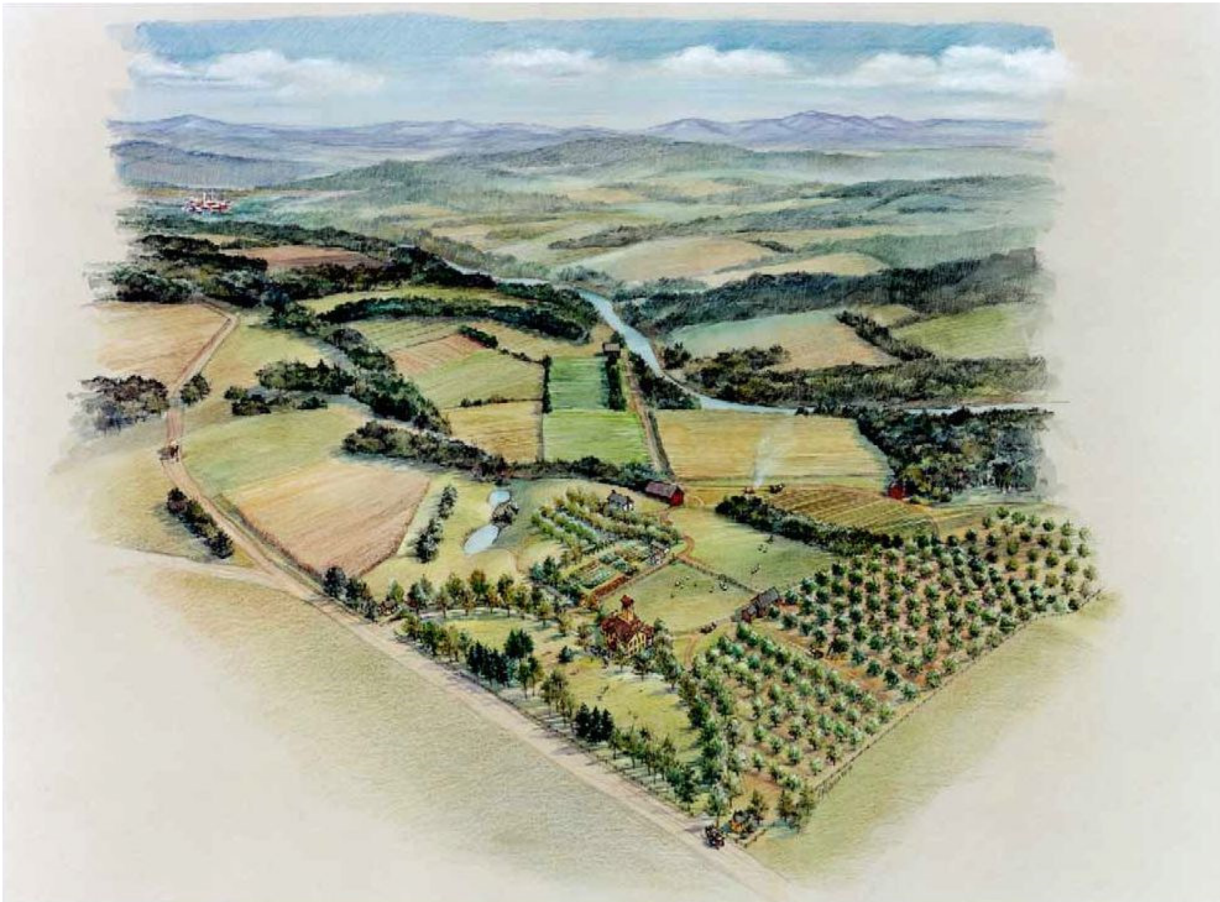
Natural Resource Stewardship and Science

Natural Resource Condition Assessment

Martin Van Buren National Historic Site

Natural Resource Report NPS/MAVA/NRR—2019/2015



ON THIS PAGE
Van Buren era Lindenwald landscape. Original by S.N. Patricia (1996), updated in 2016 by Eric D. Whiting
Martin Van Buren NHS Collection

ON THE COVER
The Lindenwald mansion at Martin Van Buren NHS.
Courtesy of NPS

Natural Resource Condition Assessment

Martin Van Buren National Historic Site

Natural Resource Report NPS/MAVA/NRR—2019/2015

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October 2019

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Tierney, G, and J. Gibbs. 2019. Natural resource condition assessment: Martin Van Buren National Historic Site. Natural Resource Report NPS/MAVA/NRR—2019/2015. National Park Service, Fort Collins, Colorado.

NPS 460/165146, October 2019

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Executive Summary

This Natural Resource Condition Assessment evaluates current conditions and trends for a subset of natural resource indicators and identifies critical data gaps for Martin Van Buren National Historic Site. The indicators of condition included herein reflect the park's resource setting, the status of resource stewardship planning and science, and the availability of data and expertise to assess current conditions for a variety of potential indicators. The goal of this report is to provide clear, credible, integrative reporting to assist and inform park managers, stake-holders and the public.

This National Historic Site interprets the life and career of the eighth President of the United States, as well as the issues facing the nation in the turbulent decades leading up to the Civil War. The park also seeks to interpret historical and modern progressive farming, as practiced by Van Buren in the mid-nineteenth century, and by modern farmers working this land today. Located in Kinderhook, New York, the park preserves the Lindenwald mansion and outbuildings, an archival and museum collection, the cultural landscape, archeological sites, and impressive views to the west, across the agrarian landscape towards the distant Catskill Mountains. Natural resources lying within the authorized park boundary include prime agricultural soils, a segment of Kinderhook Creek, a vegetated escarpment, wetlands, six man-made ponds, and habitat for many species of conservation interest.

Using the National Park Service Vital Signs Indicator Framework, 19 indicators of natural resource condition were selected for assessment and reporting herein. Assessment points were established to distinguish between acceptable or desired conditions (i.e., *good condition*) and those that warrant *moderate concern* or *significant concern*. These assessment points were derived from knowledge of ecological integrity, regulatory or program standards, park management goals, historical data or other sources.

Key findings and recommendations are summarized by resource category in Table E-1.

Table E-1. Summary of key findings and recommendations for natural resource condition at Martin Van Buren National Historic Site.

Resource Category	Key Findings	Recommendations
Air and Climate	Estimated **ozone** pollution warranted *moderate concern* for human health, and showed *good condition* for park vegetation. Ten-year trends at nearby national park units ranged from unchanging to significantly improving	Continue to monitor and work collaboratively with federal, state and local partners to reduce air pollution.
	Estimated wet deposition of nitrogen warranted *signficant concern* for **acidic deposition**, while estimated wet deposition of sulfur warranted *moderate concern*. Regional trends were improving.	Continue to monitor and work collaboratively with federal, state and local partners to reduce air pollution.
	Estimated impairment of park views due to anthropogenic haze warranted *moderate concern* for **visibility and particulate matter**. Regional trends were improving.	Continue to monitor and work collaboratively with federal, state and local partners to reduce air pollution.
	Mercury wet deposition was estimated to be moderate but park-specific data to determine condition of **mercury contamination** were lacking.	Consider on-site monitoring of mercury contamination in park dragonfly larvae or turtle toenail clippings, and work collaboratively with federal, state and local partners to reduce air pollution.
	Current condition of temperature and precipitation variables showed extreme warm and wet conditions compared to the historical record, and warranted *significant concern* for **climate**.	Expand efforts to identify and monitor status and trends of key indicators of climate change, and to identify and monitor valued park resources at high risk to climate change impacts.
	Modeled data suggest anthropogenic sound such as automobile traffic and aircraft overflights may reduce park listening area >=50%, warranting *significant concern* for **soundscape**. Data were not available to assess trend.	Consider on-site monitoring.
Geology and Soils	**Agricultural soil** showed *good condition* for many soil parameters but warranted *moderate concern* for lower than desired levels of soil organic matter, and warranted *significant concern* for very high phosphorus levels. Levels of soil organic matter showed improvement.	Continue to monitor, and continue to use best agricultural practices for maintaining soil fertility while minimizing use of chemical fertilizers.

Table E-1 (continued). Summary of key findings and recommendations for natural resource condition at Martin Van Buren National Historic Site.

Resource Category	Key Findings	Recommendations
Water Quantity and Quality	No data on **water quantity** in park ponds were available. Downstream discharge data for Kinderhook Creek showed current mid- and low-flow discharge to be elevated compared to the long-term record. These flows are regulated by upstream power plants.	Consider monitoring select ponds and Kinderhook Creek using available NPS protocols. Consider establishing assessment points based on a natural flow regime using a reference stream.
	Water quality in park ponds and Kinderhook Creek is a data gap. Recent sampling in Upper Pond and previous sampling in four park ponds showed highly eutrophic conditions. Sediment sampling in Upper Pond warranted moderate concern for DDT contamination. A highly invasive species, water chestnut, has been detected in Gravel Pond. Groundwater samples from two park wells met drinking water standards.	Assess extent and impacts of pond sediment contamination from prior agricultural chemical use. Monitor water quality, including nutrients, in one or two park ponds and Kinderhook Creek. Regularly survey for priority invasive exotic species and respond rapidly to eradicate new infestations.
	Current data were not available to assess **macroinvertebrate** condition. Previous data from 2006 showed slightly impacted condition, warranting moderate concern.	Consider monitoring using available protocols.
Biological Integrity	Preliminary assessment of **wetland and riparian** areas indicated moderate concern for buffer width and extent. No change was observed over ten years.	Monitor park wetlands and riparian areas using rapid assessment methods. Regularly survey for priority invasive exotic species and respond rapidly to eradicate new infestations. This survey should include inspection of ash trees for signs of infection by the emerald ash borer.
	Qualitative assessment of **deer-browse** indicator species in nearby parks suggested significant concern. Ten year trend in regional harvest data was unchanging.	Consider monitoring deer-browse impacts to park vegetation and crops.
	Population status and trends for **bird** species are a data gap.	Annual bird monitoring would provide useful information.
	Amphibian and reptile species are a data gap. The Southern Swamp provides important habitat for amphibian species.	Survey for vernal pools in Southern Swamp, and for turtle nesting sites on the lower terrace. Implement annual monitoring including anuran calling surveys, egg mass surveys, and periodic trapping of aquatic turtles.
	Population status and trends for **mammal** species are a data gap.	A comprehensive survey of mammal species would provide useful information, as would annual monitoring of bat species using acoustic sampling.

Table E-1 (continued). Summary of key findings and recommendations for natural resource condition at Martin Van Buren National Historic Site.

Resource Category	Key Findings	Recommendations
Biological Integrity (cont.)	Population status and trends for **insect** species are a data gap.	Consider monitoring insect biomass, bee abundance, and other key or focal taxa, such as butterflies, dragonflies and damselflies.
	The park provides habitat for many **species of conservation interest**. Population status and trends for these species are a data gap.	Survey for additional species of conservation interest in key habitats. Consider monitoring select species to determine status and trends.
Landscapes	A low probability of future development surrounding the park and minimal coverage by impervious surfaces both indicated *good condition* for **landcover and land use**.	Work with local partners to advocate for appropriate land uses in the area.
	Viewshed is a data gap.	Photo-monitoring of key park views would provide a visual record and baseline to assess proposed development within the park viewshed.

Acknowledgments

For useful input during the scoping phase of this assessment and during review of draft reports, we thank M. O'Malley, D. Hayes, S. Norris, S. Hanaburgh, C. Arnott, S. Lerman, S. Colwell, A. Babson, A. Weed, H. Salazer and P. Sharpe. We thank J. Hurst, C. Herzog, G. Stevens, A. Cheeseman, and S. Quinn for sharing information useful to this assessment. We also thank E. Brown of the NPS Natural Sounds & Night Skies Division for providing guidance and data for assessing soundscape, and C. Flanagan and K. Taylor of the NPS Air Resources Division for providing guidance and data for assessing mercury contamination.

This report was prepared under Task Agreement P17AC01578 between the National Park Service, Northeast Region and the Research Foundation of SUNY on behalf of the SUNY College of Environmental Science and Forestry, through the Cooperative Ecosystem Studies Unit (CESU).

List of Terms and Acronyms

Al	Aluminum
ALR	Anthropogenic light ratio, a measure of how much total nighttime sky brightness is elevated over natural levels
AmphIBI	Amphibian Index of Biotic Integrity, of the Ohio EPA
ANC	Acid neutralizing capacity, a measure of buffering capacity
ARD	Air Resources Division, of NPS
C of C	Coefficient of conservatism, a measure of species sensitivity to disturbance
Ca	Calcium
CBSD	Common Bird in Steep Decline
ClimAID	Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State
CSF	Climate Smart Farming Program, of Cornell University
Cu	Copper
dBa	Decibels adjusted (weighted) to reflect human hearing sensitivity to frequencies from 1,000 to 6,000 Hertz
DDD/DDE/DDT	A persistent, bioaccumulating organochlorine pesticide (DDT) banned in the U.S. and its primary breakdown products (DDD and DDE)
DBI	Deer browse index
DFW	Division of Fish and Wildlife, of NYS DEC
DO	Dissolved oxygen, an indicator of water quality
dv	Deciviews, a linear scale of human-perceived changes in air quality
EAB	Emerald ash borer (*Agrilus planipennis)*
Fe	Iron
FEP	Farmscape Ecology Program, of Hawthorne Valley Farm
GMP	General Management Plan
Hg	Mercury
HIS	Hydrographic and Impairment Statistics, an NPS database
I&M	Inventory & Monitoring, an NPS program
IBI	Index of Biotic Integrity
IMPROVE	Interagency Monitoring of Protected Visual Environments, a monitoring network
IRMA	Integrated Resource Management Application, an NPS database
ISED	Invasive Species Early Detection Program, of NPS NETN

K	Potassium
L_{50}	Noise level exceeded 50% of the time
MeHg	Methyl mercury
Mg	Magnesium
N	Nitrogen
NADP	National Atmospheric Deposition Program
NAIP	National Agriculture Imagery Program
NALCC	North Atlantic Landscape Conservation Cooperative
NETN	Northeast Temperate Network, of NPS
NHS	National Historic Site
NYS DEC	New York State Department of Environmental Conservation
nL	nanolamberts, a unit of luminance
NLCD	National Land Cover Database
NPS	National Park Service
NRCA	Natural Research Condition Assessment
NSNSD	Natural Sounds & Night Skies Division, of NPS
NWI	National Wetlands Inventory
P	Phosphorus
PIF-WL	Partners in Flight Watch List
ppb	parts per billion
ppm	parts per million
ROVA	Roosevelt-Vanderbilt National Historic Sites
S	Sulfur
SARA	Saratoga National Historical Park
SC	Special Concern, a designation for species that could become threatened in the foreseeable future
SGCN	Species of Greatest Conservation Need
SPCN	Species of Potential Conservation Need
SPL	Sound pressure level, a measure of sound in decibels
TC	Total carbon
TN	Total nitrogen
USA-RAM	US EPA Rapid Assessment Method, for monitoring wetland condition
US EPA	US Environmental Protection Agency
US FWS	US Fish and Wildlife Service

VRP	Visual Resources Program of NPS
WMU	Wildlife Management Unit
WNS	White-nose syndrome, a disease syndrome affecting hibernating bats
Zn	Zinc

1. NRCA Background Information

Natural Resource Condition Assessments (NRCAs) evaluate current conditions for a subset of natural resources and resource indicators in national park units, hereafter "parks." NRCAs also report on trends in resource condition (when possible), identify critical data gaps, and characterize a general level of confidence for study findings. The resources and indicators emphasized in a given project depend on the park's resource setting, status of resource stewardship planning and science in identifying high-priority indicators, and availability of data and expertise to assess current conditions for a variety of potential study resources and indicators.

> ***NRCAs Strive to Provide…***
>
> - *Credible condition reporting for a subset of important park natural resources and indicators*
> - *Useful condition summaries by broader resource categories or topics, and by park areas*

NRCAs represent a relatively new approach to assessing and reporting on park resource conditions. They are meant to complement—not replace—traditional issue-and threat-based resource assessments. As distinguishing characteristics, all NRCAs:

- Are multi-disciplinary in scope;[1]
- Employ hierarchical indicator frameworks;[2]
- Identify or develop reference conditions/values for comparison against current conditions;[3]
- Emphasize spatial evaluation of conditions and GIS (map) products; [4]
- Summarize key findings by park areas; and [5]
- Follow national NRCA guidelines and standards for study design and reporting products.

Although the primary objective of NRCAs is to report on current conditions relative to logical forms of reference conditions and values, NRCAs also report on trends, when appropriate (i.e., when the underlying data and methods support such reporting), as well as influences on resource conditions. These influences may include past activities or conditions that provide a helpful context for

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[1] The breadth of natural resources and number/type of indicators evaluated will vary by park.

[2] Frameworks help guide a multi-disciplinary selection of indicators and subsequent "roll up" and reporting of data for measures ⇨ conditions for indicators ⇨ condition summaries by broader topics and park areas

[3] NRCAs must consider ecologically-based reference conditions, must also consider applicable legal and regulatory standards, and can consider other management-specified condition objectives or targets; each study indicator can be evaluated against one or more types of logical reference conditions. Reference values can be expressed in qualitative to quantitative terms, as a single value or range of values; they represent desirable resource conditions or, alternatively, condition states that we wish to avoid or that require a follow-up response (e.g., ecological thresholds or management "triggers").

[4] As possible and appropriate, NRCAs describe condition gradients or differences across a park for important natural resources and study indicators through a set of GIS coverages and map products.

[5] In addition to reporting on indicator-level conditions, investigators are asked to take a bigger picture (more holistic) view and summarize overall findings and provide suggestions to managers on an area-by-area basis: 1) by park ecosystem/habitat types or watersheds, and 2) for other park areas as requested.

understanding current conditions, and/or present-day threats and stressors that are best interpreted at park, watershed, or landscape scales (though NRCAs do not report on condition status for land areas and natural resources beyond park boundaries). Intensive cause-and-effect analyses of threats and stressors, and development of detailed treatment options, are outside the scope of NRCAs.

Due to their modest funding, relatively quick timeframe for completion, and reliance on existing data and information, NRCAs are not intended to be exhaustive. Their methodology typically involves an informal synthesis of scientific data and information from multiple and diverse sources. Level of rigor and statistical repeatability will vary by resource or indicator, reflecting differences in existing data and knowledge bases across the varied study components.

The credibility of NRCA results is derived from the data, methods, and reference values used in the project work, which are designed to be appropriate for the stated purpose of the project, as well as adequately documented. For each study indicator for which current condition or trend is reported, we will identify critical data gaps and describe the level of confidence in at least qualitative terms. Involvement of park staff and National Park Service (NPS) subject-matter experts at critical points during the project timeline is also important. These staff will be asked to assist with the selection of study indicators; recommend data sets, methods, and reference conditions and values; and help provide a multi-disciplinary review of draft study findings and products.

NRCAs can yield new insights about current park resource conditions, but, in many cases, their greatest value may be the development of useful documentation regarding known or suspected resource conditions within parks. Reporting products can help park managers as they think about near-term workload priorities, frame data and study needs for important park resources, and communicate messages about current park resource conditions to various audiences. A successful NRCA delivers science-based information that is both credible and has practical uses for a variety of park decision making, planning, and partnership activities.

Important NRCA Success Factors

- *Obtaining good input from park staff and other NPS subject-matter experts at critical points in the project timeline*
- *Using study frameworks that accommodate meaningful condition reporting at multiple levels (measures ➪ indicators ➪ broader resource topics and park areas)*
- *Building credibility by clearly documenting the data and methods used, critical data gaps, and level of confidence for indicator-level condition findings*

However, it is important to note that NRCAs do not establish management targets for study indicators. That process must occur through park planning and management activities. What an NRCA can do is deliver science-based information that will assist park managers in their ongoing, long-term efforts to describe and quantify a park's desired resource conditions and management targets. In the near term, NRCA findings assist strategic park resource planning[6] and help parks to report on government accountability measures.[7] In addition, although in-depth analysis of the effects of climate change on park natural resources is outside the scope of NRCAs, the condition analyses and data sets developed for NRCAs will be useful for park-level climate-change studies and planning efforts.

NRCAs also provide a useful complement to rigorous NPS science support programs, such as the NPS Natural Resources Inventory & Monitoring (I&M) Program.[8] For example, NRCAs can provide current condition estimates and help establish reference conditions, or baseline values, for some of a park's vital signs monitoring indicators. They can also draw upon non-NPS data to help evaluate current conditions for those same vital signs. In some cases, I&M data sets are incorporated into NRCA analyses and reporting products.

NRCA Reporting Products…

Provide a credible, snapshot-in-time evaluation for a subset of important park natural resources and indicators, to help park managers:

- *Direct limited staff and funding resources to park areas and natural resources that represent high need and/or high opportunity situations* ***(near-term operational planning and management)***
- *Improve understanding and quantification for desired conditions for the park's "fundamental" and "other important" natural resources and values* ***(longer-term strategic planning)***
- *Communicate succinct messages regarding current resource conditions to government program managers, to Congress, and to the general public* ***("resource condition status" reporting)***

Over the next several years, the NPS plans to fund an NRCA project for each of the approximately 270 parks served by the NPS I&M Program. For more information visit the NRCA Program website.

[6]An NRCA can be useful during the development of a park's Resource Stewardship Strategy (RSS) and can also be tailored to act as a post-RSS project.

[7] While accountability reporting measures are subject to change, the spatial and reference-based condition data provided by NRCAs will be useful for most forms of "resource condition status" reporting as may be required by the NPS, the Department of the Interior, or the Office of Management and Budget.

[8] The I&M program consists of 32 networks nationwide that are implementing "vital signs" monitoring in order to assess the condition of park ecosystems and develop a stronger scientific basis for stewardship and management of natural resources across the National Park System. "Vital signs" are a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values.

2. Introduction and Resource Setting

2.1. Introduction

Martin Van Buren National Historic Site (NHS) preserves and interprets Lindenwald, the rural estate of the eighth President of the United States. Located in the Hudson River Valley town of Kinderhook, in Columbia County, New York (NY), the farm embodied Van Buren's ideals of an agrarian lifestyle sustained without slave labor. Today, the park interprets Van Buren's life and career as well as the issues facing the nation in the turbulent decades leading up to the Civil War. The park also seeks to interpret historical and modern progressive farming, as practiced by Van Buren in the mid-nineteenth century, and by modern farmers working this land today.

The park originally encompassed 8 ha (20 ac) surrounding the historic mansion, with an additional 7 ha (18 ac) of scenic easements protecting the park viewshed. Further legislation in 2009 expanded the park's authorized legislative boundary to 120 ha (296 ac), encompassing more than three-quarters of Van Buren's 90 ha (220 ac) farm as well as additional open space to the east, across Route 9H. The resulting park is a working agrarian landscape, much of it owned and operated by Roxbury Farms, an organic, biodynamic vegetable farm, under conservation easement and in cooperation with NPS. Additional parcels within the authorized park boundary are privately owned, while cut-out parcels surrounded by the park remain outside of the authorized boundary (Figure 2-1). The park preserves the Lindenwald mansion and outbuildings, an archival and museum collection, the cultural landscape, archeological sites, and impressive views to the west, across the agrarian landscape towards the distant Catskill Mountains. Natural resources lying within the authorized park boundary include prime agricultural soils, a segment of Kinderhook Creek, a vegetated escarpment, wetlands, six man-made ponds, and habitat for many species including several species of conservation interest.

2.1.1. Enabling Legislation

The park was established by Congress in October 1974 to commemorate the life and work of the eighth president of the United States (Public Law 93-486). Lindenwald had been designated a National Historic Landmark in 1961. In 2009, the boundary of the historic site was adjusted to include an additional 106 ha (261 ac), and the Secretary of the Interior was authorized to acquire properties within this boundary "from willing sellers by donation, purchase with donated or appropriated funds, or exchange" (Public Law 111-11).

