Vernal Pool Survey Report

High Bridge Wind Project

Town of Guilford
Chenango County, New York

Prepared for:

High Bridge Wind, LLC
717 Texas Ave, Suite 1000
Houston, TX 77002
Contact: Mr. Alec Jarvis, Director of Development
Phone: (207) 956-1169

Prepared by:

Environmental Design & Research,
Landscape Architecture, Engineering, & Environmental Services, D.P.C.
217 Montgomery Street, Suite 900
Syracuse, New York 13202
Contact: Gregory Liberman
Phone: (518) 451-9150

July 2019

MANAGEMENT SUMMARY

Involved State Agencies:	New York State Department of Public Service (NYSDPS) New York State Department of Environmental Conservation (NYSDEC) (Article 10 Application, Case No. 18-F-0262)
Type of Survey:	Vernal Pool Survey
Location Information:	Town of Guilford, Chenango County, New York
Project Description:	Proposed Wind Powered Electric Generating Facility (up to 100.8 MW)
Project Area:	3,921 acres
USGS 7.5-Minute Quadrangle Map:	Sidney, Guilford, and Oxford, NY
Report Authors:	Samouel Beguin Samantha Parker Daniel Zvirzdin
Date of Report:	July 2019

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Purpose of the Investigation 1
1.2 Facility Location and Description 2
2.0 SURVEY METHODS 2
2.1 Study Area 2
2.2 On-Site Surveys 2
3.0 SURVEY RESULTS 3
4.0 REFERENCES 6

LIST OF TABLES

Table 1. Summary of Vernal Pool Survey Data 4

LIST OF FIGURES

Figure 1: Regional Facility Location
Figure 2: Facility Layout
Figure 3: Study Area
Figure 4: Vernal Pools

LIST OF APPENDICES

Appendix A: Vernal Pool Guidelines
Appendix B: Vernal Pool Data Tables
Appendix C: Representative Photographs

1.0 INTRODUCTION

1.1 Purpose of the Investigation

On behalf of High Bridge Wind, LLC (the "Applicant" or "Project Sponsor"), Environmental Design & Research, Landscape Architecture, Engineering, & Environmental Services, D.P.C. (EDR) has prepared this Vernal Pool Survey Report ("Report") for the proposed High Bridge Wind Project ("Project" or "Facility"), located in the Town of Guilford, Chenango County, New York. This Report has been prepared in support of an Application of High Bridge Wind, LLC for a Certificate of Environmental Compatibility and Public Need pursuant to Article 10 of the New York State Public Service Law for construction of a major wind-powered electric generating facility. The information included in this Report is intended to summarize the results of vernal pool surveys that were conducted by EDR biologists for the proposed Facility and thereby assist the NYSDEC, the NYSDPS, and other agencies in their review of the proposed Facility in accordance with the requirements of Article 10. The vernal pool study was performed in order to identify potentially sensitive vernal pool habitats within the Facility Site, provide an understanding of potential impacts, and inform Facility design. Please note that information concerning the Facility's potential effects on other ecological resources will be addressed in separate studies conducted by the Applicant.

As described in 16 NYCRR § 1001.22(d), an Article 10 Application must include:

> *A characterization of the facility site and any areas to be disturbed for interconnections as to the vegetation, wildlife (including mammals, birds, amphibians, terrestrial invertebrates, and reptiles) and wildlife habitats, that occur in, on, or in the vicinity, based on reconnaissance or multi-season surveys and data collection appropriate to the nature of the site, supplemented by available data from the New York Natural Heritage Program, New York State (NYS) Amphibian and Reptile Atlas Project, the NYS Breeding Bird Atlas and range maps, Breeding Bird Survey Routes, Christmas Bird Counts and other similar reference sources, including an identification and depiction of any Significant Coastal Fish and Wildlife Habitat Areas designated by DOS/DEC and any unusual habitats or significant natural communities that could support state or federally listed endangered or threatened species or species of special concern.*

Therefore, the primary purpose of the vernal pool study was to identify the occurrence of vernal pools within the Facility Site under appropriate seasonal conditions and document the occurrence of amphibian species within these habitats. The vernal pool surveys were conducted in 2019 by qualified EDR biologists following guidelines and other publicly available reference materials developed by the New York Natural Heritage Program (NYNHP), the NYSDEC, the Massachusetts Division of Fisheries and Wildlife (MADFW), the New Jersey Division of Fish and Wildlife (NJDFW), and the Pennsylvania Natural Heritage Program (PNHP) (see Appendix A).

1.2 Facility Location and Description

The proposed Facility is an up to 100.8-megawatt (MW) wind-powered electric generating project located in the Town of Guilford, Chenango County, New York (see Figure 1). The Facility will be located on 3,921 acres of leased private land that is generally rural in nature (i.e., the "Facility Site"; see Figure 2). The proposed Facility consists of the construction and operation of up to 25 wind turbines, associated 34.5 kilovolt (kV) underground collection lines, access roads, permanent and temporary meteorological tower(s), an operation and maintenance (O&M) building, and a temporary construction staging/laydown area. To deliver electricity to the New York State power grid, the Project Sponsor also proposes to construct a collection substation, which will include battery storage, and a point of interconnection (POI) substation that will interconnect with the New York State Electric and Gas (NYSEG) Jennison to East Norwich 115 kV transmission line in the Town of Guilford. The Facility components collectively constitute a "Major Electric Generating Facility" as defined in 16 NYCRR § 1000.2(v) and the term "Facility" is used in this document to collectively refer to these components.