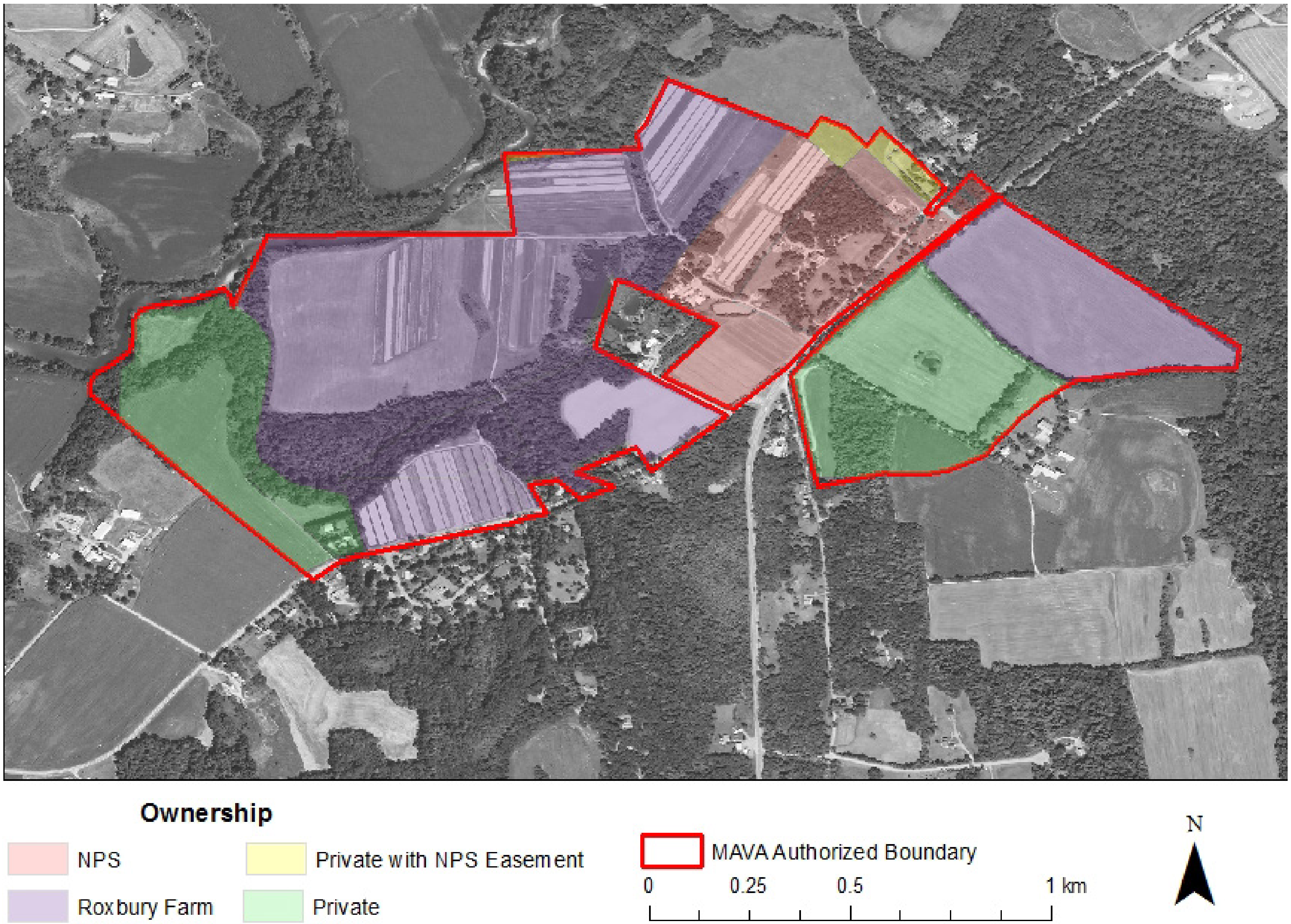

Figure 2-1. Ownership of land within the authorized boundary of Martin Van Buren National Historic Site.

2.1.2. Geographic Setting
Located in the Hudson River Valley, in Columbia County, NY, the property lies 30 km (20 miles) south of Albany and six km (four miles) east of the Hudson River, on a terraced landscape along Kinderhook Creek. The park is bordered by Kinderhook Creek to the northwest, is partially bordered by Albany Avenue to the south, and is traversed by Route 9H.The park lies in a mixed use neighborhood of agricultural, residential, commercial, and recreational land, and is zoned Agriculture Residential. The Town Comprehensive Plan seeks to "preserve and maintain the Town of Kinderhook's unique historic, agricultural and rural character" while guiding growth (Town of Kinderhook 2014). The Open Space Institute, together with the Columbia Land Conservancy, has been instrumental in preserving farmland along Kinderhook Creek, including much of the land within the park's authorized boundary (Open Space Institute 2018)

Three cut-out parcels lie along Albany Avenue. These privately-owned residences are surrounded on three-sides by the park but lie outside the park's authorized boundary. The largest, flag-shaped parcel (3 ha or 8 ac) was historically part of the Van Buren Farm, and currently shares a man-made pond (Gravel Pond) with the park. Northeast of the park boundary, the 29-ha (72-acre) wooded natural area known as the "Van Buren Nature Trails" has been owned and operated by the Friends of Lindenwald since 2013. In the 1970's this county-owned parcel had been proposed for use as a garbage dump, but its proximity to Lindenwald prevented that use. A county transfer station and public works facility borders the Van Buren Nature Trails to the north.

Regionally, the park lies within the Hudson River Valley Natural Heritage Area, a 175-km (150-mile) linear corridor established by Congress in 1996 to recognize, preserve, protect and interpret the region's cultural and natural resources. Two significant Bird Conservation Areas (BCAs; the Schodack Island and Tivoli Bays BCAs) lie within 32 km (20 miles) of the park.

2.1.3. Visitation Statistics
Annual visitation rates at the park averaged about 20,000 from 2013–2017 (NPS 2019). Visitation rates are highest during the warmer months, May through October; this is when the park visitor center is open and mansion tours are scheduled. Few park visitors (18%) are local residents, and very few (1%) are on organized tours, including school groups (Blotkamp et al. 2010).

2.2. Natural Resources
This land has been continuously farmed since the 17th century. Dudley Ray Meyer purchased much of the farm in the 1940s; he intensively farmed the land, made changes to landscape features and drainage, and excavated several ponds. Overall, however, the property and landscape retains its historic integrity in association with Van Buren (Searle 2004).

2.2.1. Ecological Units and Watersheds
The park lies in the watershed of Kinderhook Creek, a tributary of Stockport Creek (an inlet to the Hudson River). The land on the lower terrace lies in the 100-year floodplain of Kinderhook Creek at approximately 60 m (190 feet) asl, while the upper terrace, level with Route 9H, lies approximately 70 m (230 feet) asl. Natural springs occur on the property, including one located just south of the

mansion, above the site of one of Van Buren's historic ponds (NPS 2003). Historic and modern ditches connect agricultural fields on the lower terrace to Kinderhook Creek.

The park is underlain by Ordovician bedrock of three formations: Austin Glen graywacke and shale, Mount Merino and Indian River shale, slate, and chert, and Stuyvesant Falls shale and siltstone (Fisher et al. 1970). The surficial geology of the Kinderhook Creek floodplain, on the farm's lower terrace, is recent alluvium; further east, on the upper terrace, are stratified lakeshore delta deposits (Caldwell and Dineen 1987). Soils are deep, level or gently sloping, flood plain soils of Occum loam, Limerick silt loam and Linlithgo silt loam on the lower terrace, Hoosic gravelly sandy loam on the upper terrace, Knickerbocker fine sandy loam on parcels east of Route 9H, and Palms muck in the wetland area at the base of the wooded escarpment separating the two terraces (USDA NRCS 1989).

Dickert et al. (2005) surveyed and mapped habitat types on roughly half of the land currently within the park's authorized boundary, including the land owned or under easement by NPS, as well as the large parcel owned by Roxbury Farm (Figure 2-2). They mapped 21 ha (52 ac) within six vegetation associations (Table 2-1), as well as 36 ha (90 ac) of "upland meadow" corresponding to active and fallow farmland, and 8 ha (19 ac) of managed grounds, buildings and parking lots shown as "cultural habitat" or "developed" land.

Table 2-1. Vegetation associations mapped at Martin Van Buren National Historic Site (from Dickert et al. 2005).

Vegetation Association	Hectares Mapped	Description
Upland forest	6.8	Young stands, dominated by black locust, black cherry, white ash, elm and white pine. Weedy shrub layer, except where bordering Southern Swamp.
Shrubby old-field	<0.1	A small occurrence on a peninsula in Gravel Pond, with saplings of eastern cottonwood and black locust, staghorn sumac, and multiflora rose.
Hardwood swamp	3.6	Dominated by red maple, green ash and slippery elm, with northern arrowwood, nannyberry, winterberry holly, and spicebush common in the shrub layer and sedges, cinnamon fern, bog-hemp and skunk cabbage common in the herb layer.
Wet meadow	2.4	Common plants include reed canary grass, purple loosestrife, grass-leaved goldenrod, giant goldenrod, willow-herbs, obtuse spikerush, and path rush.
Man-made ponds	1.2	Large expanses of open water with abundant floating plants including watermeal and common duckweed and emergent vegetation at the edges. Some have a submerged aquatic community.
Sandbar	0.2	Dynamic habitat on exposed sediment with a few trees, patches of shrubs and a diverse herb community.

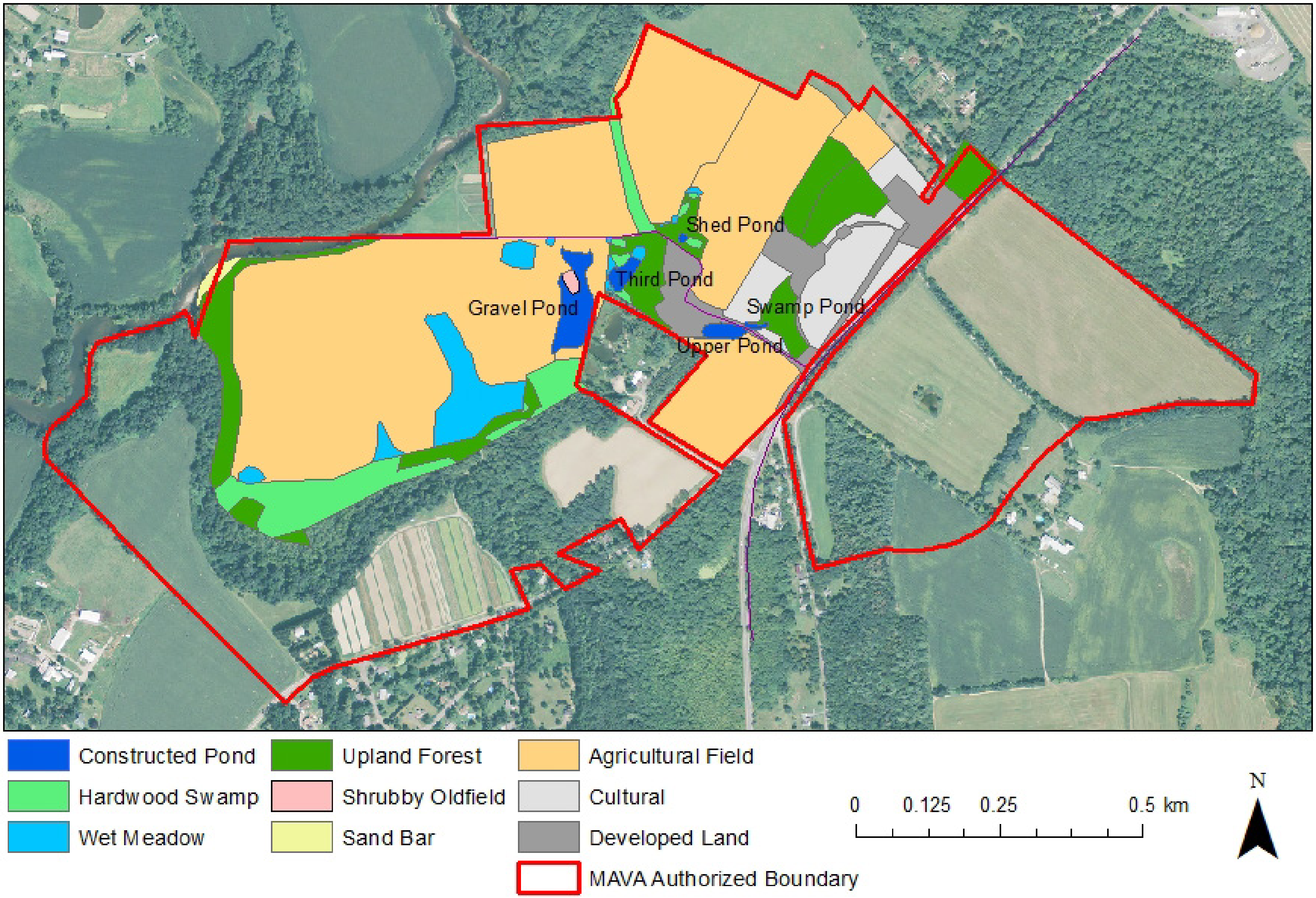

Figure 2-2. Mapped habitat types at Martin Van Buren National Historic Site (from Dickert et al. 2005).

Six ponds lie entirely or partially within the park's authorized boundary, while additional ponds lie on the flag-shaped cut-out parcel near the park's center. Two fish ponds were constructed by Van Buren about 1840, one of which remains as "Upper Pond" and is hydrologically connected to the small "Swamp Pond" lying on the other side of the Roxbury Farm entrance road. Additional ponds were excavated between 1967 and 1994 (von Bieberstein et al. 2018). The largest, referred to herein as "Gravel Pond," lies mostly inside the park boundary and appeared newly excavated in 1994 aerial photography (Dickert et al. 2005). A small (<0.1 ha; 0.2 ac) shrubby old-field habitat lies on a peninsula into Gravel Pond. Both "Third Pond" and the very small "Shed Pond" lie in a wooded section of the escarpment past the farm building complex. An additional pond lies east of Route 9H, on privately-owned land within the authorized park boundary.

Park natural areas generally occur at the edges of agricultural and cultural areas, in connection with the vegetated escarpment running southwest/northeast between the upper and lower terrace, in wet depressions, at the perimeter of man-made ponds, and along channelized streams and Kinderhook Creek (Figure 2-2). The most significant park natural area is the Southern Swamp, a roughly 3 ha (7 ac) hardwood swamp occurring at the base of the escarpment, southwest of Gravel Pond, on somewhat calcareous muck soil, within a NYS-regulated freshwater wetland (see section 4.4.1). Several patches of wet meadow extend north from this area, and strips of upland forest occur, adjacent to the wet meadow and along Muddy Brook (a channelized stream that connects this wetland to Kinderhook Creek; Dickert et al. 2005). This natural area extends beyond the mapped area, onto additional parcels within the park's authorized boundary.

Northeast of the flag-shaped cutout parcel, small patches of hardwood swamp, wet meadow and a patch of upland forest surround Third Pond. A narrow strip of hardwood swamp along a channelized stream connects this area to Kinderhook Creek. Additional patches of wet meadow occur in depressions within the agricultural fields (Dickert et al. 2005).

Northeast of the mansion, a roughly 2 ha (5 ac) patch of upland forest occupies the location of the historic orchard; NPS plans to restore this orchard (von Bieberstein and Coffin Brown 2016). Small patches of upland forest occur south of the mansion, and in a small area between the Old Post Road trace and Route 9H (Dickert et al. 2005). Additional areas of natural vegetation lie in patches outside of the mapped area, on land owned by Roxbury Farm lying south of Southern Swamp, and on privately-owned land lying east of Route 9H.

A channelized stream connects Third Pond to a wetland area adjacent to Kinderhook Creek, and another (Muddy Brook) connects Southern Swamp to Kinderhook Creek. A 0.2 ha (0.5 ac) sandbar in Kinderhook Creek is a dynamic habitat which has been colonized by trees, shrubs and a diverse herb layer (Dickert et al. 2005).

2.2.2. Resource Descriptions

The park's viewshed and soils are highly valued park resources. Dramatic views from the park's historic core across the rural landscape to the distant Catskill Mountains remain intact from Van Buren's time, and add to the historical value of the park (NPS 2015). The park lies on deep, level or gently sloping, flood plain soils, about a third of which are considered prime farmlands (Occum loams and Knickerbocker fine sandy loams; Figure 2-3; USDA NRCS 1989).

Kinderhook Creek runs along the park's northwest boundary, and lies partially within the park's authorized boundary. It is a cool, medium river with average depth 0.6 m (2 feet) and average width 14 m (45 feet), rated a class C stream by the New York State (NYS) Department of Environmental Conservation (DEC) and suitable for fishing (NPS 2015). The creek is stocked annually with brown trout, and wild brook trout are reported outside the park in the creek's upper reaches. There is no public fishing at or near the park. Irrigation water is drawn from Kinderhook Creek by Roxbury Farm.

The park provides habitat for more than 90 species of birds, at least 15 mammals, two turtles, four salamanders, seven frogs and toads, and ten fish species which have been documented on the property (Dickert et al. 2005, NPS 2019). Six state-listed species have been documented at the park; these are the endangered ovate spikerush (*Eleocharis ovata*), and the threatened northern harrier (*Circus hudsonius*), Davis sedge (*Carex davisii*), and cream avens (*Geum virginianum*), and the special concern (SC) Jefferson salamander (*Ambystoma jeffersonianum*) and osprey (*Pandion haliaetus*). The park is considered to be potential habitat for the federally endangered Indiana bat (*Myotis sodalis*), the federally threatened northern long-eared bat (*M. septentrionalis*), as well as the NYS SC small-footed bat (*M. leibii*), spotted turtle (*Clemmys guttata*) and wood turtle (*C. insculpta*). Other rare plants and animals and Species of Greatest Conservation Need (SGCN) have been documented at the park (see section 4.4).

2.2.3. Resource Issues Overview

The park has identified five key natural resource issues: 1) restoring and preserving the historic viewshed; 2) developing a program of natural resource monitoring for critical habitats, including Kinderhook creek and wetlands, and for key species; 3) sharing management of natural resources between NPS and Roxbury Farm; 4) the inclusion of agricultural practices in natural resource management strategies; and 5) adapting to climate change (NPS 2015, NPS 2016a). Additional natural resource issues of concern at the park are controlling the unauthorized use of sport vehicles (snowmobiles and ATVs), testing pond water quality (for use by wildlife and as a potential irrigation source), and potential impacts to the park soundscape from proposed widening of Route 9H (NPS 2015, von Bieberstein and Coffin Brown 2016).

Stressors of concern acting on park ecosystems include climate change, atmospheric deposition, nutrient enrichment, habitat fragmentation, and invasive species. Erosion has been problematic along Kinderhook Creek (Town of Kinderhook 2014). These stressors are driven in large part by activities occurring outside of the park boundary.

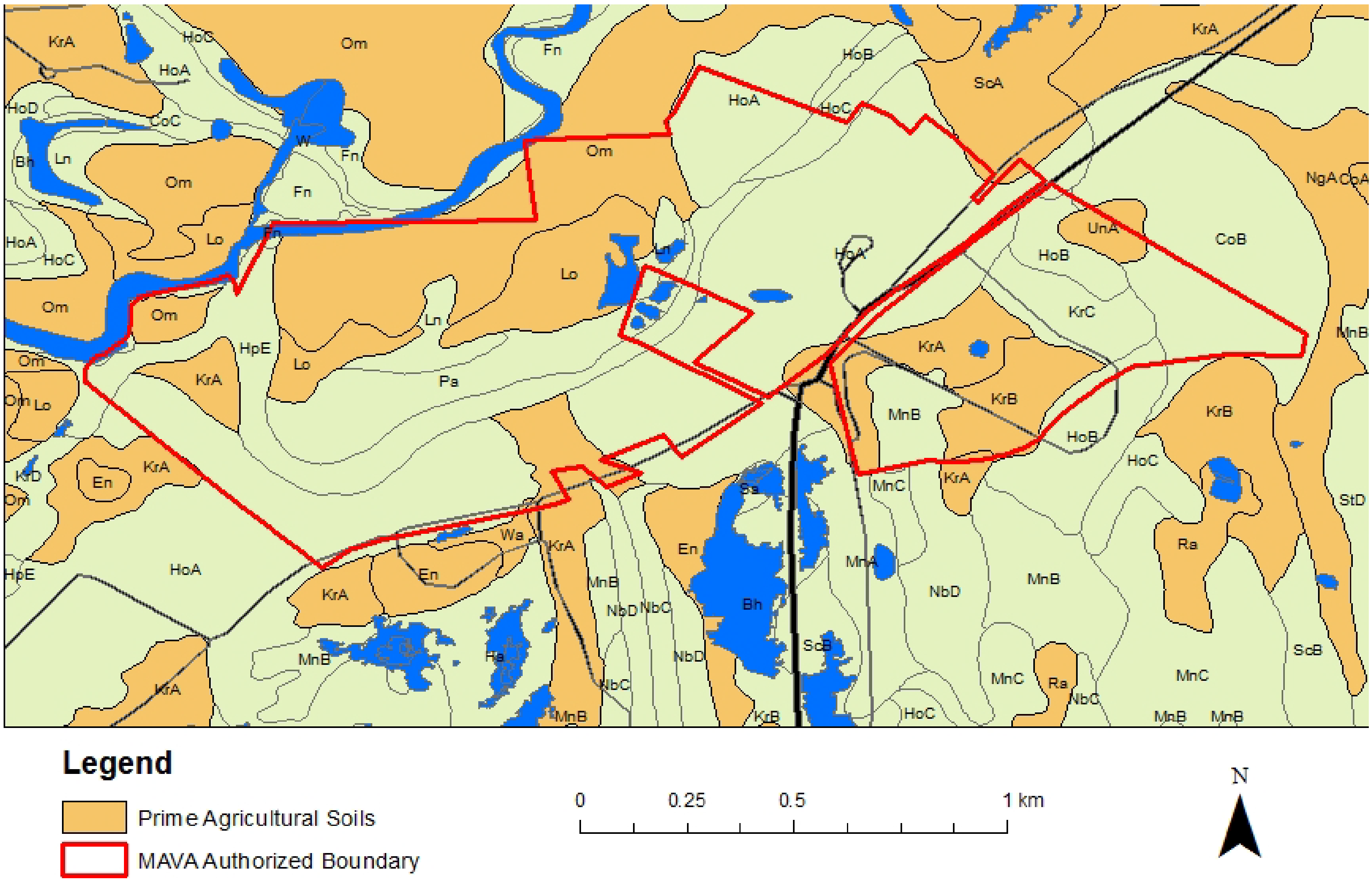

Figure 2-3. Approximate location of prime agricultural soils at Martin Van Buren National Historic Site (USDA NRCS 1989).

2.3. Resource Stewardship

2.3.1. Management Directive and Planning Guidance

The park seeks to provide visitors the opportunity to walk in the footsteps of Martin Van Buren, eighth President of the U.S., politician, progressive farmer, and family man. The park is managed to recall the historic period of Van Buren's ownership, from 1839 until his death in 1862, and park grounds are managed to reflect Van Buren's vision of progressive farming, and to emphasize both historical and current progressive and experimental agricultural practices (NPS 2015).

The park's General Management Plan (GMP) lays out five management zones: 1) Historic (including all historic buildings, the Old Post Road trace and the semi-circular entrance drive); 2) Historic Transition (lying on the upper terrace and surrounding the historic zone); 3) Administrative (lying north of the historic zone and containing the visitor center and parking lot); 4) Agricultural (including all fields); and 5) Natural Resource (including the vegetated escarpment between the upper and lower terraces, the riparian area along Kinderhook Creek, and natural areas on private lands within the authorized boundary). The GMP states that where feasible, park management will restore natural areas, and will preserve and protect "natural and cultural sounds" (NPS 2015). Within these zones, NPS authority and jurisdiction vary by category of ownership among 1) land under fee simple ownership by NPS; 2) land over which NPS owns a conservation easement; and 3) privately-owned land within the authorized boundary in which NPS may acquire an interest.

The Natural Resource and Agricultural Zones lie on land owned by Roxbury Farms under easement with NPS. Roxbury Farm is a community-supported, biodynamic farm. Operating on 160 ha (400 ac) in several locations in Kinderhook, NY, part of the farm lies within the park's authorized boundary. Based on the philosophy of Rudolf Steiner, biodynamic farming is a type of organic farming that incorporates respect for the interconnectedness of all living things and values soil fertility. At this site, Roxbury Farm produces vegetables and sometimes provides hay and pasture for Black Angus and White Park cattle. At other locations in Kinderhook, Roxbury Farm raises sheep and pigs.

Management of park agricultural activities by NPS and Roxbury Farm seeks to "perpetuate sustainable agriculture, improve historic landscape character, and expand opportunities for collaborative programming to connect people to the landscape and agriculture" (von Bieberstein et al. 2018). This vision seeks to balance historic preservation with active agricultural use and the mission to provide a meaningful visitor experience. Best management practices have been identified for the park in the areas of soil management, water use, and control of pests, disease and weeds. In addition, management will seek to retain hedgerows and fence lines characteristic of the historic agricultural landscape (von Bieberstein et al. 2018). A new trail system through the agricultural areas of the park is in the planning stage, and would link into the Greater Hudson River Greenway Trail system.

The Open Space Institute and the Columbia Land Conservancy both contributed to the park's 2009 expansion and remain important conservation partners in the region. The Friends of Lindenwald are a non-profit organization dedicated to the preservation of Lindenwald and its historical legacy. They have operated since 1984 to support activities and special events, conduct fundraising to support the park, and manage the adjacent recreational area, the Van Buren Nature Trails. The agricultural district in which the park lies is overseen by the Columbia County Agricultural and Farmland Protection Board.

2.3.2. Status of Supporting Science

In 2013, the park's administrative office merged with nearby Roosevelt-Vanderbilt National Historic Sites (ROVA) in Hyde Park, NY. As a result, the park gained natural resource staff and now has the capability for natural resource monitoring and management. Sources of data available for inclusion in this NRCA are listed in Table 2-2.

Table 2-2. Data available for assessment of natural resource condition at Martin Van Buren National Historic Site. NA is not applicable.

Natural Resource or Issue	Data Type	Year(s) Collected	Source
Air quality	Air quality assessment	Ongoing	National Park Service Air Resources Division
	Ozone sensitive species	Ongoing	National Park Service
	Hg wet deposition monitoring	Ongoing	Mercury Deposition Network
Climate	Climate trends	1901–2012	Monahan and Fisichelli 2014
	Forest vulnerability	Projection	Fisichelli et al. 2014
Soundscape	Model predictions	NA	National Park Service Natural Sounds & Night Skies Division
Lightscape	Model predictions	NA	National Park Service Natural Sounds & Night Skies Division
Geology	Bedrock map	NA	Fisher et al. 1970
Soil	Environmental assessment	1999	Ecosystem Strategies, Inc.
	SSURGO soil map	NA	USDA NRCS 1989
	Soil chemistry	1999–2016	Roxbury Farm unpublished reports
Water quantity and quality	Inventory	2002	Farris 2002
	Monitoring – Kinderhook Creek	1957–1994	United States Geological Survey
	Suspended sediments – Kinderhook Creek	2011–2014	United States Geological Survey
	Discharge – Kinderhook Creek	2011–ongoing	United States Geological Survey
	Groundwater quality	2011	Eckhardt and Sloto 2012
	Pond water quality	2019	National Park Service
Streams-macroinvertebrates	Assessment – Kinderhook Creek Assessment	2000–2003	New York State Department of Environmental Conservation
	Kinderhook Creek	2006	Hudson Basin River Watch

Table 2-2 (continued). Data available for assessment of natural resource condition at Martin Van Buren National Historic Site. NA is not applicable.