2.0 SURVEY METHODS

2.1 Study Area

Vernal pools were identified and delineated within the Wetland Study Area[1] ("Study Area") defined for the proposed Facility (see Figure 3). Forested areas and agricultural field edges where vernal pools are most likely to occur were identified within the Study Area, and these areas and were prioritized during the vernal pool surveys.

2.2 On-Site Surveys

EDR biologists conducted on-site vernal pool surveys within the Study Area from April 11 to May 14, 2019. Photographs, field notes, and GPS (Global Positioning System) data were collected[2] at identified vernal pools to document existing conditions. Vernal pools identified during surveys were assigned unique, lettered identifying codes (e.g., VP-A) and boundaries were digitized using a geographic information system (GIS) based on the GPS data collected in the field.

The primary characteristics used to identify vernal pools included: (1) the presence of obligate and/or facultative biological indicator species in or near the pools; (2) evidence for inundation (expected to hold water for at least two consecutive months between March and September); (3) hydrological isolation (no permanent inlets or outlets of flowing surface water); (4) the absence of fish; (5) the presence of standing water; (6) sparse or no vegetation growing

[1] All areas in the Facility Site that are within 500 feet of areas to be disturbed by construction.
[2] GPS units and the ESRI Collector for ArcGIS application for mobile devices were used to collect point and polygon data.

within pool areas; (7) water-stained leaves observed in a depression; (8) evidence of moss trim lines/buttressing/watermarks on nearby trees; and (9) connectivity to adjacent forested habitat. These identifying characteristics were developed based on review of northeastern state environmental conservation agency guidelines and other publications (NYNHP, 2019; NYSDEC, 2018; MADFW, 2009; NJDFW, 2010; NJDFW, 2002; PNHP, 2018).

The following data were recorded for each vernal pool identified:

- Survey date;
- Observer name(s);
- Vernal pool ID;
- Latitude and Longitude;
- Nearest road(s);
- Property owner information;
- Estimated pool depth, length, and width;
- Pool type (natural or artificial) and hydroperiod;
- Presence of inlets/outlets;
- Adjacent land cover/ecological community types;
- Biological indicator species observed (if any); and
- Characteristics used to make the determination that the feature was a vernal pool.

3.0 SURVEY RESULTS

Overall, a total of 33 vernal pools were identified by EDR within the Study Area (see Figure 4). On site vernal pools ranged considerably in size, from very small, isolated, features containing few amphibians to large, more permanent features that contained greater numbers of indicator species adults and/or egg masses. Given the abundance of egg masses observed throughout the Study Area during the survey period, the presence of biological indicator species was treated as the primary indicator of vernal pool status. However, in some cases, features with many abiotic vernal pool characteristics were still identified as vernal pools even if indicator species were not observed during the surveys.

As expected for vernal pools, evidence of seasonal drainages (i.e., impermanent inlets or outlets) suggested that many of the vernal pools exhibit ephemeral hydrological connections to other vernal pools, wetlands, and/or drainage ditches during some portion of the spring season (i.e., following spring snowmelt and rain events); however, some of these connections had dried up at the time of the surveys. In contrast, most of the larger vernal pools identified are expected to have water present throughout the year during most years. Hydroperiod classifications were assigned to each vernal

pool to reflect the anticipated degree of drying in most years based on these observations (and following MADFW, 2009).

Obligate amphibian indicator species observed at on site vernal pools included wood frog (*Lithobates sylvaticus* [or *Rana sylvatica*]) adults and egg masses, as well as mole salamander (family Ambystomatidae) egg masses. Mole salamander taxa observed included spotted salamander (*Ambystoma maculatum*) and Jefferson/blue-spotted salamander complex (*Ambystoma jeffersonianum* x *laterale*).

Because Jefferson and blue-spotted salamanders cannot be distinguished reliably in the field, all potential observations of these species were grouped within the Jefferson/blue-spotted salamander complex, as recommended in the NYSDEC's online Amphibian Identification Guide (NYSDEC, 2019). Jefferson/blue-spotted salamander complex egg masses were observed at five (5) of the on site vernal pools (VP-N, VP-V, VP-W, VP-X, and VP-Y). Both Jefferson salamander and blue-spotted salamander are listed as species of special concern (SSC) in New York State (NYSDEC, 2015).

Common facultative amphibian indicator species observed on site included American toad (*Anaxyrus* [formerly *Bufo*] *americanus*) adults and egg masses, eastern newt (*Notophthalmus viridescens*) adults and efts (terrestrial juveniles), and green frog (*Lithobates clamitans*) adults.

Table 1 below provides a summary of vernal pool survey data. Additional data for each vernal pool are provided in Appendix B and representative photographs of vernal pools and amphibian egg masses are provided in Appendix C.

Table 1. Summary of Vernal Pool Survey Data

Vernal Pool ID	Map Sheet(s) (Figure 4)	Approx. Latitude	Approx. Longitude	Approx. Area (square feet)	Hydroperiod[1]	Indicator Species Present
VP-A	1, 2, 5	42.4403	-75.4853	71	Semi-Permanent	None
VP-AE	8	42.4023	-75.4156	28	Seasonal	Obligate
VP-AF	7, 8	42.4179	-75.4052	28	Seasonal	Obligate
VP-AG	7, 8	42.4183	-75.4063	28	Seasonal	Obligate
VP-AH	7, 8	42.418	-75.4082	28	Seasonal	Obligate
VP-B	1	42.4446	-75.4968	8	Semi-Permanent	Obligate
VP-BA	3, 6	42.4481	-75.4498	65	Seasonal	Facultative
VP-BB	3, 6	42.4481	-75.4498	119	Seasonal	Facultative
VP-BC	3	42.454	-75.4506	810	Seasonal	None
VP-BFR	4, 7	42.4455	-75.4204	7,943	Permanent	None

Vernal Pool ID	Map Sheet(s) (Figure 4)	Approx. Latitude	Approx. Longitude	Approx. Area (square feet)	Hydroperiod[1]	Indicator Species Present
VP-C	1, 2, 5	42.4416	-75.4934	56,362	Semi-Permanent	Obligate and Facultative
VP-D	3, 6	42.4401	-75.4553	28	Seasonal	None
VP-E	2, 3, 5, 6	42.4488	-75.4619	3,049	Seasonal	Obligate
VP-F	1, 2, 5	42.4402	-75.4905	28	Seasonal	None
VP-G	2, 5, 6	42.4367	-75.4579	28	Seasonal	Facultative
VP-H	2, 5, 6	42.4375	-75.4588	1,049	Semi-Permanent	Obligate
VP-J	3, 6	42.4411	-75.4544	8,239	Semi-Permanent	Obligate
VP-K	3, 6	42.4407	-75.4551	28	Seasonal	Obligate
VP-L	3	42.4403	-75.4552	10	Seasonal	Obligate
VP-M	3, 6	42.4402	-75.4553	4	Seasonal	Obligate
VP-N	6	42.4378	-75.4564	28	Seasonal	Obligate[2]
VP-O	7, 8	42.4188	-75.4043	20,065	Permanent	Obligate
VP-S	4	42.4515	-75.4253	58,450	Permanent	Obligate
VP-SYA	3, 6	42.4425	-75.4505	32,019	Permanent	Facultative
VP-SYJ	3, 6	42.4466	-75.4502	333	Seasonal	Obligate
VP-T	1	42.4425	-75.4938	28	Seasonal	Obligate and Facultative
VP-U	4, 7	42.4387	-75.4219	627	Seasonal	Obligate and Facultative
VP-V	2, 5	42.4512	-75.4722	333	Seasonal	Obligate[2]
VP-W	2, 5	42.45	-75.4717	69	Seasonal	Obligate[2]
VP-X	2, 5	42.4443	-75.4681	432	Seasonal	Obligate[2] and Facultative
VP-Y	2, 5	42.444	-75.465	2,845	Seasonal	Obligate[2]
VP-Z	2, 3, 5	42.4482	-75.4621	203	Seasonal	Obligate and Facultative
VP-4A	3, 4	42.4616	-75.434	1,982	Semi-Permanent	Obligate

[1] Hydroperiod Classifications: seasonal – feature expected to dry out in most years; semi-permanent – feature expected to partially dry out in most years; permanent – feature is not expected to dry out in most years.
[2] Jefferson/blue-spotted salamander complex (*Ambystoma jeffersonianum* x *laterale*) egg masses were observed.

4.0 REFERENCES

Massachusetts Division of Fisheries and Wildlife (MADFW). 2009. Natural Heritage and Endangered Species Program's Guidelines for the Certification of Vernal Pool Habitat. Available at: https://www.mass.gov/files/documents/2017/01/uw/vpcert.pdf. Accessed April 2019.

New Jersey Department of Fish and Wildlife (NJDFW). 2002. New Jersey's Vernal Pools. Available at: https://www.state.nj.us/dep/fgw/ensp/pdf/vernalpool02.pdf. Accessed April 2019.

NJDFW. 2010. The Vernal Pool Survey Project. Available at: https://www.njfishandwildlife.com/ensp/pdf/vptrain04.pdf. Accessed April 2019.

New York Natural Heritage Program (NYNHP). 2019. Online Conservation Guide for Vernal Pools. Available at: http://www.acris.nynhp.org/guide.php?id=9902. Accessed April 2019.