Natural Resource or Issue	Data Type	Year(s) Collected	Source
Invasive species	Survey	2002–2004	Dickert et al. 2005
	Observation	2007	Farmscape Ecology Program 2008
Wetlands	NYS Regulated Wetlands	1993	New York State Department of Environmental Conservation
	National Wetlands Inventory	Ongoing	United States Fish and Wildlife Service
White-tailed deer herbivory	Regional harvest data	Ongoing	New York State Department of Environmental Conservation
Fauna	Survey	1984	Cook 1984, 1985
	Survey	2002–2004	Dickert et al. 2005
	Regional bat data	Ongoing	New York State Department of Environmental Conservation
	Observation	2007	Farmscape Ecology Program 2008
Birds	Detection	Ongoing	eBird
Vegetation inventory, classification and mapping	Survey	1984	Cook 1984, 1985
	Survey	1996	Kiviat 1997
	Survey	1997	Clemants 1997
	Classification and mapping	2002–2004	Dickert et al. 2005
	Observation	2007	Farmscape Ecology Program 2008
Landcover / ecosystem cover	Landcover and land use	Ongoing	NPScape
	Habitat, connectivity	Ongoing	Nature's Network (naturesnetwork.org)

3. Study Scoping and Design

3.1. Preliminary Scoping

A scoping meeting, held at the park on December 1, 2017, was attended by Dave Hayes (NPS), Megan O'Malley (NPS), Susanne Norris (NPS), Steve Hanaburgh (NPS), Chris Arnott (NPS Northeast Region), Seth Lerman (NPS Northeast Region), and Geri Tierney (State University of NY). Sheila Colwell (NPS Northeast Region) and Amanda Babson (NPS Northeast Region) participated in the meeting by conference call.

Chris Arnott described the NRCA program goals and methods (summarized in Chapter 1 herein). Megan O'Malley provided a comprehensive overview of the park and key management issues (section 2.2.3 herein). Agriculture is a significant park resource, with a large portion of the land area within the park's authorized boundary owned by Roxbury Farm. The relationship between NPS and Roxbury Farm is in the process of being defined as easements are renegotiated.

Geri Tierney led a discussion of proposed indicators of natural resource condition for assessment. Chris Arnott pointed out that, in some cases, resources may be described in the introduction (Chapter 2) without formal analyses of data and a determination of condition due to a lack of data or other reasons.

The group then discussed available natural resource data sources. Megan O'Malley and Dave Hayes provided several datasets and reports, and Megan O'Malley directed the group to resources of the Farmscape program of nearby Hawthorne Valley Farm (www.hvfarmscape.org). Finally, the group toured the park, observing key landscape views, the area of the historic orchard, agricultural fields, Kinderhook Creek, Muddy Brook, the Southern swamp, and several ponds (Third Pond, Gravel Pond and Upper Pond).

A follow-up call was held on January 18, 2018 to finalize the list of indicators for assessment (Table 3-1). Dave Hayes, Megan O'Malley, Susanne Norris, Chris Arnott, Geri Tierney and Aaron Weed (NPS Northeast Temperate Network [NETN]) participated. During this call, the group clarified that to the extent possible, this NRCA will consider all land included within the legislative authorized boundary, including lands currently under private ownership. Ponds of interest are the largest pond (Gravel Pond) as well as the historic pond lying south of the entrance road (Upper Pond). "Species in need of conservation" was added as an indicator of condition; this category will include species which have been identified for protection by the federal or state government (E, T or SC) or designated SGCN, rare or substantially declining by a governmental or regional conservation organization.

3.2. Study Design

3.2.1. Indicator Framework, Focal Study Resources and Indicators

This NRCA used the NPS Vital Signs framework to guide selection and reporting of indicators. The following resources were removed from the preliminary list of indicators: Lightscape (because the park is not accessible to visitors after dark); Forest vegetation (because little park area is forested); and Fish (because they are not key resources). The Wetland vegetation indicator was expanded to include Riparian vegetation. Two proposed indicators were included in other categories. Invasive exotic plants were included within both Riparian and wetland vegetation and Water quality, because invasive species are stressors rather than resources; while Bats were included within Mammals. The resulting list of indicators to be assessed herein is shown in Table 3-1. One or more metrics were used to describe the condition of each indicator selected for inclusion.

Table 3-1. Indicators of natural resource condition to be assessed at Martin Van Buren National Historic Site.

Category	Indicator	Metrics
Air & Climate	Ozone	Ozone concentration, injury to sensitive species
	Acidic deposition and stress	Total wet deposition rates
	Visibility and particulate matter	Haze index
	Mercury contamination	Concentration in wet deposition, predicted methyl mercury concentration
	Climate	Monthly temperature and precipitation
	Soundscape	Anthropogenic sound pressure level
Water	Water quantity	Stream discharge, pond water height
	Water quality	Temperature, pH, dissolved oxygen, specific conductance, nutrients, suspended sediments
	Stream macroinvertebrates	Diversity of community
Geology & Soils	Agricultural soils	Soil chemistry
Biological Integrity	Riparian and wetland vegetation	Extent, width and condition of buffer, percent cover of invasive plants, qualitative assessment of disturbance and alteration
	White-tailed deer	Regional deer population density, browse vegetation impacts
	Birds	Guild species richness, population trend
	Amphibians and reptiles	Amphibian index of biotic integrity
	Mammals	Species richness, population trend
	Insects	Guild species richness, relative abundance
	Conservation species	Population trend
Landscapes	Landcover and land use	Anthropogenic land use, impervious cover
	Viewshed	Visual impact

3.2.2. Reporting Areas

This assessment will consider all land lying within the park authorized legislative boundary, including agricultural areas managed by Roxbury Farm and, to the extent practical, parcels that are currently in private ownership.

3.2.3. General Approach and Methods

Assessment points (also known as reference values) are used to distinguish expected or acceptable condition (i.e., *good condition*) from undesired conditions that warrant concern, further evaluation or management action (Bennetts et al. 2007). Herein, assessment points were drawn from knowledge of ecological integrity, as well as from regulatory or program standards, park management goals, historical datasets, data from relatively undisturbed sites, predictive models, or expert opinion. When warranted by available information from one or more of these categories, a second assessment point was set to attempt to distinguish conditions that warrant *moderate concern* from *significant concern*. For example, the scientific literature on white-tailed deer browsing impacts on native vegetation in the eastern U.S. suggests that negative impacts on vegetation may be measurable at deer density levels as low as 8 deer/km^2 but that severe impacts are documented at deer densities at or above 20 deer/km^2 (Section 4.4.2). In this case, two assessment points were used.

Within NHS units, expected or acceptable condition for ecological integrity may conflict with desired condition for preservation or interpretation of a historical landscape; this potential conflict is evident in Vital Signs such as Land use. In these cases, assessment of ecological integrity benchmarks is valuable because it provides a deeper understanding of park condition, as well as a consistent baseline to assess management goals. However, in cases such as these, ratings of *moderate concern* or *significant concern* may not warrant management action.

Trends in condition were determined by a statistical test of significance if sufficient data were available. Unless otherwise specified, an alpha value of 0.10 was used to determine statistical significance.[1]

Confidence in condition status was assigned by considering the quality and depth of the available data, as well as the justification for the assessment points used to determine condition. High confidence was assigned to assessments based on abundant, quantitative data from multiple sites reflecting the range of variation in the park resource, and which relied on well-justified assessment points. Medium confidence was assigned to assessments based on sufficient, quantitative or qualitative data from at least one representative site in or near the park, and which relied on well-justified assessment points. Low confidence was assigned to assessments based on preliminary or incomplete data, or preliminary or incomplete assessment points. Confidence in trends was based on the length and quality of the dataset and the level of significance of the trend. High confidence in a trend was reserved for datasets containing at least 10 years of quantitative data, while medium confidence in a trend required a dataset that contains at least 8 years of quantitative or qualitative data.

Summary Indicator Symbols

NPS stoplight reporting categories and symbology (Table 3-2) were used to report condition status, trends in condition, and confidence in assessment. Table 3-3 shows examples for interpreting NPS stoplight symbols. For cases in which confidence in condition status differed from confidence in a trend, confidence in condition status was symbolically presented.

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[1] An alpha level of 0.10 is used to balance the competing objectives to 1) avoid type 1 errors and 2) maximize the power to detect trends.

Table 3-2. Indicator symbols used to indicate condition, trend, and confidence in the assessment.

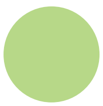
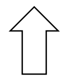
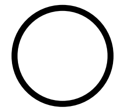
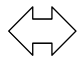
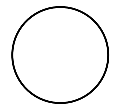
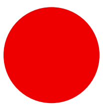
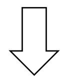
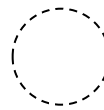
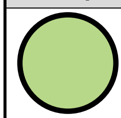
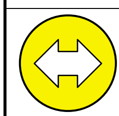
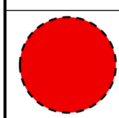
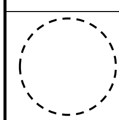
Condition Status		Trend in Condition		Confidence in Assessment	
Condition Icon	**Condition Icon Definition**	**Trend Icon**	**Trend Icon Definition**	**Confidence Icon**	**Confidence Icon Definition**
	Resource is in Good Condition		Condition is Improving		High
	Resource warrants Moderate Concern		Condition is Unchanging		Medium
	Resource warrants Significant Concern		Condition is Deteriorating		Low

Table 3-3. Example indicator symbols and descriptions of how to interpret them.

Symbol Example	Verbal Description
	Resource is in good condition; its condition is improving; high confidence in the assessment.
	Condition of resource warrants moderate concern; condition is unchanging; medium confidence in the assessment.
	Condition of resource warrants significant concern; trend in condition is unknown or not applicable; low confidence in the assessment.
	Current condition is unknown or indeterminate due to inadequate data, lack of reference value(s) for comparative purposes, and/or insufficient expert knowledge to reach a more specific condition determination; trend in condition is unknown or not applicable; low confidence in the assessment.

4. Natural Resource Conditions

4.1. Air and Climate

To better understand status and trends in air quality affecting national parks, the NPS Air Resources Division (ARD) compiles air quality data from monitoring stations across the nation, and uses these data to estimate air quality metrics and associated condition ratings for all parks within the contiguous U.S. (NPS ARD 2018). Many small parks do not contain on-site air monitoring stations; status metrics for these parks are interpolated using data from nearby monitoring stations.

Six indicators were included to assess condition and trend for Air and Climate:

- Ozone
- Acidic deposition and stress
- Visibility and particulate matter
- Mercury contamination
- Climate
- Soundscape

4.1.1. Ozone

Description

Ground level ozone is hazardous to human health and to vegetation, particularly to ozone-sensitive species. Ozone is produced in the presence of sunlight during hot summer months by a chemical reaction of nitrogen oxides and volatile organic compounds from industrial and automobile emissions. As a result of stricter air pollution control from the Clean Air Act amendments of 1990, ozone levels have been decreasing both nation-wide, and in the northeastern U.S. since 1990 (US EPA 2017). In 2015, the US EPA strengthened ozone pollution control by lowering the national ozone standard to 70 ppb, in recognition of increasing scientific evidence that damage to both human health and ecosystems was occurring at ozone levels below the previous standard of 75 ppb. Consequently the NPS ozone standard for protection of human health was adjusted to match the new EPA standard (NPS ARD 2017).

Ozone-sensitive plant species present in the park are shown in Table 4-1. Noted species are considered bio-indicator species, in which leaf damage from ambient ozone concentrations can be easily recognized.

Table 4-1. Ozone-sensitive plant species at Martin Van Buren National Historic Site, including bio-indicator species (from NPS 2019).

Common Name	Scientific Name	Bio-indicator Species
Boxelder	*Acer negundo*	Yes
Red maple	*Acer rubrum*	–
Tree of heaven	*Ailanthus altissima*	Yes
Wild sarsaparilla	*Aralia nudicaulis*	–
Common milkweed	*Asclepias syriaca*	Yes
Yellow birch	*Betula alleghaniensis*	–
Paper birch	*Betula papyrifera*	–
Devil's darning needles	*Clematis virginiana*	–
White ash	*Fraxinus americana*	Yes
Green ash	*Fraxinus pennsylvanica*	–
Common hop	*Humulus lupulus*	Yes
Clayton's sweetroot	*Osmorhiza claytonii*	–
Virginia creeper	*Parthenocissus quinquefolia*	–
Sweet mock orange	*Philadelphius coronarius*	–
Eastern white pine	*Pinus strobus*	–
Sycamore	*Platanus occidentalis*	Yes
Eastern cottonwood	*Populus deltoides*	–
Quaking aspen	*Populus tremuloides*	Yes
Pin cherry	*Prunus pensylvanica*	Yes
Black cherry	*Prunus serotina*	Yes
Chokecherry	*Prunus virginiana*	–
Allegheny blackberry	*Rubus allegheniensis*	Yes
Pussy willow	*Salix discolor*	–
Black willow	*Salix nigra*	–
Canada goldenrod	*Solidago canadensis*	–
Giant goldenrod	*Solidago gigantea*	–
Fox grape	*Vitis labrusca*	Yes

Data and Methods

NPS ARD compiles ozone data to assess condition based on five-year average concentrations for protection of both human health and vegetation, and to assess ten-year trends (NPS ARD 2017). The ozone monitoring stations nearest to the park are located 33 km (20 mi) to the north at the Loudonville Reservoir in Albany NY, and at 39 km (24 mi) to the east in Pittsfield MA. This status assessment was based on interpolated NPS ARD estimates of average ozone concentrations at the park for the five-year period 2011–2015.

Reference Conditions/Values

NPS ARD assesses ozone condition in national park units separately for protection of human health and for protection of vegetation (Table 4-2; NPS ARD 2017). For human health, the assessment points shown in Table 4-2 are tied to the primary National Ambient Air Quality Standard (NAAQS) for ground-level ozone set by the U.S. Environmental Protection Agency (US EPA) based on human health effects. To better assess condition relevant to ozone-sensitive vegetation, NPS ARD developed the W126 metric, a biologically based cumulative exposure index. This metric sums weighted ozone concentrations over daylight hours during the growing season. Assessment points for the W126 metric are derived from recorded impacts to sensitive vegetation (US EPA 2014). An ozone risk assessment for national park units in the northeastern U.S. suggested a W126 assessment point of 5.9 ppm-hrs to protect highly sensitive species (NPS 2004), which is slightly lower than the current NPS ARD assessment point.

Table 4-2. Ozone condition assessment points rating developed by National Park Service Air Resources Division (2017).

Metric	Good Condition	Moderate Concern	Significant Concern
Human health: Ozone concentration (ppb)	<= 54	55–70	>= 71
Vegetation: W126 (ppm-hrs)	< 7	7–13	> 13

Condition and Trend

Interpolated average five-year (2011–2015) ozone concentration at the park warranted *moderate concern* for human health, and showed *good condition* for vegetation health (Table 4-3, NPS ARD 2018). NPS ARD did not determine trends for this park; ten-year (2000–2009) trends in the W126 metric at nearby national park units ranged from unchanging to significantly improving (Figure 4-1; NPS ARD 2013).

Level of Confidence and Data Gaps

Confidence in status assessment based on long-term quantitative data interpolated from off-site ozone monitors is medium. Park trends were not determined, and confidence in regional trend is medium.

Source(s) of Expertise

- NPS ARD

Table 4-3. Five-year (2011–2015) average values and ratings for ozone condition at Martin Van Buren National Historic Site (from NPS ARD 2018).

Metric	5-yr Average	Rating
Human health: O3 concentration (ppb)	66.8	Moderate concern (55–70)
Vegetation: W126 metric (ppm-hrs)	5.6	Good condition (<7)

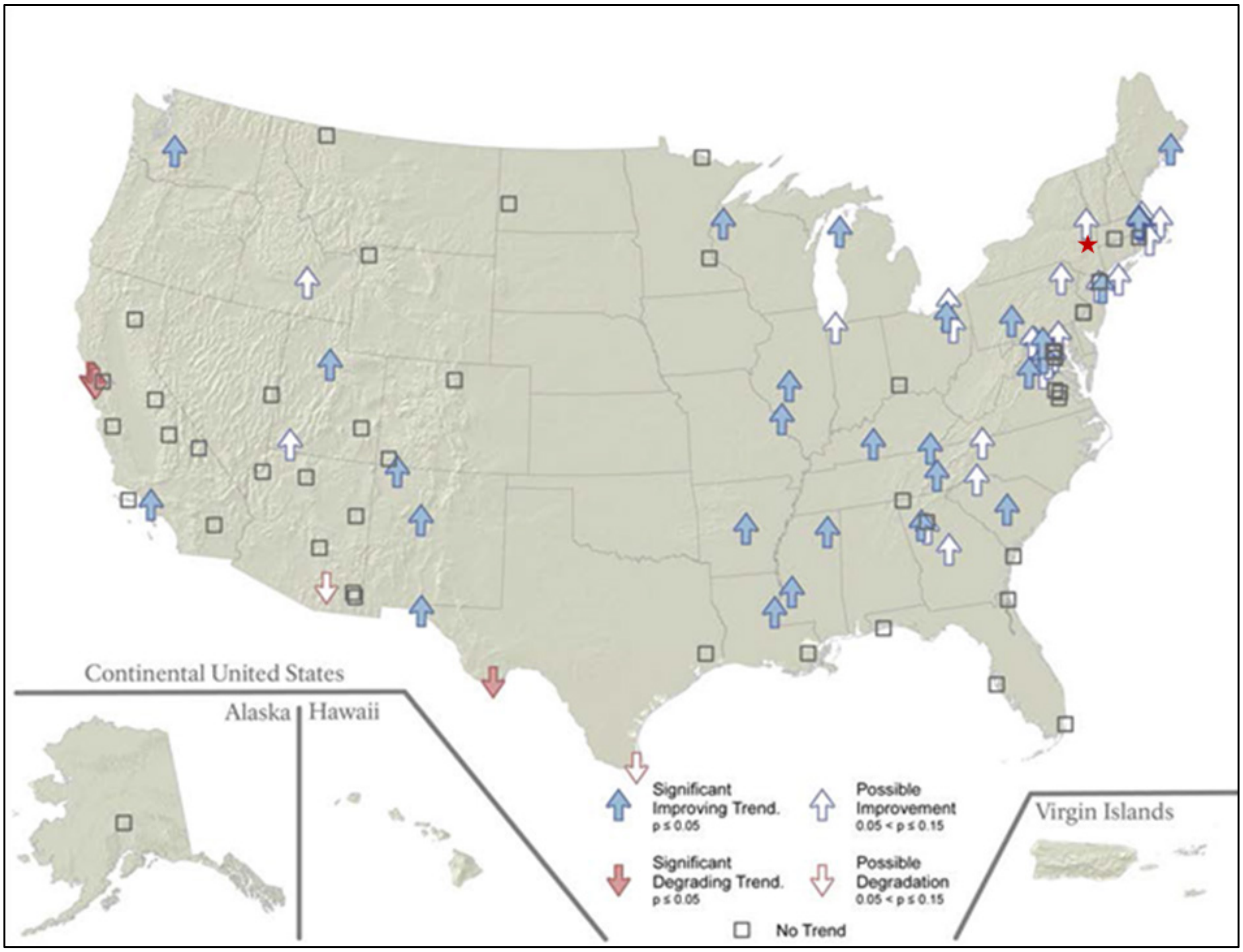


Figure 4-1. National trends in the ozone W126 metric, 2000–2009 (excerpted from NPS ARD 2013). Red star shows approximate location of Martin Van Buren National Historic Site.

4.1.2. Acidic Deposition and Stress

<u>Description</u>

Emissions of sulfur (S) and nitrogen (N) from power plants, factories, automobiles and other sources have dramatically altered precipitation chemistry in many regions, particularly the northeastern U.S. (Driscoll et al. 2001). Atmospheric deposition of S and N has contributed to acidification of soils and surface waters, export of nutrient cations (Ca, Mg, etc.), and mobilization of aluminum (Al; a toxin) in soils (Likens et al. 1996, Ruess and Johnson 1985). In addition, S deposition can stimulate microbes to transform mercury (Hg) into a toxic, bioavailable compound (methyl mercury, MeHg; US EPA 2008). N is a limiting nutrient necessary for plant growth that has historically been retained within northeastern forested ecosystems. As atmospheric deposition has increased N inputs by five- or ten-fold in the northeastern U.S., concern has arisen that excess N may "saturate" forested ecosystems, causing excess nitrification and N leaching which in turn would exacerbate the effects of acidification (Aber et al. 1998).

Broad-scale patterns of wet deposition across the northeast are well characterized and are most substantial at high elevations and in the southern and western parts of the northeast region (US EPA 2008). Substantial additional acidity can result from dry and occult deposition, and these patterns of deposition are not well characterized (NPS ARD 2013). Since passage of the 1990 Clean Air Act Amendments, wet deposition of S has decreased 35% or more across the eastern U.S., while wet deposition of N changed little in the 1990s, but generally has decreased since 2000 (US EPA 2008).

Data and Methods

NPS ARD assesses condition of wet deposition from National Atmospheric Deposition Program (NADP) data as an indicator of acidic deposition and stress on natural ecosystems in national park units across the nation, including this park (NPS ARD 2017). Condition is calculated using normalized 30-year precipitation values in order to reduce the influence of yearly variations in precipitation on results. For parks without onsite monitoring stations, park values are interpolated from nearby stations. The closest site for monitoring deposition chemistry is located 75 km (47 miles) southwest of the park at Biscuit Brook (NY68) in the Big Indian Wilderness in Claryville, NY. NPS ARD has determined trends in wet deposition for a subset of park units which did not include this park, but has not assessed dry deposition since data availability is more limited (NPS ARD 2013).

Reference Conditions/Values

NPS ARD has set current condition assessment points for N and S wet deposition as shown in Table 4-4. In park units where ecosystems are ranked "very high" in sensitivity to acidification or nutrient enrichment, wet deposition condition ratings are adjusted up to the next worse category (NPS ARD 2017). This adjustment does not apply at this park, which was not included in the group of parks assessed for ecosystem sensitivity to acidification and nutrient enrichment (Sullivan et al. 2011a; Sullivan et al. 2011b). NPS intends to improve assessment of deposition in coming years using established critical loads (NPS 2017).

Table 4-4. Wet deposition condition assessment points and rating developed by NPS ARD (2017).

Metric	Good Condition	Moderate Concern	Significant Concern
Total N wet deposition (kg/ha/yr)	< 1	1–3	> 3
Total S wet deposition (kg/ha/yr)	< 1	1–3	> 3

Condition and Trend

NPS ARD interpolated average five-year (2011–2015) wet deposition rates for the park to be 3.3 kg/ha/yr total N (warranting *significant concern*) and 1.9 kg/ha/yr total S (warranting *moderate concern*; NPS ARD 2018). NPS ARD did not determine trends in wet deposition this park. Ten-year (2000–2009) trends in S and N (combined nitrate and ammonium) wet deposition for other park units of the northeastern U.S. showed significantly improving trends (Figures 4-2 and 4-3; NPS ARD 2013) and regional trends are likely to be representative of this park.

Level of Confidence and Data Gaps

Confidence in status assessment based on long-term quantitative data interpolated from off-site ozone monitors is medium. Park trends were not determined, and confidence in regional trend is medium.

Source(s) of Expertise

- NPS ARD

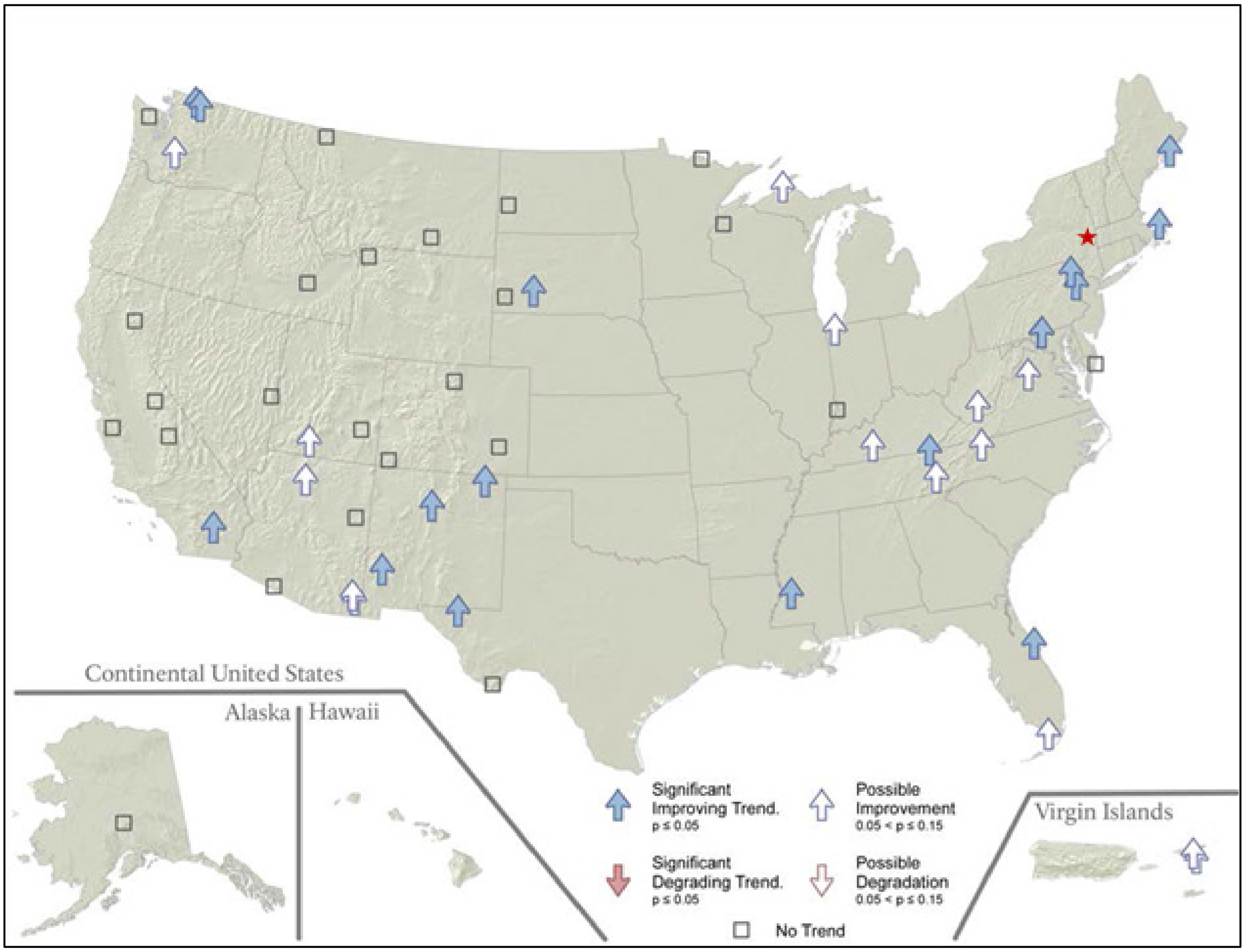


Figure 4-2. National trends in sulfate concentrations in precipitation (μeq/L/yr), 2000–2009 (excerpted from NPS ARD 2013). Red star shows approximate location of Martin Van Buren National Historic Site.