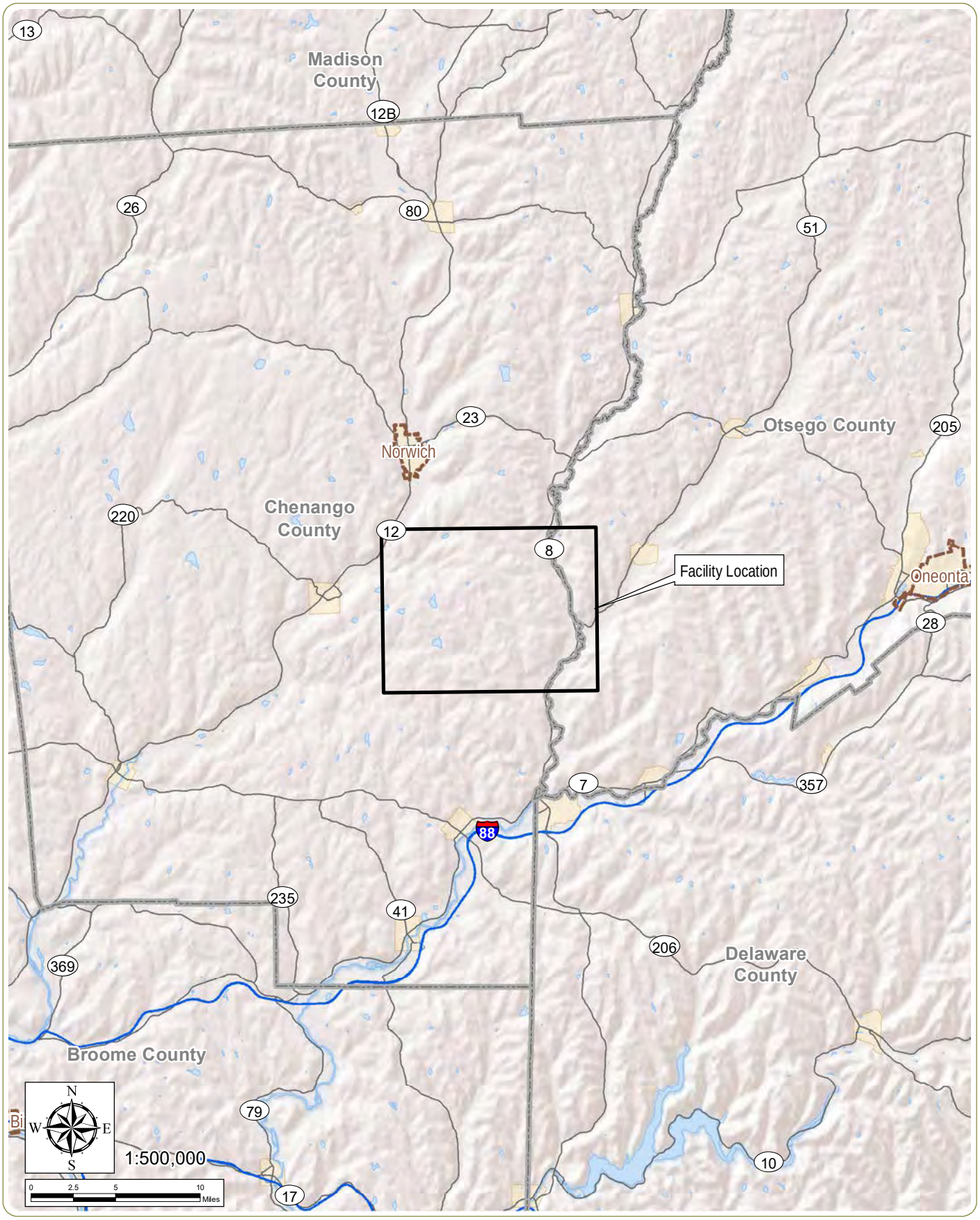
New York Department of Environmental Conservation (NYSDEC). 2015. List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State. Available at: https://www.dec.ny.gov/animals/7494.html. Accessed April 2019.

NYSDEC. 2018. Woodland Pool Wildlife Photo Identification Guide. Available at: http://www.dec.ny.gov/docs/regions_pdf/hrepwpwid.pdf. Accessed April 2019.

NYSDEC. 2019. Amphibian Identification Guide. Available at: https://www.dec.ny.gov/lands/82722.html. Accessed June 2019.

Pennsylvania Natural Heritage Program (PNHP). 2018. Vernal Pools. Available at: http://www.naturalheritage.state.pa.us/VernalPool_Animal.aspx. Accessed April 2019.

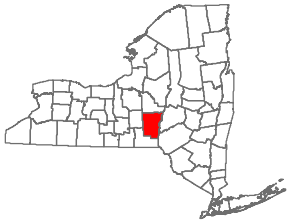
FIGURES



High Bridge Wind Project

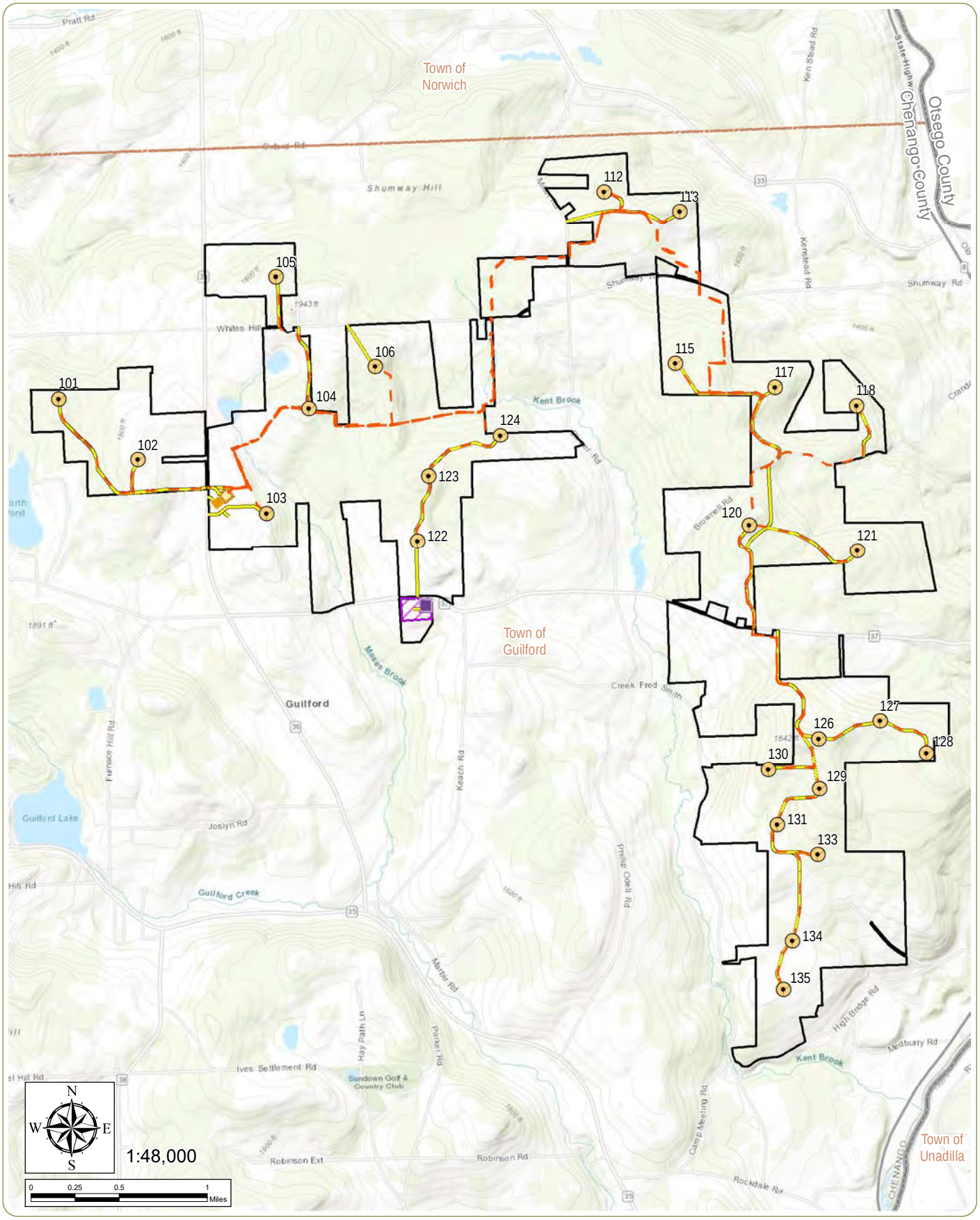
Town of Guilford, Chenango County, New York