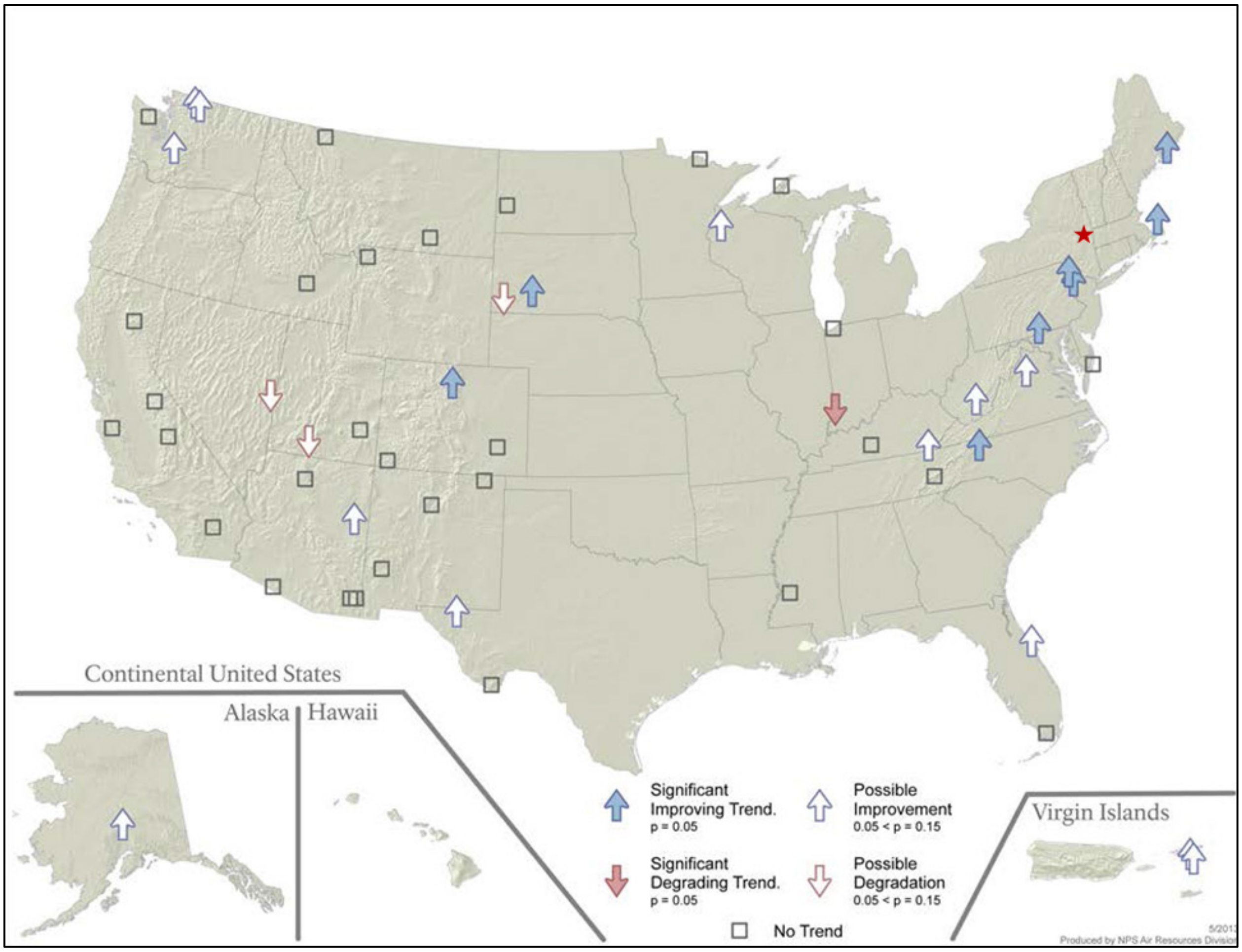


Figure 4-3. National trends in nitrogen concentrations in precipitation (μeq/L/yr), 2000–2009 (excerpted from NPS ARD 2013). Red star shows approximate location of Martin Van Buren National Historic Site.

4.1.3. Visibility and Particulate Matter

Description

The ability to clearly see landscape features is important to national park visitors. NPS actively seeks to "protect clean, clear air and spectacular scenery now and for future generations" (Action 37 in NPS 2012). Regional haze can impair the view by obscuring the color, texture and lines of the viewed landscape. Haze is caused by small (< 10 micron) particles (sulfates, nitrates, organic material, elemental carbon or soot, and soil) suspended in the atmosphere. Fine particulate matter (< 2.5 microns; PM-2.5) have a bigger impact on visibility and human health than coarser particles (2.5–10 microns). Particles may originate from natural sources (such as windblown dust or soot from wildfires) or from anthropogenic sources (including farming, traffic, and industry). Some particles are emitted directly into the atmosphere, while others form from chemical reactions in the atmosphere. In recent times, sulfates have been found to contribute 60 to 90% of the visibility degradation in the eastern U.S.; atmospheric concentrations of sulfates are highest during the summer months due to chemical reactions of atmospheric sulfate in the presence of sunlight (Malm 1999).

Data and Methods

Visibility is monitored at a network of sites across the nation by the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring network, including 50 national parks. NPS ARD interpolates visibility estimates for additional national park units, such as this one, that do not contain an IMPROVE site. The closest IMPROVE monitoring sites are located 72 km (45 mi) southeast of the park at Mohawk Mountain in Torrington, CT and 90 km (56 mi) northeast of the park at Lyebrook in Dover, VT.

Three types of measurements are made at IMPROVE sites: view, optical and particle. The visual appearance of a view is qualitatively documented with automatic photographic or video imagery. At some IMPROVE sites, optical monitors measure the ability of the atmosphere to scatter or absorb light. A particle monitor measures the mass and chemical composition of fine (PM-2.5) and coarse (PM-10) atmospheric particles.

NPS ARD has assessed ten-year (2000–2009) trends in visibility at a subset of national park units as the trend in Haze Index on the 20% clearest days and 20% haziest days (NPS ARD 2013). This Haze Index is expressed as deciviews (dv), which represent a linear scale of human-perceived changes in air quality, analogous to the decibel scale for sound. The Haze Index is near 0 dv for a pristine environment, and an increase of 1 dv represents a small but perceptible change in condition regardless of baseline visibility (Pitchford and Malm 1994).

Reference Conditions/Values

NPS ARD assesses condition for visibility at national park units using a Haze Index, as the deviation of current estimates of five-year average visibility from estimated average natural visibility in the absence of anthropogenic visibility impairment (Table 4-5; NPS ARD 2017). Interpolated estimates are used to assess condition within the contiguous U.S., and are less accurate in the eastern U.S. due to the scarcity of IMPROVE sites. In the eastern U.S., estimated natural background particulate concentrations yield visual ranges of 100 – 130 km (60 – 80 miles); this range varies across the landscape with topography, vegetation and other landscape features (Malm 1999).

Table 4-5. Visibility assessment points and rating developed by National Park Service Air Resources Division (2017).

Metric	Good Condition	Moderate Concern	Significant Concern
Haze Index (dv)	< 2	2–8	> 8

Condition and Trend

NPS ARD estimated the average five-year (2011–2015) Haze Index at this park to be 5.3 dv above natural condition, warranting *moderate concern* (NPS ARD 2018).

NPS ARD did not determine the trend in visibility for this park; ten-year (2000–2009) trends in visibility at national park units in northeastern U.S. showed significant improving trends (Figure 4-4; NPS ARD 2013). Reductions in sulfur dioxide and nitrogen oxide emissions from electric utilities and industrial boilers, required by the Clean Air Act, have contributed to this improving trend (NPS ARD 2013).

Level of Confidence and Data Gaps
Confidence in status assessment based on long-term quantitative data interpolated from distant monitors is low. Park trends were not determined, and confidence in regional trend is medium. If desired, park staff could use automated, time-lapse photographic monitoring to monitor key landscape scenes (see section 4.5.2 Viewshed).

Source(s) of Expertise

- NPS Air Resources Division

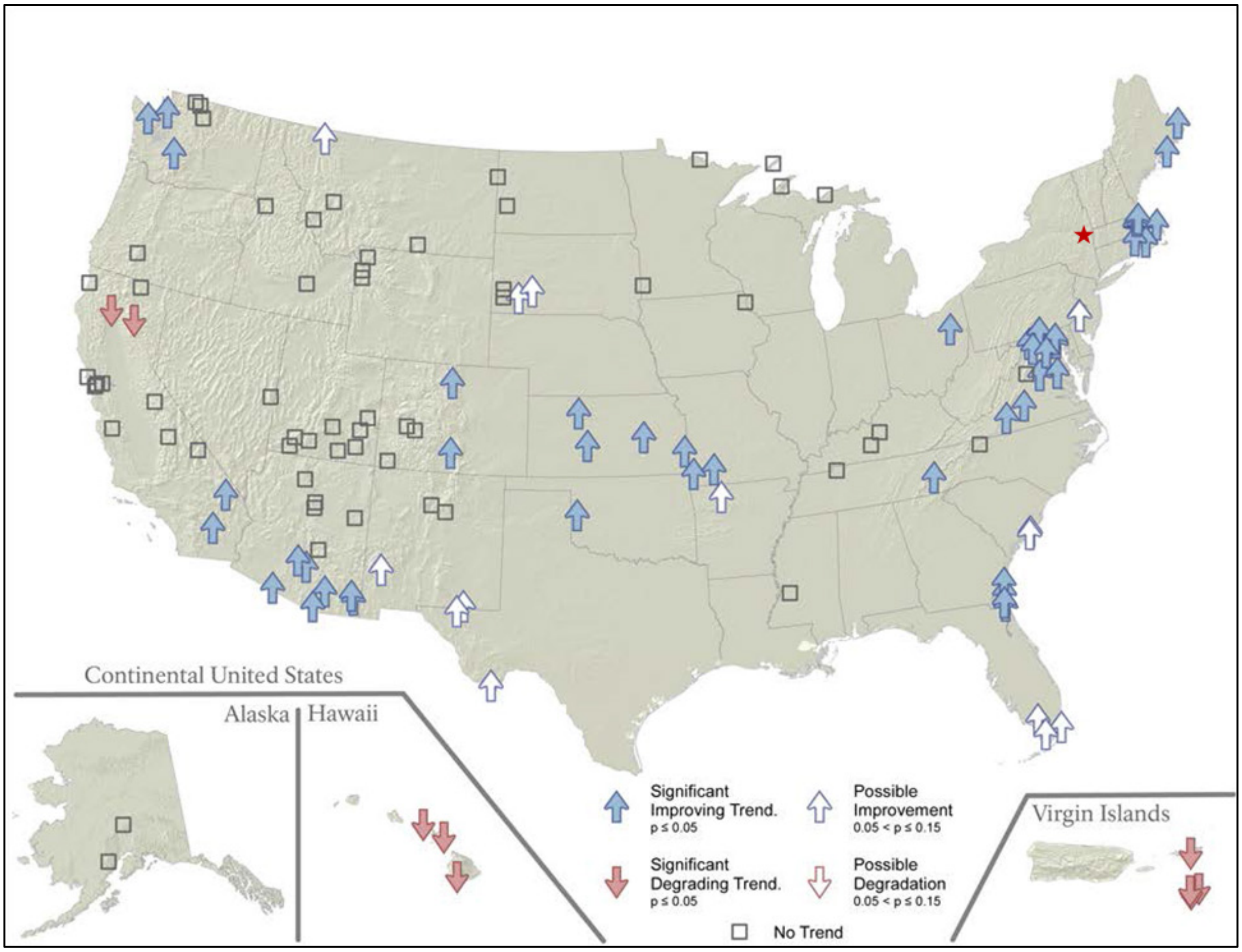


Figure 4-4. National trends in haze index on haziest days, 2000–2009 (excerpted from NPS ARD 2013). Red star shows approximate location of Martin Van Buren National Historic Site.

4.1.4. Mercury Contamination

Description
Mercury (Hg) is an environmental contaminant of concern in aquatic and, more recently, terrestrial ecosystems (Evers et al. 2005, Rimmer et al. 2009). Hg is emitted by coal-burning power plants, gold

mining, solid waste incineration, and other sources. Once in the atmosphere, Hg is widely disseminated and is deposited in both wet and dry form. Atmospheric deposition (both wet and dry) transfers Hg to surface water bodies, where it is transformed by microorganisms in wetland sediments or forest soil into an organic form (methyl mercury, MeHg), a process which can be stimulated by S deposition (US EPA 2008). MeHg is a neurotoxin which bioaccumulates up the food chain, affecting the reproduction, growth, development, and behavior of a variety of organisms including mammals, fish, salamanders, birds, plants, invertebrates and soil microflora. Trends in Hg wet deposition in the northeastern U.S. have decreased since the late 1990s (Weiss et al. 2016).

Data and Methods

In order to better understand Hg condition at national parks, NPS has estimated three-year average Hg wet deposition rates at national park units from data collected nation-wide, and has predicted MeHg concentration in surface waters at national park units from relevant surface water characteristics and wetland abundance (NPS ARD 2017). The closest site for mercury deposition is located 75 km (47 miles) southwest of the park at Biscuit Brook (NY68) in the Big Indian Wilderness in Claryville, NY. NPS has also determined ten-year trends in Hg deposition at a subset of national park units which did not include this park (NPS ARD 2013).

In addition, NPS has developed a citizen scientist monitoring program, the Dragonfly Mercury Project, to monitor dragonfly nymphs as biosentinels for Hg in aquatic food webs in parks across the nation. Dragonfly larvae are useful indicators of Hg contamination for two reasons: they bioaccumulate Hg from their prey, and they are an important food source for many species of fish.

Reference Conditions/Values

NPS ARD (2017) has developed condition ratings for Hg deposition. The Hg status condition assessment is based on two factors: 1) estimated 3-year average Hg wet deposition ($\mu g/m^2/yr$); and 2) predicted meHg concentrations (ng/L) in park surface waters. The combination of these two factors leads to condition ratings of *good condition*, *moderate concern* or *significant concern* as shown in Table 4-6.

Table 4-6. Mercury status assessment matrix developed by National Park Service Air Resources Division (2017). Green, yellow and red circles indicate, respectively, good condition, moderate concern or significant concern.

Predicted Methylmercury Concentration Rating (ng/L)	**Mercury Wet Deposition Rating (µg/m²/yr)**				
	Very Low < 3	**Low** ≥ 3 and < 6	**Moderate** ≥ 6 and < 9	**High** ≥ 6 and < 9	**Very High** > 12
Very Low **< 0.038**	Green	Green	Green	Yellow	Yellow
Low **≥ 0.038 and < 0.053**	Green	Green	Yellow	Yellow	Yellow
Moderate **≥ 0.053 and < 0.075**	Green	Yellow	Yellow	Yellow	Red
High **≥ 0.075 and < 0.12**	Yellow	Yellow	Yellow	Red	Red
Very High **> 0.12**	Yellow	Yellow	Red	Red	Red

Condition and Trend

NPS ARD estimated three-year (2013–2015) wet Hg deposition in the park to be moderate at 6.1 μg/m^2/yr, but condition for mercury contamination could not be determined due to lack of predicted surface water methylmercury concentrations and studies examining mercury levels in park taxa (K. Taylor, NPS, personal communication 10/16/18). Mercury concentrations in dragonfly larvae in parks within 75 km (50 mi) of the park were sampled in 2015–2016 and found to be in the lowest risk category (<315 ppb dry weight; Eagles-Smith et al. 2018). Ten-year (2000–2009) trends in Hg concentration in precipitation were possibly improving at assessed national park units in the northeastern U.S. (Figure 4-5, NPS ARD 2013).

Level of Confidence and Data Gaps

Mercury contamination is a data gap. This gap may be filled by collecting on-site data detailing mercury levels in park taxa, such as in coordination with the NPS Dragonfly Mercury Project or by analyzing toenail clippings from the common snapping turtle (*Chelydra serpentina*).

Source(s) of Expertise

- NPS ARD

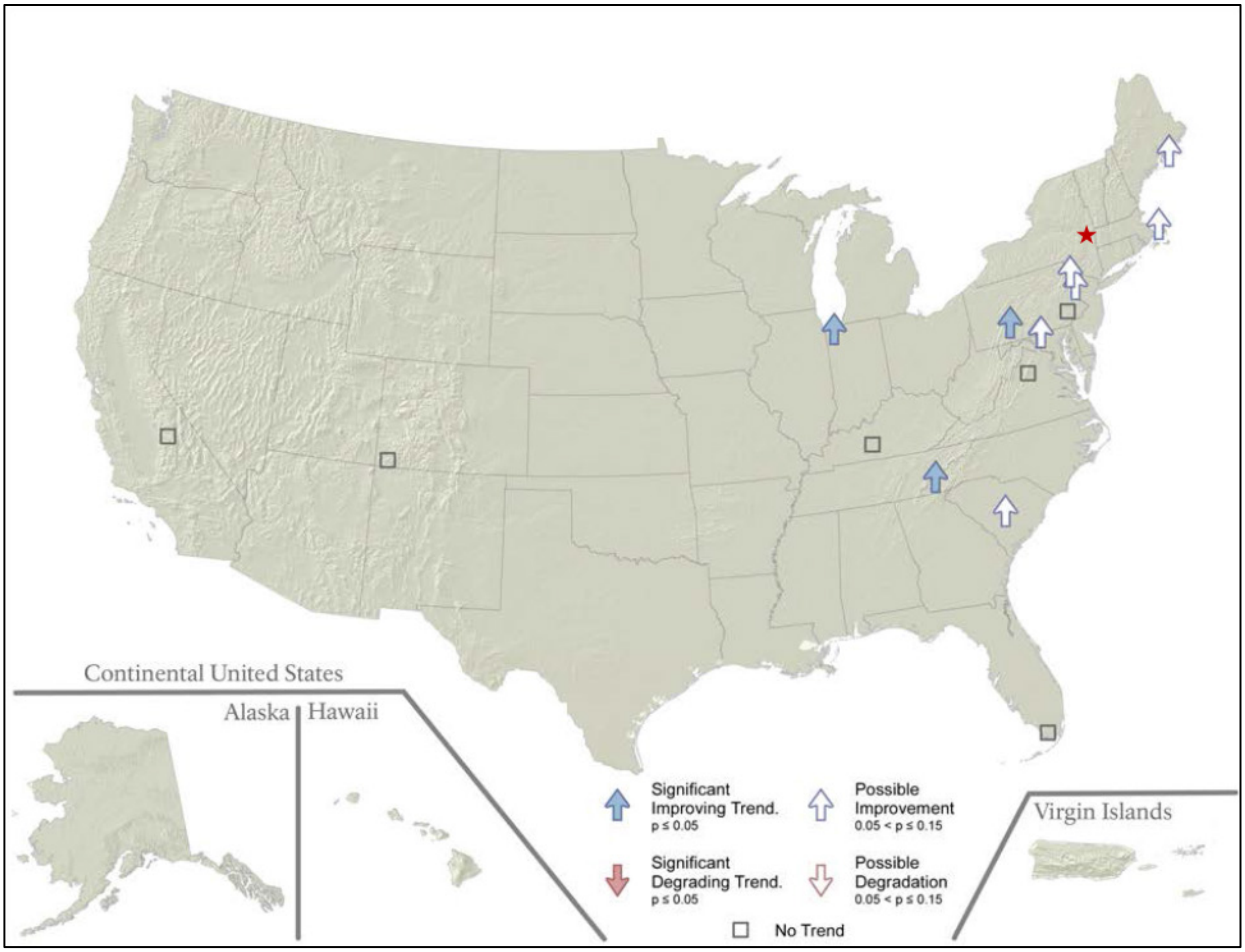


Figure 4-5. National trends in mercury concentrations in precipitation (ng/liter/yr), 2000–2009 (excerpted from NPS ARD 2013). Red star shows approximate location of Martin Van Buren National Historic Site.

4.1.5. Climate

Description

Climate is a dominant driver of ecological and agricultural systems. It is clear that human activities are affecting the earth's climate, and that climate change is occurring (IPCC 2014). NPS has recognized climate change as a major threat to national park units, and has developed a coordinated Climate Change Response Strategy to increase understanding of climate change through science, mitigate climate change with high standards for energy efficiency and greenhouse gas reduction, adapt to climate change with planning and management strategies, and to communicate broadly about the issue (NPS 2010).

In New York State, annual temperatures have been rising over the last century with larger increases seen in winter temperatures, and this trend has lengthened the growing season (Rosenzweig et al. 2011). Continuing increases in temperatures state-wide are expected to bring milder winters and further lengthen the growing season as well as to increase periods of heat stress during the growing season. Modest increases in precipitation are expected as short, extreme precipitation event which may increase flooding and erosion in susceptible areas. Flooding associated with extreme rain events may delay planting, increase soil erosion or compaction, damage roots, and increase contamination of waterways. Increased year-to-year variability in precipitation has also been documented. These changes will allow new agricultural pests, pathogens and weeds to move into the region, and will allow increases in population size of others already present but held in check by cold winters. These changes will present farmers with both challenges and opportunities (Rosenzweig et al. 2011).

Data and Methods

Monahan and Fisichelli (2014) used gridded climate data from the Climatic Research Unit's high-resolution time series to examine 25 climate-related variables over 112 years (1901–2012) at 289 parks across the nation, including two nearby parks (ROVA and Saratoga National Historical Park [SARA]) but not at this park. They used a moving window analysis at three scales (10-, 20-, and 30-year windows) to characterize each park's historical range of variability (HRV; Figure 4-7), and to compare recent averages to historical conditions, noting extreme current condition (i.e., <5% or >95% percentile compared to HRV).

Fisichelli et al. (2014) investigated potential forest change over the 21st century in response to climate change at 121 national parks in the eastern US, including this park. They examined potential changes under two possible future climate scenarios ("least change" and "major change") for the end of the century (2100). The two scenarios represented an increase in mean annual temperature of 2.3–7.1° C (4.1–12.8° F) and increased annual precipitation (9.5 to 15%) over baseline conditions (1961–1990).

Wu et al. (2018) examined changes in climate suitability for bird species at national park units across the nation, based on IPCC climate projections for mid-century (2040–2070) in both summer and winter. Their analysis included projections for two nearby parks (ROVA and SARA) but not this park. It is important to note that these projections considered only changing climatic conditions, and not other critical determinants of bird range and abundance.

The Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State (ClimAID) provides information on vulnerabilities and potential benefits of climate change in order to inform adaptation strategies in nine key sectors, including both ecosystems and agriculture (Rosenzweig et al. 2011).

The Cornell University Cornell University's Climate Smart Farming (CSF) Program provides tools to help farmers prepare for climate change. Online tools include county-level data on current trends and future projections in temperature and precipitation. For example, in Columbia County, NY, average growing season length increased from about 140 days in 1950 to about 160 days in 2010, and by 2100 may increase to 173 days (low emissions scenario) or 200 days (high emissions scenario; CSF 2019). This program also provides a cover crop planting scheduler tool, and a water deficit calculator.

Reference Conditions/Values

Assessment points for climate condition have not been determined.

Condition and Trend

Modeled data suggest increases in mean growing season temperatures of 2.2–7.6 °C (4.0–13.7 °F) and increases in growing season precipitation of 10–15% at the park by the year 2100 due to anthropogenic climate change (Fisichelli et al. 2014). Current condition of temperature and precipitation variables at parks within 75 km (50 mi) show extreme warm and wet conditions compared to the historical record (Monahan and Fisichelli 2014). Projected turnover rates in bird species composition based on summer and winter climate were relatively high in parks of the NE U.S., including both ROVA and SARA (Wu et al. 2018).

Although assessment points for climate condition have not yet been determined, the extent and magnitude of ecosystem impacts expected over the next century under current warming projections warrant *significant concern*.

Level of Confidence and Data Gaps

Confidence in status assessment is low because understanding of ecosystem changes in response to climate change is poor and because assessment points have not been established. Installation of an automated weather station at the park would be a cost-effective way to provide useful information tracking temperature, relative humidity, precipitation, and wind speed and direction. In addition, monitoring of plant or animal phenology here could add to our understanding of the changes that are occurring and the effects on park ecosystems. Phenology is the study of the timing of recurrent biological events, such as flowering, leaf-out, migration, and hibernation, and provides a simple and straightforward process in which to track changes in the ecology of species in response to climate change. The NPS Northeast Temperate Network (NETN) has developed methods for monitoring phenology in national park units by park staff or volunteer observers (Tierney et al. 2013); and the USA National Phenology Network (NPN) provides coordination, support and data visualization tools for monitoring and understanding phenological change.

In addition, decision tools developed by Cornell University's CSF may help identify opportunities and adaptation strategies for responding to climate change. Potential farm adaptation responses might include drainage systems for flood-prone fields, shifting planting dates, selecting new crops, and increasing soil organic matter. Finally, the USDA Northeast Climate Hub provides expertise, tools and opportunities for collaboration for land managers and other stakeholders in the northeast U.S.

Source(s) of Expertise

- NPS Climate Change Response Program

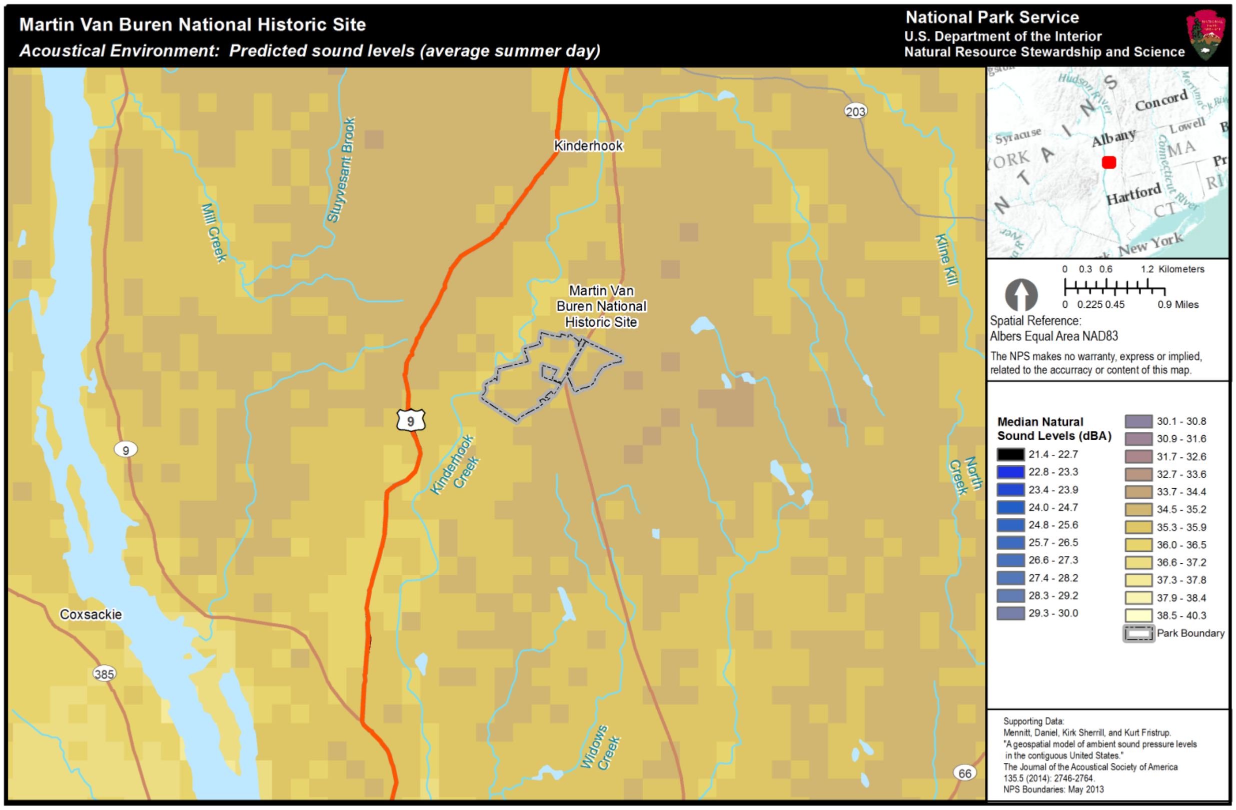
4.1.6. Soundscape

Description

Most visitors to national parks seek an experience undisturbed by man-made noise (Haas and Wakefield 1998). In addition to affecting visitor experience, noise can have significant impacts on wildlife, influencing communication, courtship and mating, predation and predator avoidance, and effective use of habitat (NPS 1994, Barber et al. 2010). The natural soundscape is an inherent component of "the scenery and the natural and historic objects and the wildlife" protected by the NPS Organic Act of 1916 (16 USC 1). Management Policies require the NPS to "restore to the natural condition wherever possible those park soundscapes that have become degraded by unnatural sounds (noise)," "protect natural soundscapes from unacceptable impacts," and preserve the cultural soundscape "for appropriate transmission of cultural and historic sounds that are fundamental components of the purposes and values for which the parks were established" (§ 4.9 and 5.3.1.7 in NPS 2006). Director's Order 47 (NPS 2000) directs park managers to monitor the park soundscape and manage noise. Parks may be affected by noise sources originating both within the park (due to park equipment and management) as well as outside the park (such as airplane and automobile traffic, and nearby land uses and development).

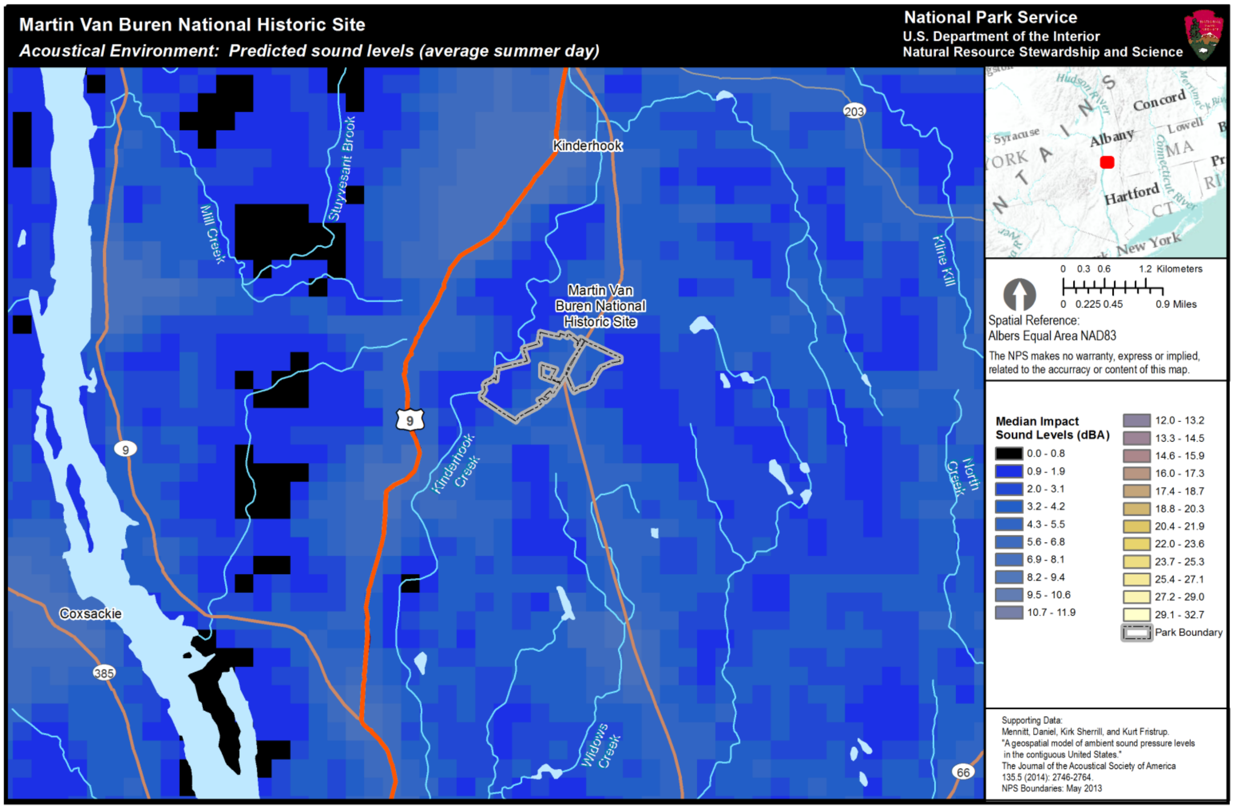
Data and Methods

Soundscape data have not been collected in the park. However, using acoustic data collected at 244 sites, the NPS Natural Sounds & Night Skies Division (NSNSD) has developed a geospatial model which predicts both natural and existing ambient sound levels with 270 meter resolution using 109 spatial explanatory layers from seven categories (location, climatic, landcover, hydrological, anthropogenic, temporal, and equipment; Mennitt et al. 2014). Anthropogenic explanatory variables included road density, distance to all roads and major roads, flight frequency observation data, and a naturalness index based upon land use, housing density and traffic. Natural ambient sound level is the acoustical condition that exists in the absence of human-caused noise and represents the level from which the NPS measures impacts to the acoustic environment (Figure 4-6). Existing ambient sound level is the current sound level in an area, including both natural and human-caused sounds. In addition, the model calculates the difference between these two metrics, providing a measure of impact to the natural acoustic environment from anthropogenic sources. The resulting impact metric indicates how much anthropogenic noise has raised the existing sound pressure levels in a given location (Figure 4-7). Sound pressure levels (SPL) are shown as L_{50} dBA, where L_{50} represents the level that is exceeded 50 percent of the time during a summer day, and dBA is the sound pressure level (amplitude) in decibels (dB) adjusted (weighted) to reflect human hearing sensitivity to frequencies from 1,000 to 6,000 Hz (Turina et al. 2013).



NPS Natural Sounds & Night Skies Division and NPS Inventory and Monitoring Program MAS Group 20180920

Figure 4-6. Modeled natural ambient sound levels (L_{50} dBA) at Martin Van Buren National Historic Site (Figure provided by NPS NSNSD). Lighter colors indicate higher natural sound levels.



NPS Natural Sounds & Night Skies Division and NPS Inventory and Monitoring Program MAS Group 20180920

Figure 4-7. Modeled impact sound levels (L_{50} dBA) at Martin Van Buren National Historic Site range from 1.6 to 4.6 (Figure provided by NPS NSNSD). Impact sound levels represent alteration to the natural acoustic environment. Lighter colors indicate higher impact sound levels.

Reference Conditions/Values

NPS NSNSD has developed interim guidance to assist parks in assessing soundscape condition (Turina et al. 2013). The suggested assessment points for non-urban parks (Table 4-7) are applicable here. Since each 3 dB increase in background sound level will reduce a given listening area by half, the assessment point between *moderate concern* and *significant concern* corresponds to a 50% reduction in listening area (Turina et al. 2013). This means that a rating of *significant concern* is applied to a park in which anthropogenic noise has increased sound levels enough to reduce by half the area over which a park visitor can perceive sounds.

Table 4-7. Suggested assessment points for Soundscape condition in non-urban parks (Turina et al. 2013).

Metric	Good Condition	Moderate Concern	Significant Concern
Mean Impact SPL (L50 dBA)	≤ 1.5	1.5–3.0	≥ 3.0
Corresponding Reduction in Listening Area	≤ 30%	30–50 %	≥ 50%

Condition and Trend

Soundscape condition was assessed for the park by NPS NSNSD using a modeled dataset (Mennitt et al. 2014). Predicted median impact SPL for the park (3.6 L_{50} dBA) corresponding to a reduction in listening area ≥ 50 % and warranting *significant concern*. The trend in soundscape condition was not assessed. Nationwide trends indicate that prominent sources of noise in parks (namely vehicular traffic and aircraft) are increasing (US DOT FHWA 2013, US DOT FAA 2010). However, conditions in specific parks may differ from national trends.

Level of Confidence and Data Gaps

Confidence in status assessment is low because this assessment did not incorporate onsite monitoring, and trend was not assessed. Confidence in soundscape assessment could be increased by onsite monitoring. NPS has developed an Acoustical Monitoring Training Manual (NPS NSNSD 2013) which provides guidance to park managers seeking to define park acoustical zones, select sounds and sites of interest for monitoring, deploy and maintain automated recorders and meteorological instruments, collect data, conduct on-site listening sessions, and analyze acoustical data. A useful first step is to develop an inventory of audible sounds to better understand what sounds presently contribute to the acoustic environment, which are the most common, and which could possibly threaten the quality of the acoustic environment. Inventory data can be collected simply by a single, focused listener in calm weather conditions during a series of listening sessions in several different locations and across different times of day to capture spatial and temporal variation in acoustic conditions (Lynch et al. 2011).

Source(s) of Expertise

- NPS Natural Sounds and Night Skies Division

4.2. Water

Six ponds, a section of Kinderhook Creek, and a channelized creek (Muddy Brook) lie within the park's authorized boundary (Figure 4-8). The spring-fed Upper Pond, constructed by Van Buren in the 1840s, is hydrologically connected to the small Swamp Pond lying on the opposite side of the Roxbury Farm entrance road. Downslope from Upper Pond, additional ponds were excavated in a wetland complex between 1967 and 1994 (von Bieberstein et al. 2018). The largest, Gravel Pond, lies mostly inside the park boundary and appeared newly excavated in 1994 aerial photography (Dickert et al. 2005). Gravel Pond feeds the channelized creek Muddy Brook, which flows through the Southern Swamp into Kinderhook Creek (Farris 2002, Dickert et al. 2005). Both Third Pond and the very small Shed Pond lie in a wooded section of the escarpment past the farm building complex. An additional pond lies east of Route 9H, on privately-owned land within the authorized park boundary. Additional ponds lie on the flag-shaped cut-out parcel near the park's center, outside the current authorized boundary and adjacent to Gravel Pond. Nearby residences draw water from on-site wells, sometimes using water softening, and use on-lot sewage disposal.

Kinderhook Creek runs along the park's northwest boundary and is used by Roxbury Farm for irrigation water. It is a cool, medium river with average depth 0.6 m (2 feet) and average width 14 m (45 feet), rated a class C stream by the NYS DEC, suitable for fishing (NPS 2015). Historic and modern ditches connect agricultural fields on the lower terrace to Kinderhook Creek.

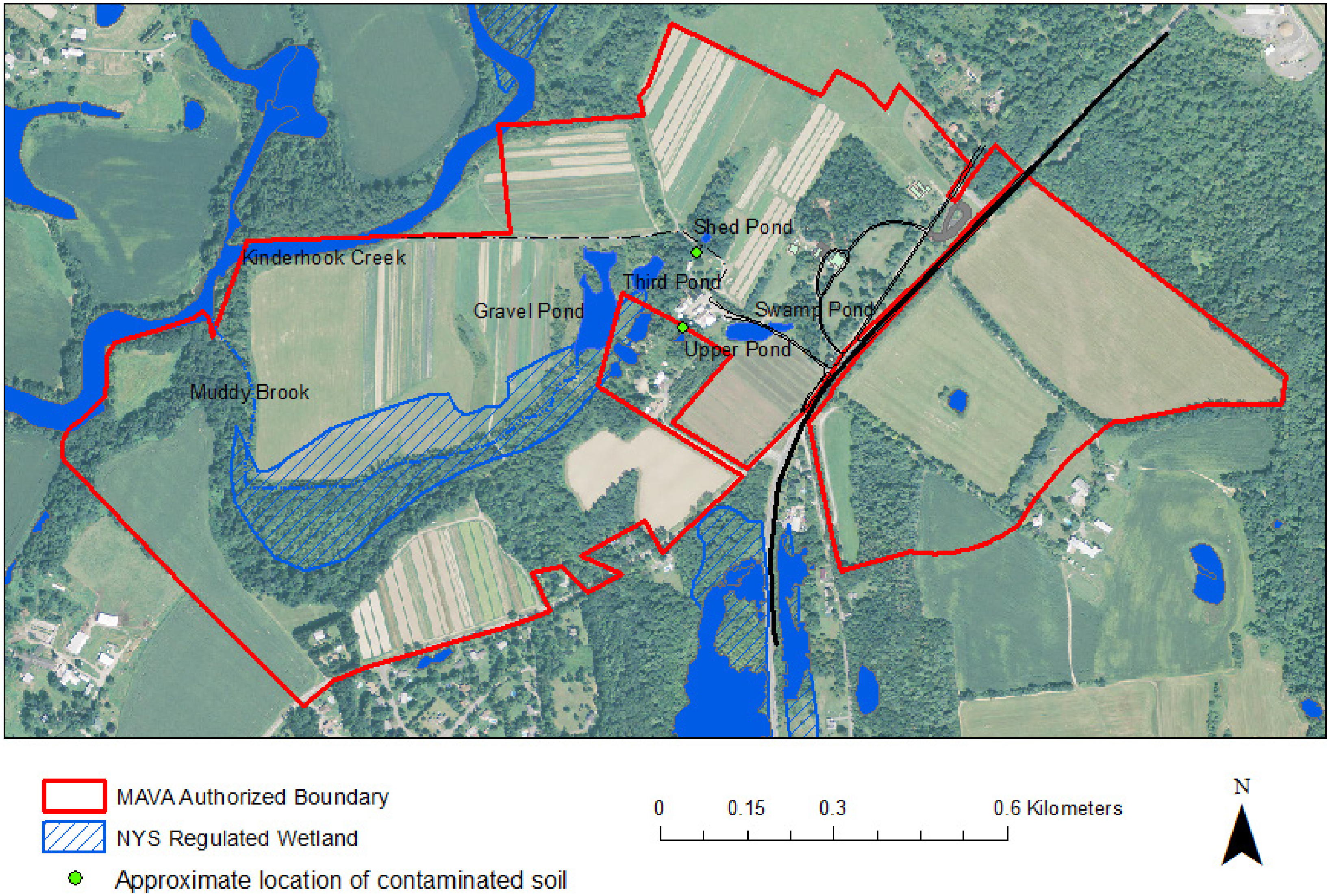


Figure 4-8. Location of water resources at Martin Van Buren National Historic Site. Approximate location of New York State (NYS) regulated wetlands from NYS Department of Environmental Conservation Freshwater Wetland Map Coverages was updated in 1993. See section 4.2.2 for description of contaminated soil.

Three indicators were included to assess condition and trends for Water:

- Water quantity
- Water quality
- Streams – Macroinvertebrates

4.2.1. Water Quantity

Description and Relevance

Climate is a primary driver of hydrology, and variation in the timing and magnitude of precipitation and snowmelt are important drivers of change in water quantity. Low streamflows can create adverse conditions for aquatic life, such as high temperatures and low dissolved oxygen. Regionally, streamflow in the northeast has increased in many areas over recent decades (Tamuddun et al. 2016, Collins 2006).

Low and medium flow conditions in Kinderhook Creek are currently regulated by upstream power plants. The park is affected by occasional flooding from Kinderhook Creek and Upper Pond (Megan O'Malley, personal communication 5/14/19). Kinderhook Creek is used by Roxbury Farm for irrigation; park ponds are not currently used for irrigation but are considered a potential future resource (Megan O'Malley, NPS, personal communication 12/1/2017).

Data and Methods

No data describing water quantity in park ponds were available. Stream discharge for Kinderhook Creek has been measured since 1929 at USGS station 01361000, located at the Rossman Road bridge (about 6.8 river km [4.2 river miles] downstream from the park; Figure 4-9), where diurnal fluctuation and low to medium flow are regulated by upstream power plants (USGS 2019). Trend was determined by comparing recent (2013–2017) mean high-flow (10% exceeds), mid-flow (50% exceeds) and low-flow (90% exceeds) discharge to the historical record (1929–2012).

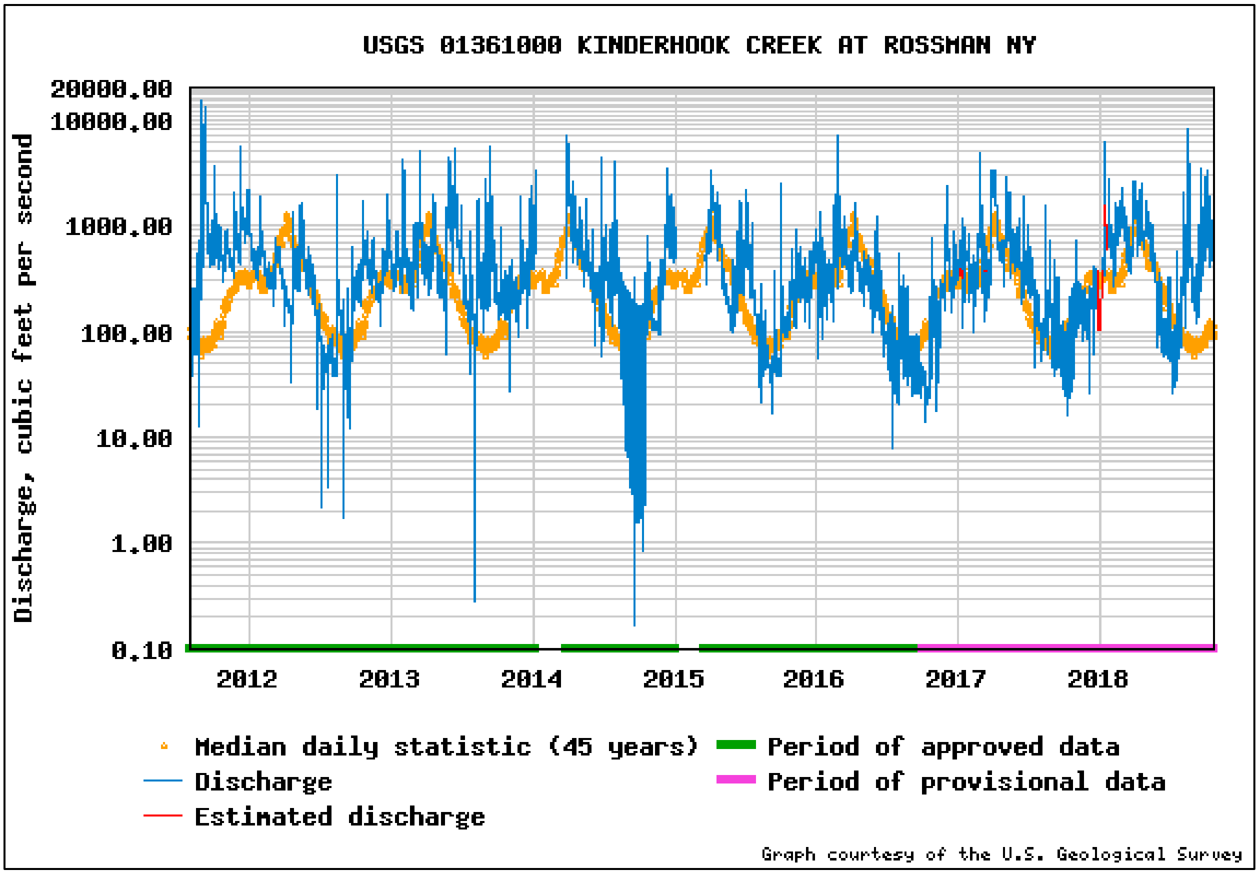


Figure 4-9. Kinderhook Creek stream discharge measured at Rossman, New York, downstream from Martin Van Buren National Historic Site (USGS 2019).

Reference Conditions/Values

Assessment points for water quantity have not been set. Minimum and maximum values for pond water height may be set in comparison to mean values measured onsite, and with consideration of ecological functioning. For Kinderhook Creek stream flow, which is partially regulated by upstream users, reference values consistent with a natural flow regime could be set using data from an appropriate reference stream system in conjunction with minimum flow data from Kinderhook Creek (Pete Sharpe, personal communication 5/14/19). This would identify instances in which Kinderhook Creek streamflow differs substantially from a natural flow regime, and determine minimum flow requirements.

Condition and Trend

Water quantity condition for Kinderhook Creek was not determined due to the lack of established assessment points. Recent (2013–2017) mean high-flow discharge (10% exceeds) for Kinderhook Creek at Rossman (downstream from the park) did not significantly depart from the long-term record (1929–2012). However, recent mid-flow discharge (50% exceeds) was significantly higher than the historical record ($p = 0.04$), and recent low-flow discharge (90% exceeds) was borderline significantly higher than the historical record ($p = 0.10$). Low and medium flow conditions are currently regulated by upstream power plants.

Level of Confidence and Data Gaps
Condition was not assessed.

Source(s) of Expertise

- Pete Sharpe, NPS Northeast Region

4.2.2. Water Quality

Description
Water chemistry is an essential indicator for determining condition of aquatic resources, providing fundamental information about the quality of the resource and its ability to support aquatic life. The pH measures the availability of hydrogen ion, which determines acidity and is influenced by acidic deposition. Temperature affects water chemistry and biology, and temperature is inversely correlated with dissolved oxygen (DO). DO is a critical indicator of water quality because low oxygen levels can kill or stress most aquatic life. A marked increase in specific conductance (a measure of the level of dissolved ions in water) can be an indicator of pollution. Naturally occurring values of specific conductivity, measured in microsiemens (µS) cover a wide range (less than 20 to more than 1,000 µS/cm). N is an essential plant element and is often the limiting nutrient in terrestrial systems and marine waters, though it can also be limiting in some freshwater systems. Phosphorus (P) is a major plant nutrient which is typically limiting to plant growth in streams and ponds. Suspended sediments are particles carried in the water that may accumulate on the river or lake bottom. These sediments increase the turbidity of the water and decrease light penetration, affecting aquatic vegetation, the aquatic food chain, and reproduction of some species. The suspension, transport and deposition of sediment are natural processes that are impacted by anthropogenic activities and landuse. Contamination by organochlorine pesticides (i.e., chlordane and DDT) and lead-containing compounds used at the park under previous ownership can also affect water quality.