Figure 1: Regional Facility Location



Notes: 1. Basemap: ESRI "Shaded Relief" map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



High Bridge Wind Project

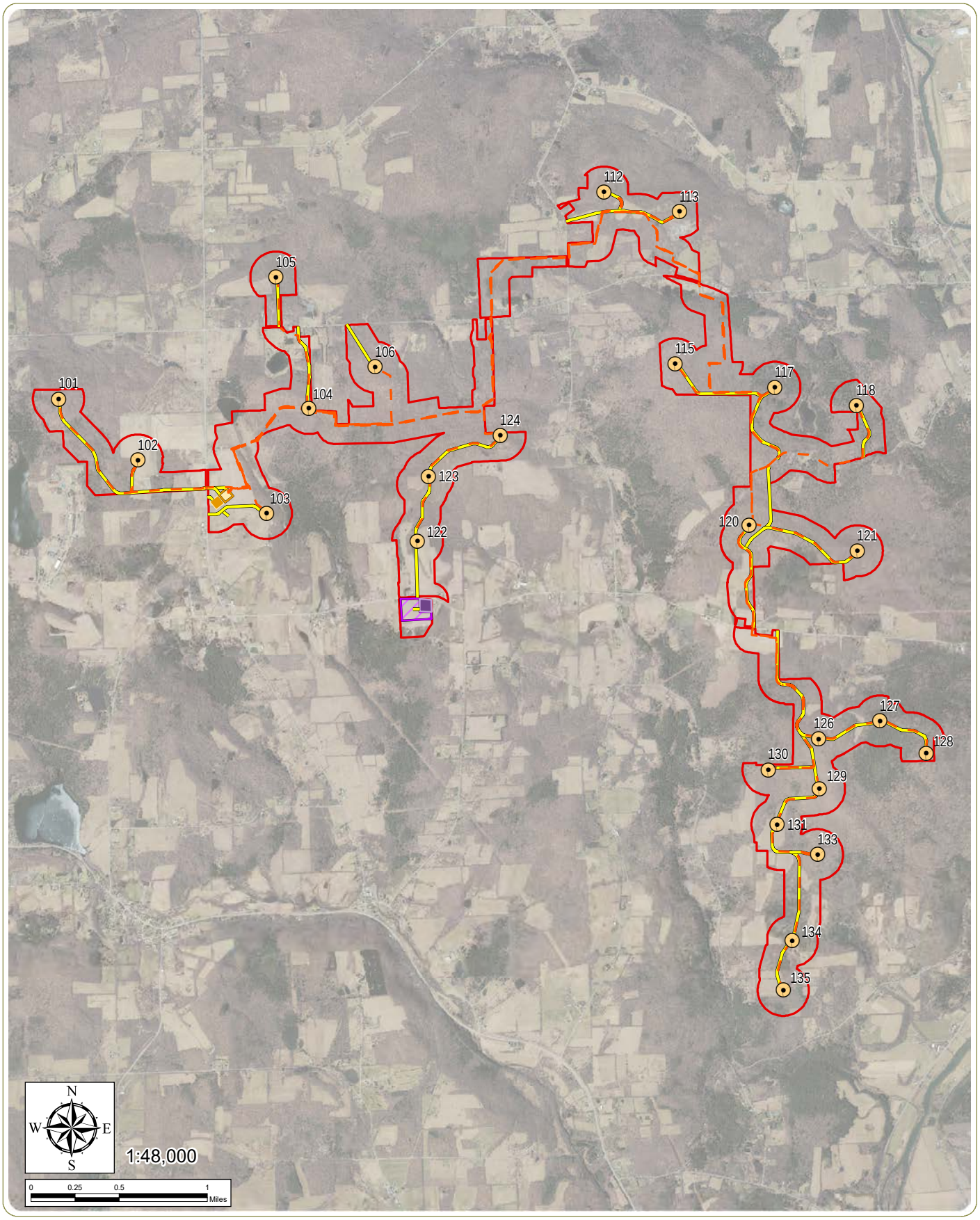
Town of Guilford, Chenango County, New York

Figure 2: Facility Layout

Notes: 1. Basemap: ESRI ArcGIS Online "World Topographic Map" map service.
2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic.
Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Collection Line
- Access Road
- Collection Substation
- POI Substation
- Laydown Area and Batch Plant
- O&M Facility
- Facility Site
- Town Boundary
- County Boundary

www.edrdpc.com



High Bridge Wind Project

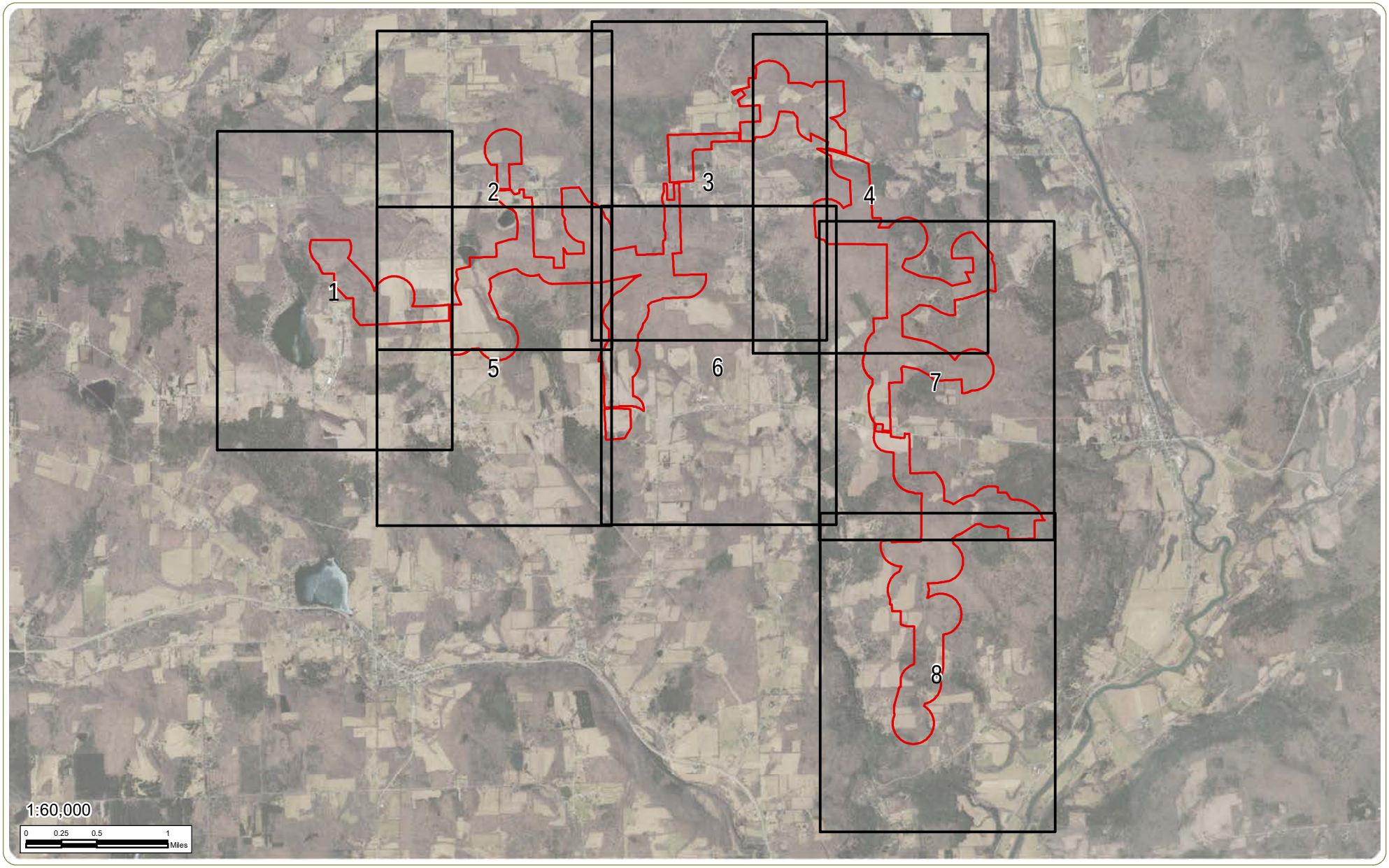
Town of Guilford, Chenango County, New York

Figure 3: Study Area

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service.
2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic.
Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Collection Line
- Access Road
- Collection Substation
- POI Substation
- Laydown Area and Batch Plant
- O&M Facility
- Wetland Study Area