Data and Methods
Water and sediment samples from Upper Pond were sampled for contamination (organochlorine pesticides and polychlorinated biphenyls) and nutrients in spring 2019 (Adirondack Environmental Services 2019). Current water quality monitoring data were not available to assess condition and determine trends in other park water bodies or Kinderhook Creek. However, water quality was sampled previously (2002) in four park ponds (Upper Pond, Gravel Pond, Shed Pond, and Third Pond), Muddy Brook, and Kinderhook Creek (at the intersection with Muddy Brook), and groundwater in two park wells was tested in 2011 (Farris 2002, Eckhardt and Sloto 2012). In addition, suspended sediments were measured in Kinderhook Creek from 2011–2014 at USGS station 01361000, located at the Rossman Road bridge (about 6.8 river km [4.2 river miles] downstream from the park; Figure 4-10; USGS 2019). Also, the NPS Hydrographic and Impairment Statistics (HIS) database summarizes information on park hydrologic impairment from state management agencies.

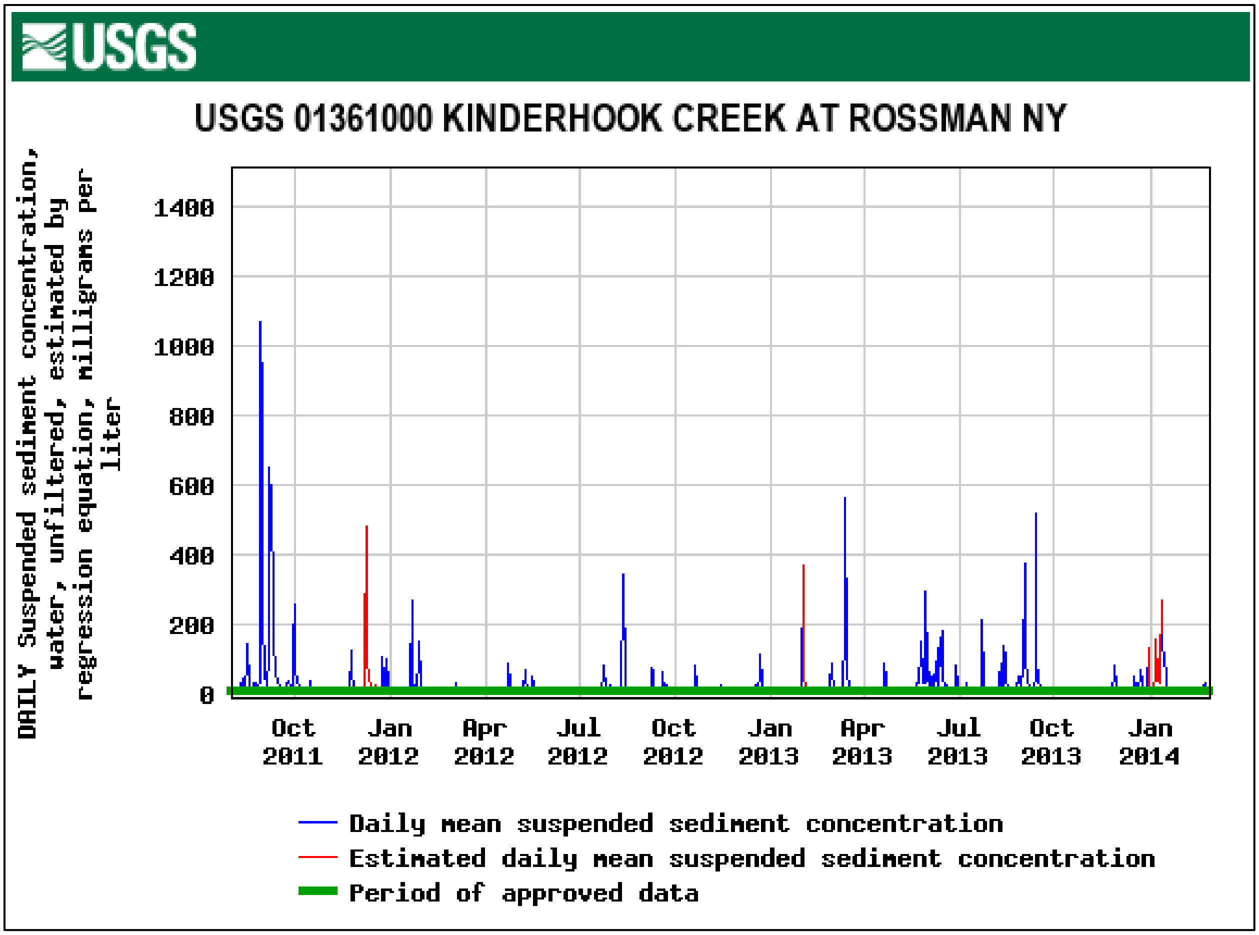


Figure 4-10. Suspended sediments in Kinderhook Creek at Rossman, New York, downstream from Martin Van Buren National Historic Site (USGS 2019).

In 1999, an Environmental Assessment detected soil contamination in two areas near to park ponds and drainage areas (see Figure 4-8; Ecosystems Strategies 2000a and 2000b). First, outside the farm building complex directly north of Upper Pond, surface soil was found to be contaminated with very high levels of chlordane (20,000 µg/kg) and 4,4'-DDT (up to 360,000 µg/kg) as well as 4,4'-DDE (a breakdown product of DDT) above NYS DEC guidance levels for remediation (540 µg/kg for chlordane and 2,100 µg/kg for both 4,4'-DDT and 4,4'-DDE). The highest levels were found directly outside a barn storage area historically used for pesticide storage and at a water spigot near the north corner of this barn, and high levels were also found along a path leading from the storage area to the greenhouses. It was recommended that this area be covered with a concrete or asphalt cap to prevent contact with contaminated soil (Ecosystems Strategies 2000b). Second, surface soil testing east of the loop access road, immediately west of a vehicle fuel tank shed (near Shed Pond) was found to be contaminated by lead (497 mg/kg, roughly twice the NYS DEC action level of 250 mg/kg) 4,4'-DDT (4,000 µg/kg) and 4,4'-DDE (2,800 µg/kg). This area was not recommended for remedial action (Ecosystems Strategies 2000a).

Reference Conditions/Values

Condition of water quality in park ponds and streams may be determined using water quality assessment points from the state, the U.S. EPA, and other sources (Table 4-8). NYS water quality standards were developed for the protection of human health and wildlife (6 NYCRR Part 703, NYS DEC Division of Water 2014). U.S. EPA criteria provide assessment points for nutrient pollution developed specifically for Ecoregion VII (the Glaciated Dairy Region of central New York and the upper Midwestern states) and represent conditions that are minimally impacted by human activities (US EPA 2000a, US EPA 2000b). The EPA criteria are not regulatory values. For ANC, a minimum assessment point of 100 µeq/L is suggested for adequate buffering (Stoddard et al. 2003). For chloride, the U.S. EPA national criteria for chronic exposure to aquatic life is 230 mg/l (US EPA 1988).

Table 4-8. Water quality assessment points for water bodies and streams at Martin Van Buren National Historic Site. Assessment points for significant concern were not determined.

Metric	Good Condition	Moderate Concern	Source
DO* (mg/L)	≥ 5.0	< 5.0	New York State
pH (standard units)	6.5 – 8.5	< 6.5 or > 8.5	New York State
Pond TN (mg/L)	<= 0.66	> 0.66	US Environmental Protection Agency
Stream TN (mg/L)	<= 0.54	> 0.54	US Environmental Protection Agency
Pond TP (µg/L)	<= 15	> 15	US Environmental Protection Agency
Stream TP (µg/L)	<= 33	> 33	US Environmental Protection Agency
Pond Chl a (ug/L)	<= 2.6	> 2.6	US Environmental Protection Agency
Stream Chl a (ug/L)	<= 1.5	> 1.5	US Environmental Protection Agency
Turbidity (NTU)	<= 1.7	>1.7	US Environmental Protection Agency
ANC (µeq/L)	≥ 100	< 100	Stoddard et al. 2003
Chloride (mg/L)	≤ 230	> 230	US Environmental Protection Agency

*Minimum daily average.

Standards for suspended sediment have not been set for the state or for the surrounding region. A water quality standard for suspended sediment should take into account background levels and the duration of the departure from these levels. Recommended assessment points for protection from ecological impacts range from 10 mg/l to 100 mg/l (Berry et al. 2003, Rowe et al. 2003). Sediment contamination was assessed using NYS DEC Bureau of Habitat (2014) guidelines for combined DDD/DDE/DDT contamination (Table 4-9).

Table 4-9. Sediment contamination assessment points for Martin Van Buren National Historic Site.

Metric	Good Condition	Moderate Concern	Significant Concern
Combined DDD/DDE/DDT	< 44 µg/kg	44–48,000 µg/kg	> 48,000 µg/kg

Aquatic habitat can be severely impacted by invasive exotic species. Priority aquatic invasive exotic plant species of concern in the northeast US, identified by the NPS NETN Invasive Species Early Detection (ISED) Program, are shown in Table 4-10. Early detection and rapid response to new infestations of these species may be successful in controlling habitat impacts.

Table 4-10. Priority aquatic invasive plant species of concern for early detection in the northeast U.S.

Scientific Name	Common Name
Didymosphenia geminata	didymo (alga)
Hydrilla verticillata	hydrilla
Hydrocharis morsus-ranae	common frogbit
Myriophyllum aquaticum	parrotfeather
Myriophyllum heterophyllum	variable watermilfoil
Myriophyllum spicatum	Eurasian watermilfoil
Najas minor	brittle waternymph
Potamogeton crispus	curly pondweed
Trapa natans	European water chestnut

Condition and Trend

Data were not sufficient to determine current condition and trend in water quality in the park. Groundwater samples from two park wells met all drinking water standards in 2011 (Eckhardt and Sloto 2012). However, 2019 water sampling in Upper Pond and 2002 sampling in four park ponds (Upper Pond, Gravel Pond, Shed Pond, and Third Pond) showed highly eutrophic conditions. The 2002 water sampling also showed high specific conductance (indicating degraded water quality), and fecal coliform levels in Third Pond which exceeded NYS water quality standards (Farris 2002).

Sediment sampling in Upper Pond in 2019 detected combined 4,4'-DDD/DDE/DDT contamination up to 960 µg/kg, warranting moderate concern (44–48,000 µg/kg) and additional testing. This is not surprising, given that high levels of soil contamination were detected previously in two areas near park ponds (Upper Pond and Shed Pond) and drainages indicating the potential for contamination from runoff into these ponds as well as Muddy Brook, which flows from Gravel Pond through the Southern Swamp into Kinderhook Creek (Figure 4-8; Ecosystems Strategies 2000a and 2000b). In addition, one high priority invasive exotic species (European water chestnut) was detected in Gravel Pond during a 2007 survey (FEP 2008). This limited information warrants *moderate concern*.

Suspended sediments measured in Kinderhook Creek at Rossman from 2011–2014 showed most (65%) daily values falling below 10 mg/L, a level associated with few if any ecological effects and indicative of good water quality, while 4% of daily values exceeded 100 mg/L, a level associated with negative ecological effects and poor water quality. The NPS HIS database reported no known impairment of waterways or water bodies in the park (Dean Tucker, NPS, personal communication 1/31/19).

Level of Confidence and Data Gaps
Water quality is a data gap that could be filled by periodic sampling of select park ponds and Kinderhook Creek. The NPS NETN provides standardized methods and expertise for monitoring of water quality in national park units in this region (Gawley et al. 2015). Monitoring should include assessment of nutrient levels and examination for infestations of key invasive exotic species (Table 4-10), in addition to basic water quality parameters. The extent and ecological impacts of sediment contamination in park ponds from previous agricultural activities should be assessed.

Source(s) of Expertise
- Pete Sharpe, NPS

4.2.3. Stream Macroinvertebrates

Description
Stream macroinvertebrates, such as insect larvae and worms, were identified as a Vital Sign to be monitored in national park units in the northeastern U.S. (Mitchell et al. 2006). The richness and composition of macroinvertebrate taxa in streams respond rapidly to changes in the physical and chemical environment, and provide a useful indicator of stream condition.

Data and Methods
Stream macroinvertebrates are not monitored at this park. However, the Hudson Basin River Watch has assessed stream macroinvertebrate abundance and diversity in Hudson River tributaries including Kinderhook Creek (Hudson Bay River Watch 2006). In 2006, macroinvertebrates were sampled in Kinderhook Creek just above the CR 25A bridge, near Stuyvesant Falls (about 3.2 river km [2 river mi] downstream from the park). Stream macroinvertebrates were previously sampled in 2000 at this site by the NYS DEC Stream Biomonitoring Unit (SBU; Bode et al. 2004).

Reference Conditions/Values
The NYS DEC assigns condition rating for stream macroinvertebrates using a multi-metric assessment tool called the Biological Assessment Profile (BAP; Table 4-11; NYS DEC Division of Water 2014). Rating is assigned using eight criteria including species richness, diversity, dominance, richness of sensitive and pollution-tolerant species, and comparison of species distribution to minimally-impacted reference streams. A rating of non-impacted condition indicates a diverse macroinvertebrate community with mayflies, stoneflies, caddisflies, and beetles, and the absence or sparseness of aquatic worms.

Table 4-11. Condition ratings for stream macroinvertebrate condition from New York State Department of Environmental Conservation Division of Water (2014).

Category	Good Condition	Moderate Concern	Significant Concern
BAP rating	7.51–10.00	5.01–7.50	0–5.00
Description of condition	Non-impacted with very good water quality	Slightly impacted with good water quality	Moderately or severely impacted with poor or very poor water quality

Condition and Trend

Current data for assessing macroinvertebrate condition in Kinderhook Creek were not available. Macroinvertebrate data collected in 2006 from Kinderhook Creek near Stuyvesant Falls (about 3.2 river km [2 river mi]) downstream from the park scored 6.05 (out of 10) in the NYS DEC BAP, indicating slightly impacted condition (Hudson Bay River Watch 2006). Data collected from that site in 2000 showed non-impacted condition (Bode et al. 2004); this indicates deterioration in condition during the period 2000–2006.

Level of Confidence and Data Gaps

Condition could not be assessed due to lack of current park data. If desired, this data gap could be filled using the methods of the NYS DEC Division of Water (2014).

Source(s) of Expertise

- NYS DEC Stream Biomonitoring Unit

4.3. Geology and Soils

One indicator was included to assess condition and trend for Geology and Soils:

- Agricultural soils

4.3.1. Agricultural Soils

Description

Agricultural soil is a key park natural resource at that is central to both the park's historical significance as well as to the park's continuing mission to interpret progressive farming today. The park lies on deep, level or gently sloping flood plain soils, about a third of which are considered prime farmlands (see Figure 2-3). Soils on the lower terrace are Occum loam, Limerick silt loam and Linlithgo silt loam, with Hoosic gravelly sandy loam on the upper terrace, Knickerbocker fine sandy loam on parcels east of Route 9H, and Palms muck in the wetland area at the base of the wooded escarpment separating the two terraces (USDA NRCS 1989). This land has been continuously farmed since the 17th century.

Data and Methods

Roxbury Farms has performed soil fertility testing on park agricultural soils periodically since 1999. Current condition was determined from test results from twelve fields within the park's authorized boundary during the two most current years available (2014 and 2016) averaged across years. Soil chemistry analysis was performed by commercial agricultural soil testing services using the Mehlich 3 extraction protocol. Previous (2006) data from two fields under NPS ownership was available to examine trends, and change between previous and current sampling for soil organic matter and phosphorus (P) was estimated using t-tests; however, differences in sampling methods and location between the two sampling periods limit confidence in trend analysis.

An Environmental Assessment in 1999 found limited areas of soil contamination, indicating that the "historical application of pesticides on the subject property has not impacted the majority of on-site soils" (Ecosystem Strategies, Inc. 2000b). The soil contamination detected at two locations is described in section 4.2.2, and locations are shown in Figure 4-8.

Reference Conditions/Values

Guidelines for determining condition of soil chemistry metrics are shown in Table 4-12. Soil pH, a measure of the acidity or alkalinity of the soil, controls many soil chemical properties including the availability of nutrients and toxins. While many crops grow best under pH of 6–7, some crops grow better in more acidic soil. Soil pH is affected by soil parent material, plant cover, and rainfall, as well as environmental pollution and application of fertilizer. Soil organic matter consists of decomposing plant and animal material in the soil, and organic matter provides many physical, chemical and biological benefits. While addition of fertilizer or soil amendment can improve crop yields, excessive use of N and P fertilizer can cause negative environmental impacts in nearby waterways and wetlands. Salinization from irrigation or runoff from roads treated with road salt can inhibit plant growth. Several elements necessary for plant growth in small quantities (i.e., micronutrients) can become toxic at higher levels, including the heavy metals zinc (Zn), iron (Fe), and copper (Cu).

Table 4-12. Guidelines for assessment of condition for agricultural soils.

Metric	Good Condition	Moderate Concern	Significant Concern
pH	Within optimal levels for crop (typically 6–7).	Suboptimal levels for crop.	Levels negatively impacting soil processes.
Nutrients (P, K, Mg, Ca, B)	Within optimal levels for crop and control of ecosystem impacts.	Suboptimal levels for crop.	Levels causing negative impacts to crops or ecosystems.
Heavy metals (Zn, Fe, Cu)	Above critical level for plant growth, but below levels of toxicity.	Below critical level for plant growth.	Levels causing toxicity to crops, human health or the food web.
Salinity (Na)	Below levels causing documented negative effects.	Levels causing negative effects to sensitive organisms.	Levels causing negative effects to organisms not considered sensitive.

Condition and Trend

Agricultural soil condition (2014–2016) showed good condition for many soil parameters but warranted *moderate concern* for lower than desired levels of soil organic matter and high iron levels, and warranted *significant concern* for very high phosphorus levels (see Table 4-13). Current levels of soil organic matter showed improvement (i.e., increase) from 2006 levels in both fields examined for change between time periods, while levels of soil P indicated improvement (i.e., declined) in the Lindenwald field (located southwest of the mansion).

Table 4-13. Agricultural soil condition at Martin Van Buren National Historic Site.

Characteristic	Min	Median	Max	Interpretation
pH	6.1	6.5	6.8	*Good condition* (6–7 for most crops).
Soil organic matter	2.4	3.0	3.6	Low (< 3.0) to medium. *Moderate concern* for suboptimal levels.
P	114	287	592	Very high (> 75). *Significant concern* for impacts to freshwater ecosystems.
K	94	220	350	Medium to very high (> 135). *Good condition*.
Mg	126	168	208	Medium to very high (> 150). *Good condition*.
Ca	805	1120	1500	Medium to very high (> 900). *Good condition*.
Zn	2.0	6.0	9.8	Medium to high, but below levels of concern (>= 50). *Good condition*.
Fe	213	276	358	Very high. *Moderate concern* for levels >= 300.
Cu	1.0	5.1	13	Medium to high, but below levels of concern (>= 75). *Good condition*.
B	0.2	0.6	0.8	A few low values (<= 0.3) but overall sufficient, indicating *good condition*.
Na	7.0	20	26	Very low (< 40 ppm), indicating *good condition*.

Level of Confidence and Data Gaps

Confidence in estimates of condition from two years of quantitative data is medium, while confidence in estimate of change between sampling events is limited by the small number of samples and by differences in sampling methods between the two time periods.

4.4. Biological Integrity

Seven indicators were included to assess condition and trend for Biological Integrity:

- Riparian and wetland vegetation
- White-tailed deer
- Birds
- Amphibians and reptiles
- Mammals
- Insects
- Conservation species

4.4.1. Riparian and Wetland Vegetation

Description

Freshwater wetlands and riparian zones provide many valuable ecosystem services including surface water detention and filtration, sediment retention, and nutrient transformation, in addition to providing critical habitat for many species of plants, insects, amphibians, fish and mammals. A state-regulated freshwater wetland (including the "Southern Swamp") lies within the park at the base of the escarpment on somewhat calcareous muck soil, and a riparian area associated with Kinderhook Creek runs along the park's northwest boundary (see Figure 4-8). The farm's lower terrace lies within the 100-year floodplain of Kinderhook Creek, and a network of ditches and/or channelized streams connect agricultural fields on the lower terrace to Kinderhook Creek. Dickert et al. (2005) describe one channelized stream (Muddy Brook) connecting the Southern Swamp to Kinderhook Creek, a second connecting the vegetated escarpment surrounding Third and Shed Ponds to Kinderhook Creek, and additional smaller ditches draining the agricultural fields. These ditches have altered the hydrology of the farm, allowing agricultural in areas prone to flooding but likely have also short-circuited water filtering by wetland buffers and potentially reduced associated water quality benefits.

The emerald ash borer (*Agrilus planipennis*; EAB) is a destructive Asian beetle that kills most native species of ash (*Fraxinus* spp.) within two to four years of infection. One exception is blue ash (*F. quadrangulata*), a tree of calcareous substrates native to the Midwestern U.S. and which has shown some resistance to this pest (Nisbet et al. 2015). EAB is present in the region and has been detected in the Town of Kinderhook (NYS DEC 2019). Characteristic signs of EAB infection include dieback, browning and yellowing of leaves, and distinctive D-shaped exit holes in tree boles and branches, often in the canopy. The rapid loss of ash trees from the park would have a cascading set of impacts on park riparian and wetland ecosystems, including potential alteration of aquatic food webs and biogeochemical cycling, and the loss of specialized arthropod species highly associated with ash (Nisbet et al. 2015). Ash leaves have a relatively low lignin: nitrogen ratio, allowing decomposition at a faster rate than that of several other riparian tree species, and providing a labile food source to aquatic food webs (Nisbet et al. 2015). In this park, swamp areas are dominated by red maple, green ash and slippery elm; while red maple leaf litter has higher tannin levels and is less labile than green ash, slippery elm leaf litter has similar properties to ash which may buffer impacts of ash mortality on aquatic food webs and biogeochemical cycling. Some national park units are protecting selected ash trees with regular injections of insecticide, and federal agencies are exploring biocontrol options (Matthews and Nortrup 2018). In riparian and wetland areas where substantial ash are lost to EAB, land managers may consider planting replacement trees with similar leaf litter nutrient quality, such as bitternut hickory (*Carya cordiformis*) or Dutch-elm disease resistant American elm (*Ulmus americana*; Nisbet et al. 2015).

Data and Methods

Status and trends in wetland and riparian vegetation are not currently monitored at this park. However, preliminary assessment of the buffer condition of two wetland and riparian areas was assessed from ortho-imagery using the U.S. EPA Rapid Assessment Method (USA-RAM; US EPA 2011). USA-RAM methodology assesses wetland condition and stress based on four components: buffer, hydrology, physical structure and biological structure. NETN draws upon the RAM and other methods for assessment of wetland vegetation at Acadia National Park (Miller and Mitchell 2013). While most of these components require a site visit, preliminary assessment of the condition of wetland buffers can be assessed using ortho-imagery, and ideally would be confirmed by ground-truthing during a subsequent site visit.

In the present assessment, two areas were examined: 1) the state-regulated wetland which includes the park's Southern Swamp, and 2) the riparian strip lying south of Kinderhook Creek within the park's authorized boundary. Condition was assessed from National Agricultural Imagery Program (NAIP) 2017 ortho-imagery using USA-RAM methods as summarized here (US EPA 2011). The wetland's assessment area corresponded to the NYS DEC wetland boundary, and the assessed buffer zone extended 100 m from the wetland boundary. To qualify as wetland or riparian buffer, a land cover patch must meet a minimum size requirement (at least 5 m wide and extending at least 10 m along the boundary) and be a natural land cover type. Anthropogenic cover types such as built structures, highways and parking lots, agricultural fields, lawns, and ATV trails do not qualify as wetland buffer. The percent of assessment area having a buffer was visually estimated to the nearest 5%. To estimate buffer width, a central point was selected within the wetland area and eight transects were drawn in the 4 cardinal directions (N, S, E, and W) and 4 ordinal directions (NE, SE, SW, and NW). Then, buffer width was measured to the nearest 5 m along each transect, up to a distance of 100 m, and the eight measurements were averaged. To estimate buffer width in the riparian zone, eight transects were drawn perpendicular to the shoreline at regular intervals along the length of the park segment, the eight measurements were averaged. This condition assessment is considered preliminary because a subsequent site visit for ground-truthing was not part of this assessment. Trend was assessed by comparison of current (2017) to previous (2007) NAIP imagery.

Reference Conditions/Values

Suggested assessment points for determining condition of wetland and riparian buffers from selected USA-RAM metrics are shown in Table 4-14.

Table 4-14. Suggested metrics and assessment points for determining condition of wetlands and riparian zones (adapted from US EPA 2011 and Faber-Langendoen 2009).

Metric	Good Condition	Moderate Concern	Significant Concern
Amount (percent) of assessment area having a buffer	> 50 – 100%	25–49%	< 25 %
Buffer width (average)	>= 100 m	30–99 m	< 30 m
Stress to buffer zone	No stressors affecting >= 1/3 of buffer	At least 1 stressor affecting >= 1/3 of buffer	At least 1 stressor affecting >= 2/3 buffer
Alterations to hydroperiod	Hydroperiod alterations are not severe	At least 1 moderately severe alteration impacting hydroperiod	At least 1 severe alteration impacting hydroperiod
Stress to water quality	Water quality stressors are not severe	At least 1 moderately severe stressor impacting condition	At least 1 severe stressor impacting condition
Habitat/substrate alterations	Substrate alterations are not severe	At least 1 moderately severe alteration impacting substrate	At least 1 severe alteration impacting substrate
Percent cover of invasive plants	0 %	< 5 % in any strata	>= 5 % in any strata
Vegetation disturbance	Vegetation disturbance are not severe	At least 1 moderately severe vegetation disturbance noted	At least 1 severe vegetation disturbance noted

Wetland and riparian habitat can be severely impacted by invasive exotic species. Priority invasive exotic species of concern in the northeast U.S., identified by the NPS NETN ISED Program, are shown in Table 4-15. Early detection and rapid response to new infestations of these species may be successful in controlling habitat impacts.