www.edrdpc.com



High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools - Index

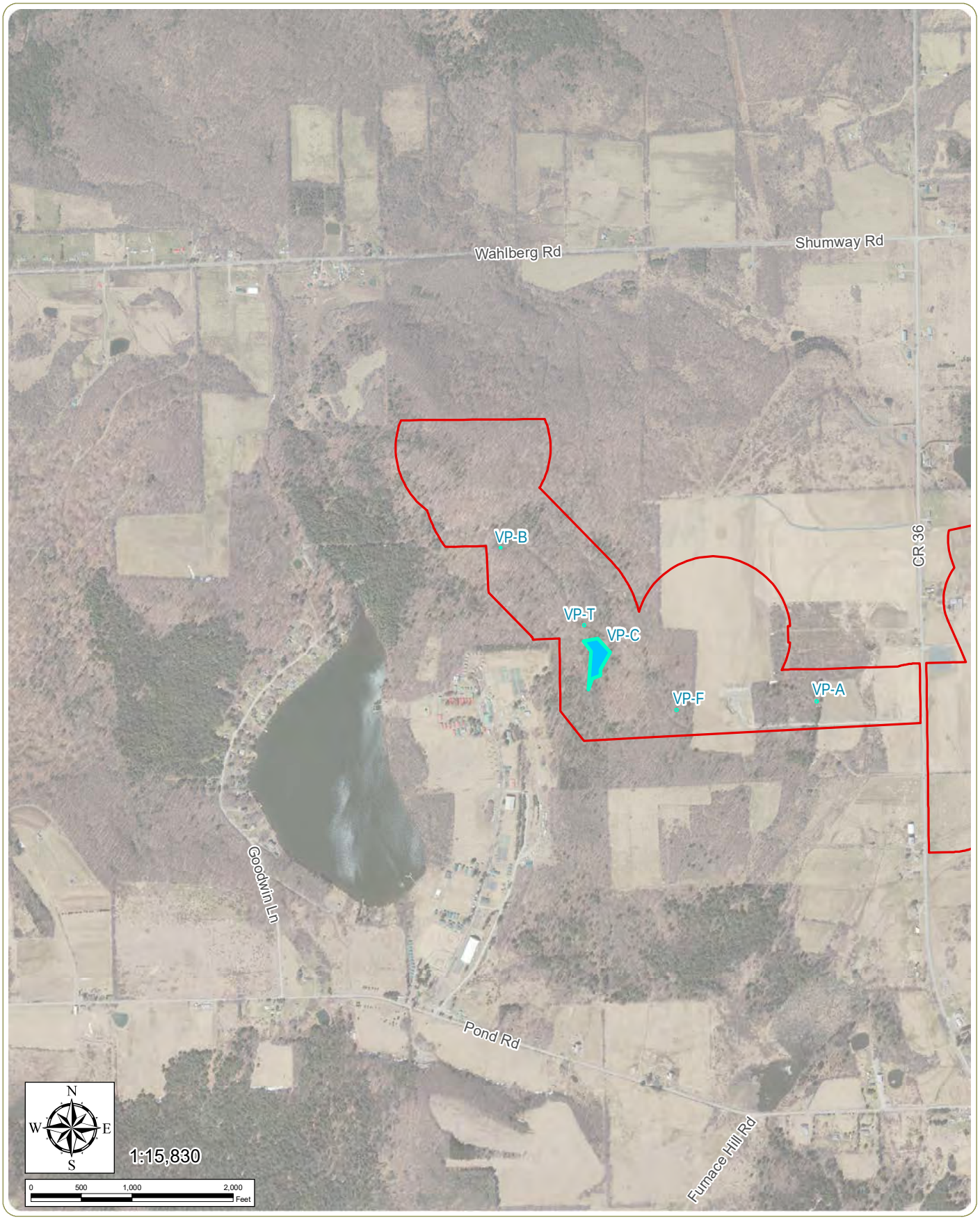
Map Sheet

Wetland Study Area

Notes: 1. Basemap:NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

N
W
E
S

www.edrdpc.com



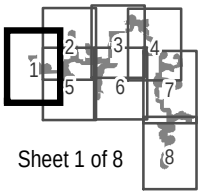
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