Table 4-15. Priority invasive plant species of concern for early detection in the northeast United States.

Lifeform	Scientific Name	Common Name
Herb	*Alliaria petioloata*	garlic mustard
	Cardamine impatiens	narrowleaf bittercress
	Fallopia japonica	Japanese knotweed
	Heracleum mantegazzium	Giant hogweed
	Microstegium vimineum	Japanese stiltgrass
	Oplismenus hirtellus ssp. *undulatifolius*	wavyleaf basketgrass
	Phragmites australis	common reed
	Ranunculus ficaria	lesser celandine
Vine	*Ampelopsis brevipedunculata*	porcelainberry
	Dioscorea oppositifolia	Chinese yam
	Lonicera japonica	Japanese honeysuckle
	Persicaria perfoliata	mile-a-minute
	Pueraria montana	kudzu
	Vincetoxicum nigrum/ V. rossicum	black / European swallowwort
Shrub	*Aralia elata*	Japanese aralia
	Elaeagnus umbellata	autumn olive
	Euonymus alatus	winged burning bush
	Ligustrum spp.	privet
	Rhamnus cathartica	buckthorn
	Rhamnus frangula	glossy buckthorn
	Rosa multiflora	multiflora rose
	Rubus phoenicolasius	wine raspberry
Tree	*Ailanthus altissima*	tree of heaven
	Paulownia tomentosa	princess tree

Condition and Trend

Preliminary assessment of the condition of wetland and riparian buffer showed *good condition* (50 to 100%) for amount (percent) of the park's Kinderhook Creek segment having a buffer, *moderate concern* (25–49%) for amount (percent) of the Southern Swamp having a buffer; and *moderate concern* (30–99 m) for both areas for limited buffer width. However, the existing network of ditches and/or channelized streams connecting agricultural fields on the lower terrace to Kinderhook Creek likely reduces the benefit of wetland buffering along the creek by allowing water to bypass the filtering process within the vegetated buffer (Pete Sharpe, personal communication 5/14/19). Comparison of current (2017) to previous (2007) imagery showed no change in buffer widths over the past decade.

Level of Confidence and Data Gaps

Confidence in estimate of condition and trend from a single remote parameter is low. While EAB has not yet been detected in the park, it is present in the Town of Kinderhook. Park staff should survey ash trees in the Southern Swamp, along Kinderhook Creek, and in other locations annually for signs of EAB infection. Park managers may consider chemical or biological control options for key trees.

Source(s) of Expertise

- US EPA RAM
- Pete Sharpe, NPS Northeast Region

4.4.2. White-tailed Deer

Description

White-tailed deer are a "keystone" species in the northeastern U.S., having a strong effect on the composition, structure and function of the ecosystems they inhabit (Waller and Alverson 1997). Sustained, selective browsing by a historically high population of white-tailed deer is currently impacting understory species composition and tree regeneration in parts of the northeast U.S (Cote et al. 2004, Kain et al. 2011). Sustained browsing pressure can result in population reduction or loss of species preferred by deer (such as native perennial forbs and regeneration of many tree species) and increases in browse-resistant or non-preferred species (such as grasses and sedges, ferns, and exotic species; Augustine and deCalesta 2003, Rooney 2009).

Roxbury Farm has reported that deer browse impacts their crops, particularly beets, sweet potatoes and lettuce, and that in time of drought, deer will browse ″any and all crops″ (Megan O'Malley, NPS, personal communication 12/19/18).

Data and Methods

Local deer population size and the amount of browse available determine browse pressure on vegetation. Deer population size and impacts are not monitored in the park; however, data on deer-browsing impacts has been collected at SARA and ROVA, located within 75 km (50 mi) of the park, as part of the NPS I&M Long-term Forest Monitoring Program. As part of that program, an index of deer browse impacts (DBI) is qualitatively assessed in long-term monitoring plots using a 5-point scale. Current data for those parks was collected from 2015–2018 (Miller and Seirup 2017, Miller and Seirup 2018).

In addition, the NYS DEC Division of Fish and Wildlife (DFW) monitors deer population within state wildlife management units (WMU) using harvest data (NYS DEC 2017). Trend in white-tailed deer population was inferred from harvest data for WMU 4T, located in northwestern Columbia County (Jeremy Hurst, NYS DEC, personal communication 9/24/18). Regression analysis was used to determine trend in deer take from 2007–2016.

Reference Conditions/Values

Historical densities of white-tailed deer in the eastern U.S. are estimated at 3–4 deer per km^2 (McCabe and McCabe 1997). Negative browse impacts have been documented where deer densities exceed 8 deer per km^2 for 10 or more years, and severe impacts have been observed with deer densities ≥ 20 per km^2 (Horsley et al. 2003, Augustine and deCalesta 2003). Condition ratings for white-tailed deer are shown in Table 4-16.

Table 4-16. Condition ratings for white-tailed deer population density and browse impacts. DBI is a deer-browse impact index (Miller and Sierup 2018).

Metric	Good Condition	Moderate Concern	Significant Concern
Deer population density (deer per km2)	< 8	8–20	≥ 20
Deer-browse impacts	No or low impact. Preferred browse species abundant.	Medium impact. Preferred browse species present, but most < 30 cm tall.	High impact. Preferred browse species rare to absent. Distinct browse line.
DBI value	1–2	3	4–5

Condition and Trend

Qualitative assessment of deer-browse impacts at national park units within 75 km (50 mi) of the park warranted *significant concern* for high impacts, and deer-browse impacts at those parks may be increasing (Miller and Seirup 2017, Miller and Seirup 2018). Ten-year trend (2007–2016) in regional deer buck take showed no trend, though reported doe and fawn sighting rates in 2016–2017 were higher than the 10-year average (NYS DEC 2017).

Level of Confidence and Data Gaps

Level of confidence in condition estimate from nearby parks is low. Confidence in regional ten-year population trend from harvest data is medium.

Source(s) of Expertise

- NPS Northeast Temperate Network
- NYS DEC Division of Fish and Wildlife

4.4.3. Birds

Description

Birds are a visible and charismatic faunal group, inspiring great public interest. They are sensitive to habitat degradation, so changes in bird abundance and relative species richness provides insight into environmental health. Across North America, populations of grassland birds have declined steeply since the 1970s, but appear to have stabilized in the last fifteen years while populations of wetland birds have shown strong increases since the 1990s (NABCI 2017). Bird populations face many threats, including habitat degradation and loss, predation by cats and other animals, pesticides, and climate change impacts to bird habitat and biotic interactions between birds and their prey. The park provides habitat for birds of grasslands/agricultural fields and wetlands.

Data and Methods

Bird populations are not monitored in the park. More than 90 species of birds have been documented to occur here, including many species of conservation interest (see Table 4-17; NPS 2019, Dickert et al. 2005). This category includes species which are protected as threatened (T) or endangered (E) by the federal (US) or state government (NYS) or have been identified by the state as Special Concern (SC), or Species of Greatest Conservation Need (SGCN) or Potential Conservation Need (SPCN). In addition, Partners in Flight (PIF) has developed and maintains the Avian Conservation Assessment Database, a resource which assess the population status of all North American bird species and identifies at-risk species on a Watch List (PIF-WL), as well as Common Birds in Steep Decline (CBSD).

Table 4-17. Bird species of conservation interest documented or potentially present at Martin Van Buren National Historic Site.

Scientific Name	Common Name	Conservation Status	Park Status
Bonasa umbellus	Ruffed grouse	Species of Greatest Conservation Need	Historic
Anas rubripes	American black duck	Species of Greatest Conservation Need	Present, rare
Chaetura pelagica	Chimney swift	Partners in Flight Watch List	Present, rare
Coccyzus americanus	Yellow-billed cuckoo	Common Birds in Steep Decline	Potential
C.erythropthalmus	Black-billed cuckoo	Species of Greatest Conservation Need, Partners in Flight Watch List	Potential
Scolopax minor	American woodcock	Species of Greatest Conservation Need, Partners in Flight Watch List	Present, rare
Ardea alba	Great egret	Species of Greatest Conservation Need	Present, rare
Butorides virescens	Green heron	Common Birds in Steep Decline	Present, rare
Botarus lentiginosus	American bittern	New York State Special Concern	Historic
Pandion haliaetus	Osprey	New York State Special Concern	Present, rare
Circus cyaneus	Northern harrier	New York State Threatened	Present, rare
Accipiter striatus	Sharp-shinned hawk	New York State Special Concern	Historic
Accipiter cooperii	Cooper’s hawk	New York State Special Concern	Historic
Buteo lineatus	Red-shouldered hawk	New York State Special Concern, Species of Greatest Conservation Need	Potential

Table 4-17 (continued). Bird species of conservation interest documented or potentially present at Martin Van Buren National Historic Site.

Scientific Name	Common Name	Conservation Status	Park Status
Falco sparverius	American kestrel	Species of Greatest Conservation Need	Present, rare
Empidonax minimus	Least flycatcher	Common Birds in Steep Decline	Present, rare
Eremophila alpestris	Horned lark	Species of Greatest Conservation Need	Potential
Plectrophenax nivalis	Snow bunting	Common Birds in Steep Decline	Potential
Hylocichla mustelina	Wood thrush	Species of Greatest Conservation Need, Partners in Flight Watch List	Present, uncommon
Toxostoma rufum)	Brown thrasher	Species of Greatest Conservation Need	Historic
Dolichonyx oryzivorus	Bobolink	Species of Greatest Conservation Need, Partners in Flight Watch List	Present, rare
Sturnella magna	Eastern meadowlark	Species of Greatest Conservation Need	Potential
Vermivora cyanoptera	Blue-winged warbler	Species of Greatest Conservation Need	Present, rare
Vermivora chrysoptera	Golden-winged warbler	New York State Special Concern, Species of Greatest Conservation Need, Partners in Flight Watch List	Potential
Oreothlypis peregrina	Tennessee warbler	Species of Potential Conservation Need	Present, rare
Setophaga (Dendroica) cerulea	Cerulean warbler	New York State Special Concern, Species of Greatest Conservation Need, Partners in Flight Watch List	Potential
Cardellina canadensis	Canada warbler	Species of Greatest Conservation Need	Potential
Spizella arborea	American tree sparrow	Common Birds in Steep Decline	Present
Spizella pusilla	Field sparrow	Common Birds in Steep Decline	Present
Piranga olivacea	Scarlet tanager	Species of Greatest Conservation Need	Present, rare

As described above in section 4.1.5, Wu et al. (2018) examined changes in climate suitability for bird species at national park units across the nation, including nearby ROVA and SARA, based on IPCC climate projections for mid-century (2040–2070). This analysis identified a small group of bird species that are highly sensitive to climate change and occur at ROVA or SARA (Schuurman and Wu 2019a, Schuurman and Wu 2019b). Of these highly sensitive species, three also occur at Martin Van Buren NHS, with two species (northern harrier and merlin [*Falco columbarius*]) potentially finding climate refuge in area parks, and a third (mallard [*Anas platyrhynchos]*) potentially being extirpated in summer.

At a nearby NHP (SARA), birds have been monitored since 2006 at about 50 point count stations across the park. SARA is an important bird habitat for grassland species, while also providing habitat for wetland, shrub land and forest birds. Grassland species such as bobolinks and Eastern meadowlark are common at SARA, and grassland bird condition was assessed to warrant moderate concern for relative species richness of grassland birds (5–10%) and exotic bird species (0.1 – 3%) for the period 2011–2014 (Faccio and Mitchell 2015).

Reference Conditions/Values

Assessment of bird condition in this agricultural landscape could be determined based on the abundance and proportional richness and population trend of grassland obligate species (American kestrel, bobolink, eastern meadowlark, grasshopper sparrow, Henslow's sparrow, northern harrier, savannah sparrow, vesper sparrow) as well as other species of conservation interest and exotic species, similar to methods proposed by Faccio et al. (2015). Using this approach, a relatively high proportional richness of grassland or conservation species would be considered good condition.

Condition and Trend

Data were not available to determine condition or trend in birds.

Level of Confidence and Data Gaps

Park bird populations are a data gap. This gap could be filled with annual monitoring by staff or volunteers at point count stations, as described in the NETN Bird Monitoring Protocol (Faccio et al. 2015). The Alan Devoe Bird Club is active in bird observation in Columbia County and could potentially be a source of monitoring volunteers.

Source(s) of Expertise

- NPS NETN Bird Monitoring Program

4.4.4. Amphibians and Reptiles

Description

Amphibians and reptiles are valued park resources that may serve as useful bioindicators of environmental stress from changes in wetland extent and quality, atmospheric deposition, climatic change, habitat degradation and habitat loss.

Data and Methods

Four salamander species, eight frogs, two turtles, and one snake species have been documented in the park, including two species of conservation interest (the Jefferson salamander complex, and the common snapping turtle; NPS 2019, Dickert et al. 2005). Additional species of conservation interest may be present (Table 4-18). During a 2007 survey of park ponds, FEP (2008) found abundant green frogs (*Lithobates clamitans*) and bull frogs (*L. catesbeianus*), few spring peepers (*Pseudacris crucifer*) and grey tree frogs (*Hyla versicolor*), and no vernal-pool breeding species. However, Dickert et al. (2005) observed spotted salamander (*Ambystoma maculatum*) and wood frogs (*L. sylvaticus*) at the park, found Jefferson salamander complex in the Southern Swamp, and found amphibian larvae in Shed Pond (but not in Gravel or Third Ponds). The most common salamander observed was the woodland salamander (*Plethodon cinereus*; Dickert et al. 2005).

Table 4-18. Amphibian and reptile species of conservation interest documented or potentially present at Martin Van Buren National Historic Site.

Lifeform	Scientific Name	Common Name	Conservation Status	Park Status
Reptile	*Chelydra serpentina*	Common snapping turtle	Species of Greatest Conservation Need	Present
Reptile	*Clemmys guttata*	Spotted turtle	New York State Special Concern, Species of Greatest Conservation Need	Potential
Reptile	*Clemmys insculpta*	Wood turtle	New York State Special Concern, Species of Greatest Conservation Need	Potential
Amphibian	*Ambystoma jeffersonianum*	Jefferson salamander	New York State Special Concern, Species of Potential Conservation Need	Present
Amphibian	*Hemidactylium scutatum*	Four toed salamander	Species of Greatest Conservation Need	Potential

Reference Conditions/Values

Assessment of amphibian condition in this agricultural landscape could be determined using Index of Biotic Integrity such as the AmphIBI developed by the Ohio Environmental Protection Agency (Micacchion 2004). AmphIBI assesses condition based on five metrics of amphibian community composition: three metrics assess the relative abundance of sensitive and tolerant amphibian species, one metric assesses the number of pond-breeding salamanders, and one metric assesses the presence or absence of spotted salamanders or wood frogs (vernal pool breeding species correlated with the availability of forested cover). Species sensitivity to disturbance is estimated using a coefficient of conservatism (C of C) ranging from 1 to 10, with higher numbers assigned to sensitive species. A maximum of 10 points is awarded for each metric, which are summed to yield a maximum total index score of 50 points. Micacchion (2011) identified index scores >= 30 as superior wetland habitat, while scores below 20 are considered restorable wetland habitat (10–19) or limited wetland habitat (< 10). Accordingly, we suggest assessment points for amphibian community condition as shown in Table 4-19, suggesting *significant concern* below 20, since this is designated by Micacchion as restorable, indicating management is warranted.

Table 4-19. Suggested assessment points for rating amphibian community condition (adapted from Micacchion 2011).

Metric	Good Condition	Moderate Concern	Significant Concern
AmphIBI score	30–50	20–29	< 20

Condition and Trend

Data were not available to determine condition or trend in amphibians and reptiles.

Level of Confidence and Data Gaps

Condition and trend of park amphibian and reptile populations are a data gap. This gap could be filled by annual monitoring using anuran calling surveys, egg mass surveys, and periodic trapping of aquatic turtles. Additionally, surveys of vernal pools in the Southern Swamp and surveys for turtle nesting sites on the lower terrace would identify these key habitats for protection.

Source(s) of Expertise

- Ohio EPA AmphIBI

4.4.5. Mammals

Description

National park units provide important habitat for native mammal species, which in turn play important roles in park ecosystems as consumers of park vegetation and as predators. Data describing the status and trends in key mammal populations provides valuable information to park managers. Bats provide valuable ecosystem services, including insect consumption and pollination. In the northeastern U.S., several bat species have been seriously impacted by white-nose syndrome (WNS), one of the worst wildlife health crises in recent history.

Data and Methods

Park mammals have not been inventoried or monitored. Eighteen mammal species have been documented in the park and it is likely that many more species are present (NPS 2019, Cook 1985, Kiviat 1997, Dickert et al. 2005). The NYS SC New England cottontail, documented in Columbia County, is unlikely to be present in the park due to the lack of preferred habitat (very dense shrub land or heathlands with mountain laurel and blueberry; A. Cheeseman, SUNY ESF, personal communication 3/28/19).

Several bat species of conservation concern are known to inhabit the region and could be present at the park (Table 4-20; C. Herzog, NYS DEC, personal communication 9/18/18). Two known maternity colonies for the federally endangered Indiana bat occur in a nearby town, placing a portion of these bats' expected foraging range in the Town of Kinderhook. In addition, two relatively minor hibernacula of the federally threatened northern long-eared bat occur in Columbia County and a third occurs in nearby Greene County. Finally, Kinderhook is within easy flight distance from two major hibernaculum concentration areas that include dozens of caves and mines housing all six of the state's hibernating bat species (small-footed bat, little brown myotis, tri-colored bat and big brown bat [*Eptesicus fuscus*]) in addition to the two protected species already mentioned; C. Herzog, NYS DEC, personal communication 9/18/18).

Table 4-20. Mammal species of conservation interest documented or potentially present at Martin Van Buren National Historic Site.

Scientific Name	Common Name	Conservation Status	Park Status
Lasionycteris noctivagans	Silver-haired bat	Species of Greatest Conservation Need	Potential
Lasiurus borealis	Eastern red bat	Species of Greatest Conservation Need	Potential
Lasiurus cinereus	Hoary bat	Species of Greatest Conservation Need	Potential
Myotis leibii	Small-footed bat	New York State Special Concern, Species of Greatest Conservation Need	Potential
Myotis lucifugus	Little brown myotis	Species of Greatest Conservation Need	Present
Myotis septentrionalis	Northern long-eared myotis	US and New York State Threatened	Potential
Myotis sodalis	Indiana bat	US and New York State Endangered	Potential
Perimyotis subflavus	Tricolored bat	Species of Greatest Conservation Need	Potential

Reference Conditions/Values

If bat monitoring is undertaken, the assessment points shown in Table 4-21 could be used to interpret bat condition from acoustic monitoring data, using recorded calls per hour as an index of bat activity.

Table 4-21. Proposed assessment points for bat condition.

Metric	Good Condition	Moderate Concern	Significant Concern
Bat activity	>= 80% of baseline	50% to 80% of baseline	< 50 % of baseline

Condition and Trend

Data were not available to determine condition or trend in mammals.

Level of Confidence and Data Gaps

Mammal population condition and trends are a data gap. A mammal survey would provide a more complete picture of mammal populations in the park. Given the conservation status of bat species potentially occurring here, annual acoustic monitoring for bats is recommended. NPS has developed preliminary guidance for acoustic bat monitoring in parks, covering deployment of detectors, processing of call files, and data management (NPS 2016b). The North American Bat Monitoring Program also provides standardized methods for monitoring of bat populations using counts and acoustic analysis, and for analysis of resulting datasets (Loeb et al. 2015).

Source(s) of Expertise

- NYS DEC

4.4.6. Insects

Description

Insects can be useful indicators of biological condition due to their diversity, abundance, and sensitivity to environmental change, as well as their important function in terrestrial and aquatic ecosystems. Both introduced honey bees and native bees are key pollinators in the northeastern U.S., are sensitive to environmental contamination and pathogens, and have experienced widespread decline in recent decades (Cameron et al. 2011, Porrini et al. 2003). Butterflies often exhibit high host-plant specialization and are vulnerable to habitat change, while their conspicuous appearance and beauty attract park visitors and butterfly enthusiasts. Reports of declines in insect biomass in recent decades in a variety of ecosystems are cause for concern (Sanchez-Bayo and Wyckhuys 2019).

Data and Methods

Park insect communities are not currently monitored. However, the Farmscape Ecology Program (FEP) surveyed some taxa of insects in 2007 at Roxbury Farm's two discountinuous units (the south farm, located within the park's authorized boundary, and the north farm, located further north in the Town of Kinderhook; FEP 2008). FEP observed bees on crops, netted bees for identification, and sampled bees using bee bowls. That study collected 17 bee species representing 11 genera at the two farm units combined. Observational surveys by FEP detected 23 butterfly species, including five species on the FEP Farmland Butterfly Watch List (FBWL)[2] from the two farms combined (FEP 2008). Two butterflies of regional conservation interest were observed within the park boundary in

[2] The FEP Farmland Butterfly Watch List seeks to identify species found in farmland habitats which appear to be declining.

2004, as well as the host plant of a rare moth species (Table 4-22; Dickert et al. 2005). FEP's pond survey at the south farm (within the park) observed seven damselfly species and eleven dragonfly species (FEP 2008). The NYS Natural Heritage Program has reports of three rare dragonflies found on Kinderhook Creek 0.6 km (0.4 mi) west of the park in 2008; these are listed in Table 4-22 as potential park species (A. Chaloux, NY NHP, personal communication 4/9/19). Finally, two NYS SGCN insect species were observed in the park in 2004 (Table 4-22; Dickert et al. 2005).

Table 4-22. Insect species of conservation interest documented or potentially present at Martin Van Buren National Historic Site. Rarity status designated by the New York State Natural Heritage Program, where S1 is critically imperiled, S2 is imperiled, and S3 is vulnerable.

Lifeform	Scientific Name	Common Name	Conservation or Rarity Status	Park Status	Habitat
Coleoptera	*Cicindela hirticollis*	Hairy-necked tiger beetle	S1S2, Species of Greatest Conservation Need	Present	Sandbar in Kinderhook Creek
Odonata	*Hetaerina americana*	American rubyspot damselfly	S3, Species of Greatest Conservation Need	Present	Sandbar in Kinderhook Creek
Odonata	*Ophiogomphus aspersus*	Brook snaketail	S3, Species of Greatest Conservation Need	Potential	Kinderhook Creek
Odonata	*Hylogomphus abbreviatus*	Spine-crowned clubtail	S1, Species of Greatest Conservation Need	Potential	Kinderhook Creek
Odonata	*Neurocordulia obsoleta*	Umber shadowdragon	S1, Species of Greatest Conservation Need	Potential	Kinderhook Creek
Lepidoptera	*Libytheana carinenta*	American snout	Farmland Butterfly Watch List	Present	Hackberry tree[1]
Lepidoptera	*Pyrgus communis*	Checkered skipper	Regionally rare[2]	Present	Disturbed habitats
Lepidoptera	*Papaipema sp. 2*	Ostrich fern borer moth	S1S3	Potential	Ostrich fern

[1] The American snout catepillar feeds on hackberry, a tree which has not been noted to occur at MAVA.

[2] Regionally rare as determined by Hudsonia Ltd. (Dickert et al. 2005).

<u>Reference Conditions/Values</u>

Assessment points have not been defined.

Condition and Trend

Data were not available to determine condition or trend in insects. Visual observation of bees on crops suggested a relatively high abundance both of honey bees and native bees at Roxbury Farms two units combined, while data from bee bowls reflected an average abundance of bees compared to other area farms (FEP 2008). An observational survey of butterflies, dragonflies and damselflies associated with ponds found low species richness in the park relative to other ponds in Columbia County (FEP 2008).

Level of Confidence and Data Gaps

Insect populations are a data gap could be filled if funding permits. A protocol for monitoring bee populations was developed for use at National Wildlife Refuges and other locations (Droege et al. 2016). While identification of bees to species level requires specialized training and can be costly, monitoring of abundance of bee morphospecies (e.g., honey bee, green metallic sweat bee) or genera can provide useful information at lower cost (Mason and Arathi 2019). Annual monitoring of overall insect biomass using sweep nets and vacuum sampling would also provide useful data, as would monitoring of select taxa such as butterflies or dragonflies and damselflies.

Source(s) of Expertise

- USGS Native Bee Inventory and Monitoring Lab

4.4.7. Conservation Species

Description

The park provides habitat for more many species of conservation interest which have been documented in the park including three state-listed plants (Tables 4-23 and 4-24), the state threatened Northern harrier, two state SC species (Jefferson salamander and osprey), and many SGCN species. No monitoring data is available for these species. The park may provide habitat for additional species of conservation interest, including the federally endangered Indiana bat, federally threatened northern long-eared bat, and state SC small-footed bat, which have not been detected but may be present in the park (see section 4.4.5).

Table 4-23. Fish species of conservation interest documented or potentially present at Martin Van Buren National Historic Site.

Scientific Name	Common Name	Conservation Status	Park Status
Anguilla rostrata	American eel	Species of Greatest Conservation Need	Present
Catostomus catostomus	Long-nosed sucker	Species of Greatest Conservation Need	Potential

Table 4-24. State-listed (endangered or threatened) or rare vascular plant species documented or potentially present at Martin Van Buren National Historic Site. S3 is a vulnerable species designated by the New York State Natural Heritage Program.

Scientific Name	Common Name	Conservation Status	Park Status	Habitat
Carex davisii	Davis sedge	New York State Threatened	Present	Floodplain, open woodland.
Eleocharis ovata	Ovate spikerush	New York State Endangered	Present	Wet habitats, especially sandy, mucky or peat shores.
Geum virginianum	Rough avens, cream avens	New York State Threatened	Present	Floodplain, rich forest, fields.
Crotalaria saggitalis	Rattlebox	New York State Endangered	Potential	Open soil and wasteland
Potamogeton pulcher	Spotted pondweed	New York State Threatened	Potential	Pond
Mimulus alatus	Winged monkey flower	S3	Potential	Floodplain

Data and Methods

Conservation species are not currently monitored.

Reference Conditions/Values

The assessment points shown in Table 4-25 could be used to interpret population trend of selected species.

Table 4-25. Suggested assessment points for condition of populations of species of conservation concern.

Metric	Good Condition	Moderate Concern	Significant Concern
Population size compared to baseline	> 80 %	50 to 80 %	< 50 %
Annual population trend	Stable or increasing trend > -1.0%	Slightly decreasing trend -1.0 to -2.75%	Steeply decreasing trend < -2.75%

Condition and Trend

No data were available to determine condition or trend of conservation species.

Level of Confidence and Data Gaps

Condition and trend of conservation species are data gaps. Surveys of key areas would help confirm the presence of species of conservation interest. This would include surveys of Kinderhook Creek for Odonates of conservation interest (Table 4-22), surveys of bare or sparsely vegetated ground near Gravel Pond and the Kinderhook Creek sandbar for insects (Hymenoptera, Coleoptera, and others) unique to this habitat, and surveys for vascular plants and bryophytes in Southern Swamp (Dickert et al. 2005). The park could initiate monitoring programs for selected species of conservation interest, particularly federally or state-protected species such as the Davis sedge.

4.5. Landscapes

Two indicators were included to assess condition and trend for Landscapes:

- Landcover and land use
- Viewshed

4.5.1. Landcover and Land Use

Description

Conversion of land to anthropogenic uses eliminates and fragments wildlife habitat and increases sources of local pollution and pathways for invasive exotic species. Land conversion to impervious surfaces increases runoff and reduces water quality and watershed buffering. Small parks are particularly vulnerable to land conversion that occurs outside park borders, particularly conversion occurring upstream of park wetlands and water courses. Historical and cultural parks may also be more vulnerable to fragmentation due to their mandate to preserve and interpret historical features, which may include fragmented landscapes.

Data and Methods

The NPS I&M has provided data for assessing status and trends in landscape dynamics within national parks (NPS NRSS I&M 2014). This data source includes landcover classification and impervious surfaces derived from the National Land Cover Database (NLCD). Generated by a consortium of federal agencies, the NLCD is a periodically updated resource combining Landsat satellite imagery with additional data sources including census information, providing spatially referenced information describing land cover and change across the nation (Homer et al. 2012). The analysis herein considered impervious cover within a 1 km buffer surrounding the park (Figure 4-11).

Another source of landscape data comes from Nature's Network, a collaborative project facilitated by the U.S. Fish and Wildlife Service (US FWS) that seeks to "to identify the best opportunities for conserving and connecting intact habitats and ecosystems and supporting imperiled species to help ensure the future of fish and wildlife across the Northeast region." Combining geophysical models with historical patterns of urban growth, Nature's Network has estimated the probability of new development by 2030 across the northeastern US at a 30 m scale (Figure 4-12; NALCC 2017).

Reference Conditions/Values

Wagner et al. (2014) suggested assessment points for impervious cover used here, based on impacts to water quality and habitat (Table 4-26; Goetz et al. 2003, Schiff and Benoit 2007).

Table 4-26. Assessment points for land use condition.

Metric	Good Condition	Moderate Concern	Significant Concern
Impervious cover	< 10%	11–25%	> 25%
Development pressure	Low	Moderate	High

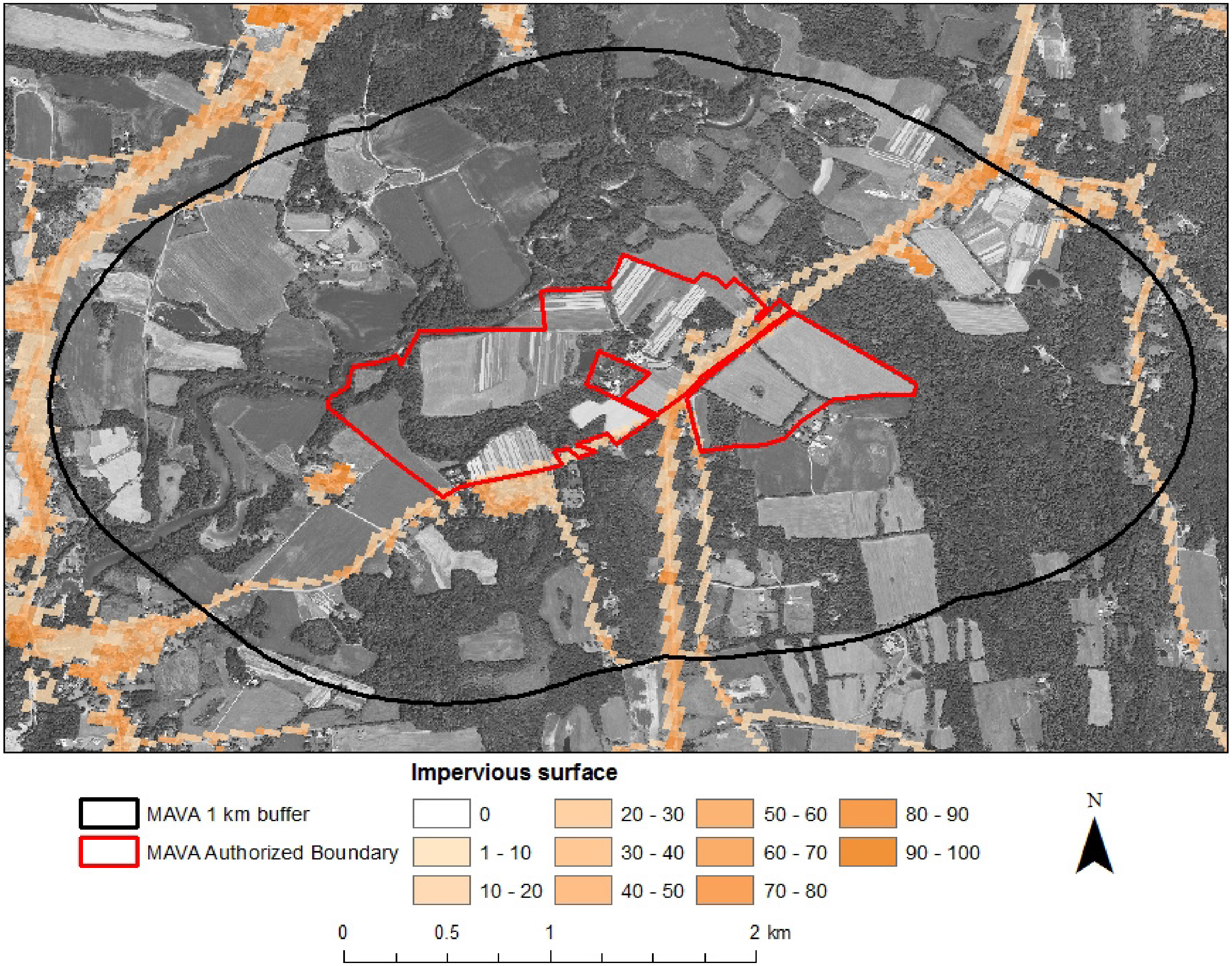


Figure 4-11. Impervious surfaces at Martin Van Buren National Historic Site (NPS NRSS I&M 2014).

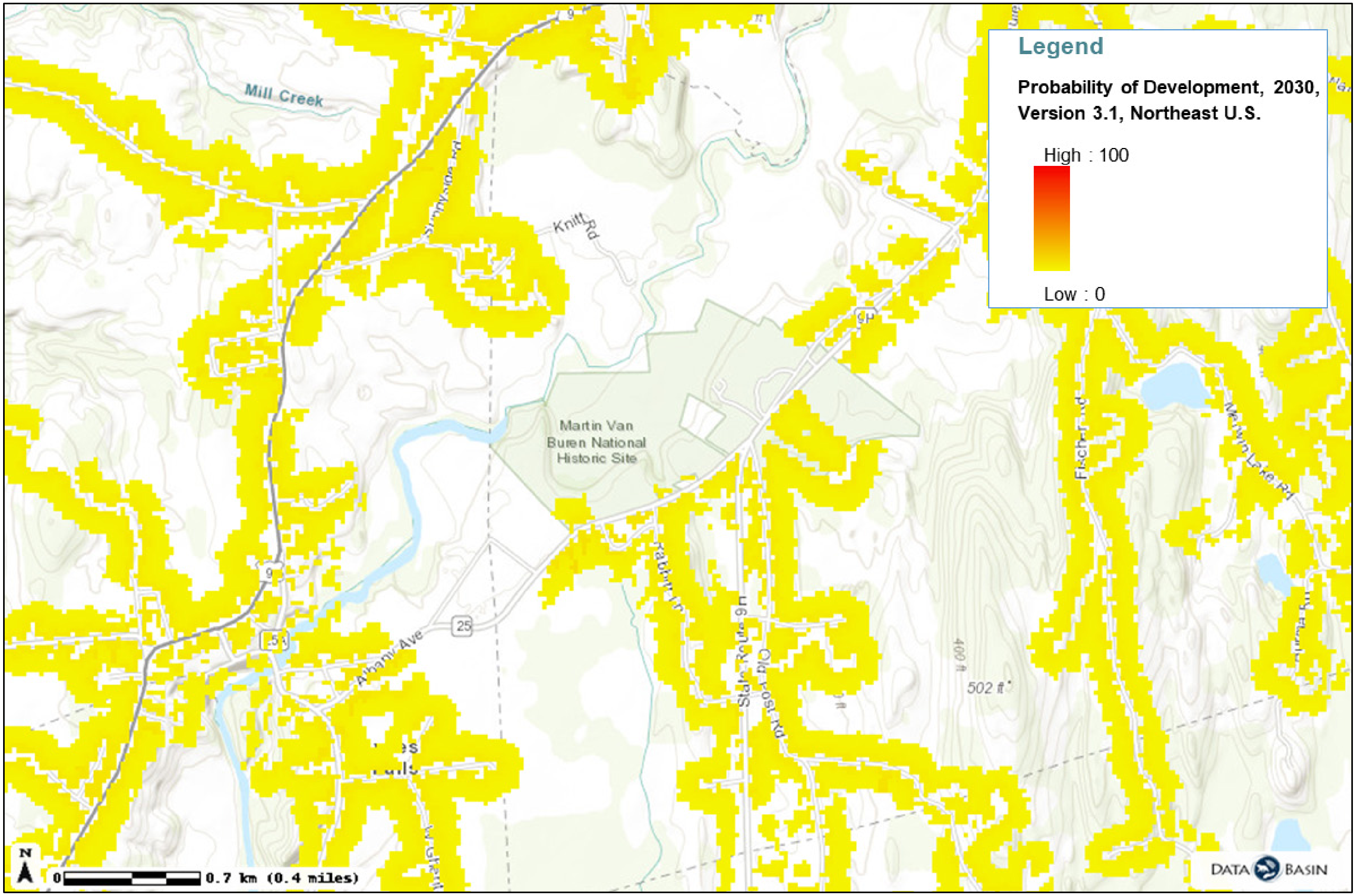


Figure 4-12. Probability of development by 2030 surrounding Martin Van Buren National Historic Site (NALCC 2017).

Condition and Trend

With the exception of road corridors, land surfaces within a 1-km (0.6-mile) boundary surrounding the park contain < 10% impervious cover. A low probability (1–3%) of development by 2030 within and surrounding the authorized park boundary and minimal coverage by impervious surfaces both indicated *good condition* for landcover/ landuse.

Level of Confidence and Data Gaps

Confidence in estimate of condition from two metrics is medium.

Source(s) of Expertise

- NPS Natural Resource Stewardship and Science, Inventory and Monitoring Division
- Nature's Network (http://naturesnetwork.org/)

4.5.2. Viewshed

Description

NPS is mandated to preserve parks unimpaired for the enjoyment of future generations, and this mandate includes the conservation of scenery (NPS Organic Act). Visitors to national parks overwhelmingly report that scenic views are an important component of the visitor experience (Kulesza et al. 2013). Viewshed provides a useful concept for understanding the visitor's scenic experience, and is defined simply as the area visible from a given observation point.

The park's Cultural Landscape Inventory (CLI) recognizes two key views as contributing to the historical setting: 1) the view of the distant Catskill Mountains from the Mansion (Figure 4-13); and 2) the view of the Mansion from the Old Post Road (Figure 4-14; NPS 2013). The park's Cultural Landscape Treatment Plan further recommends restoring view of Catskill Mountains along proposed visitor circulation route (von Bieberstein and Coffin Brown 2016).

Figure 4-13. View of the distant Catskill Mountains from the Lindenwald Mansion at Martin Van Buren National Historic Site (photo from the Olmstead Center for Landscape Preservation).

Figure 4-14. View of the Lindenwald Mansion from the Old Post Road at Mansion at Martin Van Buren National Historic Site (photo from the Olmstead Center for Landscape Preservation).

Data and Methods

Data were not available to assess Viewshed.

Reference Conditions/Values

Viewshed reference conditions have not been determined. However, materials from the NPS Visual Resources Program (VRP) may provide guidance in determining impacts to park viewsheds. Assessment of viewshed impacts involves understanding both the important visual qualities and character of the landscape within the project viewshed, and the visual experience of visitors observing the viewshed from key observation points (Sullivan and Meyer 2014).

Condition and Trend

Data were not available to determine condition and trend of Viewshed.

Level of Confidence and Data Gaps

Viewshed is a data gap that could be filled using methods provided by the NPS VRP and existing methodologies for photo-monitoring. Key park views have been identified. A next step would be to develop a systematic description of the visual elements of important views both within and outside the park boundary, and assess their scenic quality and importance. Once views are inventoried, park staff could set appropriate resource management objectives, and use periodic digital photography to monitor key views. This dataset would provide a useful baseline to evaluate future risks or threats to the resource and to promote protection of the viewshed.

Source(s) of Expertise

- NPS VRP

5. Discussion

Assessment of natural resource condition in the park reflects condition supportive of a variety of native flora and fauna within the park's wetlands, riparian areas, and agricultural matrix. Due to the park's relatively small size, the condition of natural resources is particularly affected by stressors originating outside of park boundaries, including climate change, air pollution, road impacts, invasive species and regional wildlife trends. Status and trends in park natural resource condition are summarized in Appendix A.

5.1. Data Gaps

This assessment revealed several data gaps which could be filled by additional park monitoring as funding permits. These gaps and potential additional monitoring activities are summarized in Table 5-1.

Table 5-1. Data gaps and potential monitoring activities at Mansion at Martin Van Buren National Historic Site.

Data Gap	Potential Monitoring Activities
Mercury contamination	• Participation in the NPS Dragonfly Mercury Project[1] or analysis of turtle toenail clippings would provide site-specific information on mercury levels in park taxa.
Climate change	• **An automated weather station would provide useful and cost-effective information for park managers and agricultural activities**[2]. • Monitoring of plant or animal phenology would increase understanding of climate change impacts on park ecosystems.
Soundscape	• Monitoring with automated recorders would provide baseline data for assessment of soundscape impacts from upcoming projects, such as the potential widening of Route 9H.
Water quantity	• Monitoring of water quantity in select park ponds and Kinderhook Creek could provide useful information for park managers and agricultural activities. • Reference condition could be established based on a natural flow regime using data from a reference stream system.
Water quality	• Assess extent and ecological impacts of pond sediment contamination from prior agricultural chemical use. • **Monitor water quality, including nutrients and surveys for invasive exotic species, in Gravel and Upper Ponds and Kinderhook Creek**[2].
Riparian and wetland vegetation	• **Monitor the Southern Swamp and the Kinderhook Creek riparian zone using rapid methods**[2].

[1] The NPS Dragonfly mercury project is described at https://www.nps.gov/articles/dragonfly-mercury-project.htm and Ksienya Taylor (ksienya_taylor@nps.gov) is a useful contact person for that program.

[2] Priority monitoring activities

Table 5-1 (continued). Data gaps and potential monitoring activities at Mansion at Martin Van Buren National Historic Site.

Data Gap	Potential Monitoring Activities
Invasive species	• **An annual survey for key invasive exotic species in all habitats would enable early detection and rapid response. This survey should include inspection of ash trees for signs of infection by the emerald ash borer**[2].
Birds	• **Annual monitoring at point count stations using park staff or volunteer birders would provide useful information**[2].
Amphibians and reptiles	• **Survey for turtle nesting sites on lower terrac**e[2]. • **Survey for vernal pools in Southern Swamp**[2]. • **Annual monitoring using anuran calling surveys, egg mass surveys, and periodic trapping of aquatic turtles**[2].
Mammals	• A mammal inventory would provide a more complete species list. • **Monitor bat community with acoustic monitoring**[2].
Insects	• **Monitor bee abundance in farm fields using bee bowls or direct observation**[2]. • **Monitor insect biomass**[2]. • Monitor butterflies, dragonflies and damselflies.
Conservation species	• Survey for vascular plants and bryophytes in Southern Swamp. • Monitor NYS Threatened and Endangered plant species using counts and photography. • Survey Kinderhook Creek for Odonates of conservation interest. • Survey bare or sparsely vegetated ground near Gravel Pond and the Kinderhook Creek sandbar for species of conservation interest.
Viewshed	• Photo-monitoring of key views would provide a visual record and baseline to assess proposed development within the park viewshed[2].

[1] The NPS Dragonfly mercury project is described at https://www.nps.gov/articles/dragonfly-mercury-project.htm and Ksienya Taylor (ksienya_taylor@nps.gov) is a useful contact person for that program.

[2] Priority monitoring activities

5.2. Management Recommendations

Management recommendations to protect and preserve the natural resources assessed in this report are summarized in Table 5-2.

Table 5-2. Suggested management activities at Martin Van Buren National Historic Site.

Area	Management Suggestions
Climate change	• Decision tools developed by Cornell University's Climate Smart Farming Program* may help identify opportunities and adaptation strategies for responding to climate change. • Focus on supporting key species identified as highly sensitive to climate change, and on improving habitat connectivity across park boundaries.
Water quality	• Implement the recommended concrete or asphalt cap over highly contaminated soil adjacent to a storage barn near Upper Pond. • Utilize land management techniques that minimize runoff into Kinderhook Creek. • Continue practices that minimize use of fertilizer and pesticides. • Use best practices for de-icing park pavement and water softening. • Carefully review new transportation projects within the park watershed for impacts to park wetlands, ponds and water courses.
Riparian and wetland vegetation	• Protect vegetation in Southern Swamp and Kinderhook Creek riparian area. Leave standing and fallen dead wood in place. • Protect wet meadows in fields on lower terrace.
Wildlife conservation	• Use curbing that does not impede salamanders and turtle hatchlings. • Install bat houses as alternative roosts. • Install nest boxes for kestrels. • Use best mowing practices. Mow as infrequently as possible and restrict mowing to fall. If necessary to mow during the warm season, mowing should occur during times of drought and high heat intensity, such as in August, when turtles avoid open areas and bird nesting has finished. Set blades 4" or higher on lower terrace.
Invasive species	• Respond rapidly to eradicate new infestations of priority invasive species.
Viewshed	• Carefully review new development projects within the park viewshed for impacts to park key park views.

*The Cornell Climate Smart Farming Program is described at http://climatesmartfarming.org/.

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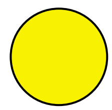
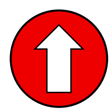
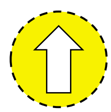
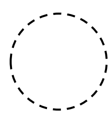
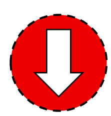
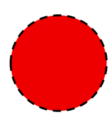
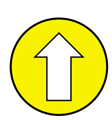
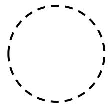
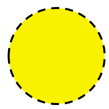
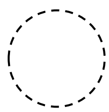
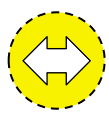
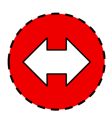
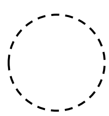
Appendix A: Natural Resource Condition at Martin Van Buren National Historic Site.

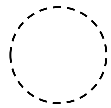
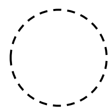
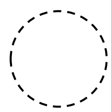
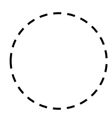
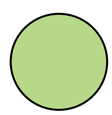
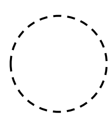
Appendix A Table 1. Natural Resource Condition at Martin Van Buren National Historic Site.

Category	Vital Sign	Condition & Trend	Findings
Air and Climate	Ozone		Estimated ozone pollution warranted *moderate concern* for human health, and showed *good condition* for park vegetation. Data were not sufficient to assess trend. Ozone pollution reflects regional trends resulting from activities occurring outside NPS boundaries.
	Acidic deposition & stress		Estimated wet deposition of nitrogen warranted *significant concern*. Regional trends were improving. Acidic deposition reflects regional trends resulting from activities occurring outside NPS boundaries.
	Visibility & particulate matter		Estimated impairment of park views due to anthropogenic haze warranted *moderate concern*. Regional trends were improving. Visibility is impaired by pollution from activities primarily occurring outside NPS boundaries.
	Mercury contamination		Mercury wet deposition is estimated to be moderate but park-specific data to determine condition were lacking. Mercury deposition reflects regional trends resulting from activities occurring outside NPS boundaries.
	Climate		Changes in temperature and precipitation over the historical record warrant *significant concern*. Climate change reflects global and regional trends resulting from activities occurring outside NPS boundaries.
	Soundscape		Modeled data suggest anthropogenic sound may reduce park listening area >= 50%. Soundscape is affected activities originating from both within and outside NPS boundaries.
Geology and Soils	Agricultural soils		Agricultural soil showed good condition for many soil parameters but warranted *moderate concern* for low soil organic matter, and warranted *significant concern* for very high phosphorus levels. Levels of soil organic matter showed improvement. Soil condition is affected by activities occurring both within and outside NPS boundaries, as well as by historical agricultural practices.

Appendix A Table 1 (continued). Natural Resource Condition at Martin Van Buren National Historic Site.

Category	Vital Sign	Condition & Trend	Findings
Water	Water quantity		No water quantity data were available from park ponds. Downstream discharge data for Kinderhook Creek showed current mid- and low-flow discharge to be elevated compared to the long-term record. These flows are regulated by upstream power plants. Water quantity is affected by factors originating from both within and outside NPS boundaries.
	Water quality		Recent sampling in Upper Pond and previous sampling in four park ponds showed highly eutrophic conditions. Sediment sampling in Upper Pond warranted moderate concern for DDT contamination. A highly invasive species, water chestnut, has been detected in Gravel Pond. Water chemistry is affected by activities originating from both within and outside NPS boundaries.
	Stream macroinvertebrates		Stream macroinvertebrates are a data gap which could be monitored using available protocols. Previous data from 2006 showed slightly impacted condition, warranting moderate concern. This indicator is affected by activities originating from both within and outside NPS boundaries.
Biological Integrity	Riparian and wetland vegetation		Preliminary assessment of wetland and riparian areas indicated moderate concern for buffer width and extent. No change was observed over ten years. This indicator is affected by activities originating from both within and outside NPS boundaries.
	White-tailed deer		Qualitative assessment of deer-browse indicator species in nearby parks suggested significant concern. Ten year trend in regional harvest data was unchanging. This indicator is affected by activities originating from both within and outside NPS boundaries.
	Birds		Birds are a data gap. Annual bird monitoring would provide useful information. This indicator is affected by activities originating from both within and outside NPS boundaries.

Appendix A Table 1 (continued). Natural Resource Condition at Martin Van Buren National Historic Site.

Category	Vital Sign	Condition & Trend	Findings
Biological Integrity (cont.)	Amphibians and reptiles		Amphibian and reptile species are a data gap. Surveys for vernal pools in Southern Swamp, and turtle nesting sites on the lower terrace would provide useful information, as would annual monitoring including anuran calling surveys, egg mass surveys, and periodic trapping of aquatic turtles. This indicator is affected by activities originating from both within and outside NPS boundaries.
	Mammals		Mammal species are a data gap. Comprehensive surveys of mammal species would provide useful information, as would annual monitoring of bat species using acoustic sampling. This indicator is affected by activities originating from both within and outside NPS boundaries.
	Insects		Insect species are a data gap. Opportunities for monitoring include butterflies, damselflies and dragonflies, bees, and dung beetles. This indicator is affected by activities originating from both within and outside NPS boundaries.
	Conservation species		The park provides habitat for many species of conservation interest. Population trends for these species are a data gap. This indicator is affected by activities originating from both within and outside NPS boundaries.
Landscapes	Landcover and land use		A low probability of future development surrounding the park and minimal coverage by impervious surfaces both indicated *good condition*. Trends were not assessed. This indicator is affected primarily by activities originating outside NPS boundaries.
	Viewshed		Viewshed is a data gap. Photo-monitoring of key views would provide a visual record and baseline to assess proposed development within the park viewshed. This indicator is affected primarily by activities originating outside NPS boundaries.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 460/165146, October 2019

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