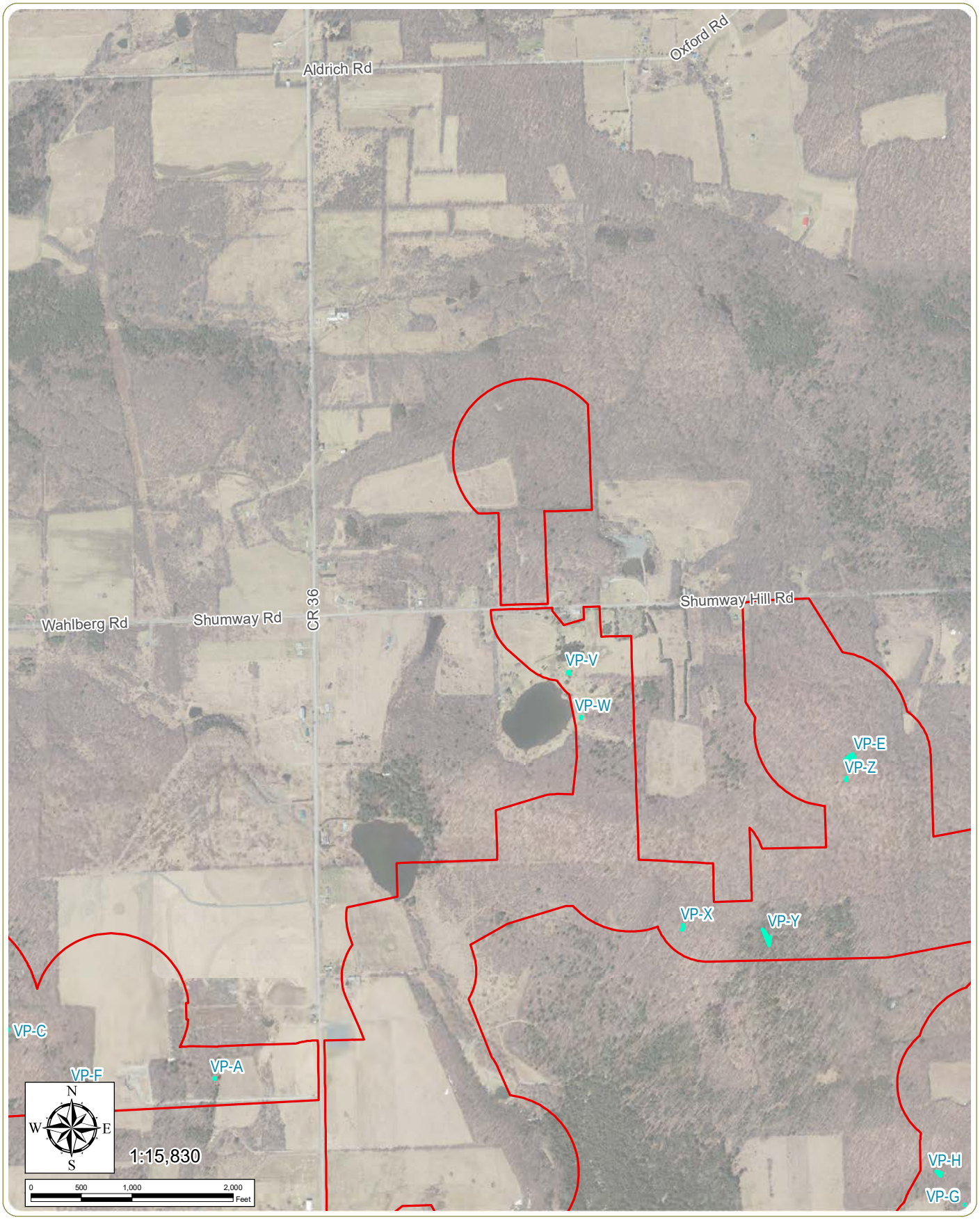
Wetland Study Area



Sheet 1 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



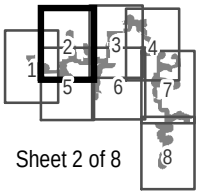
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

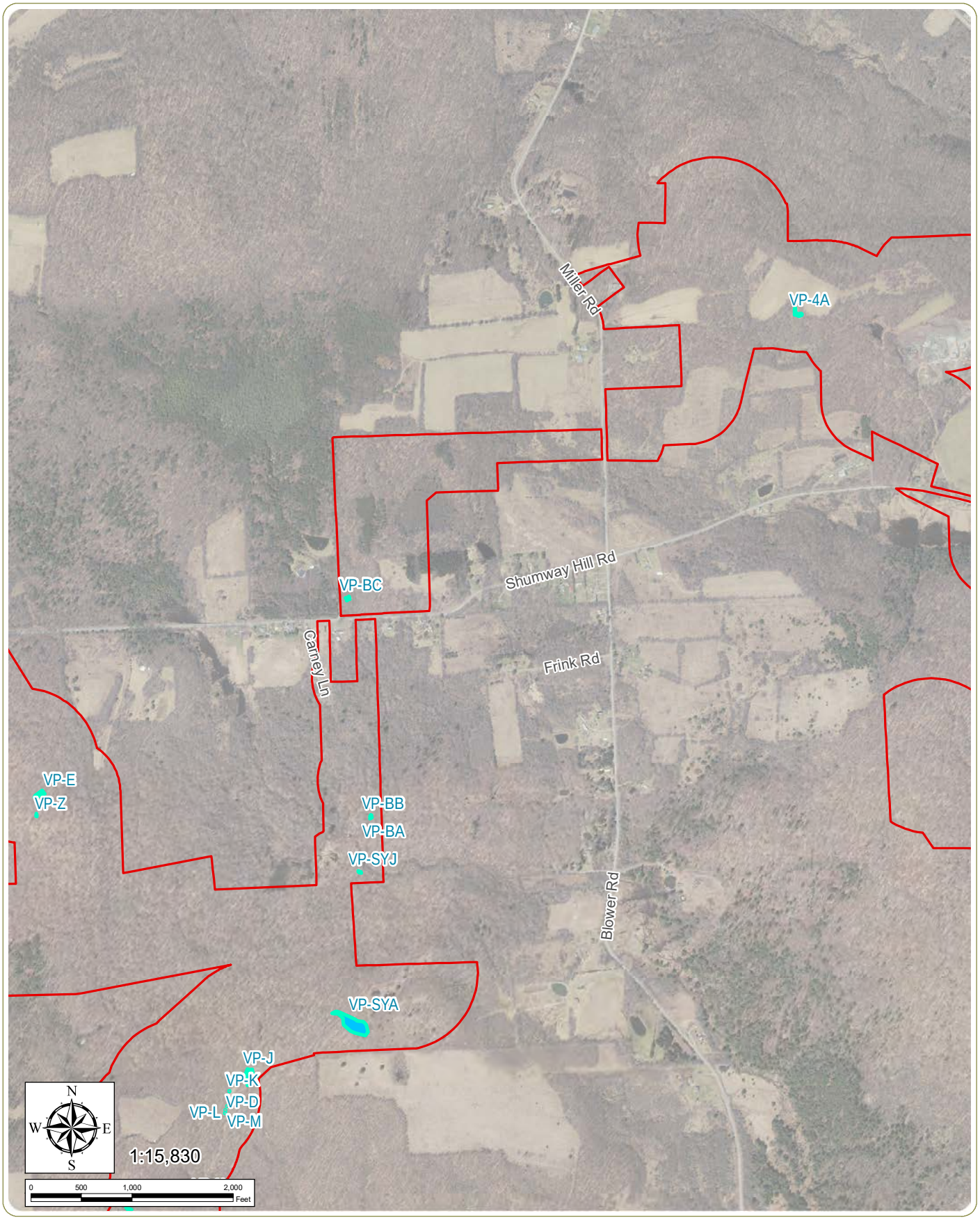
Wetland Study Area



Sheet 2 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



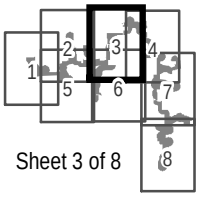
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

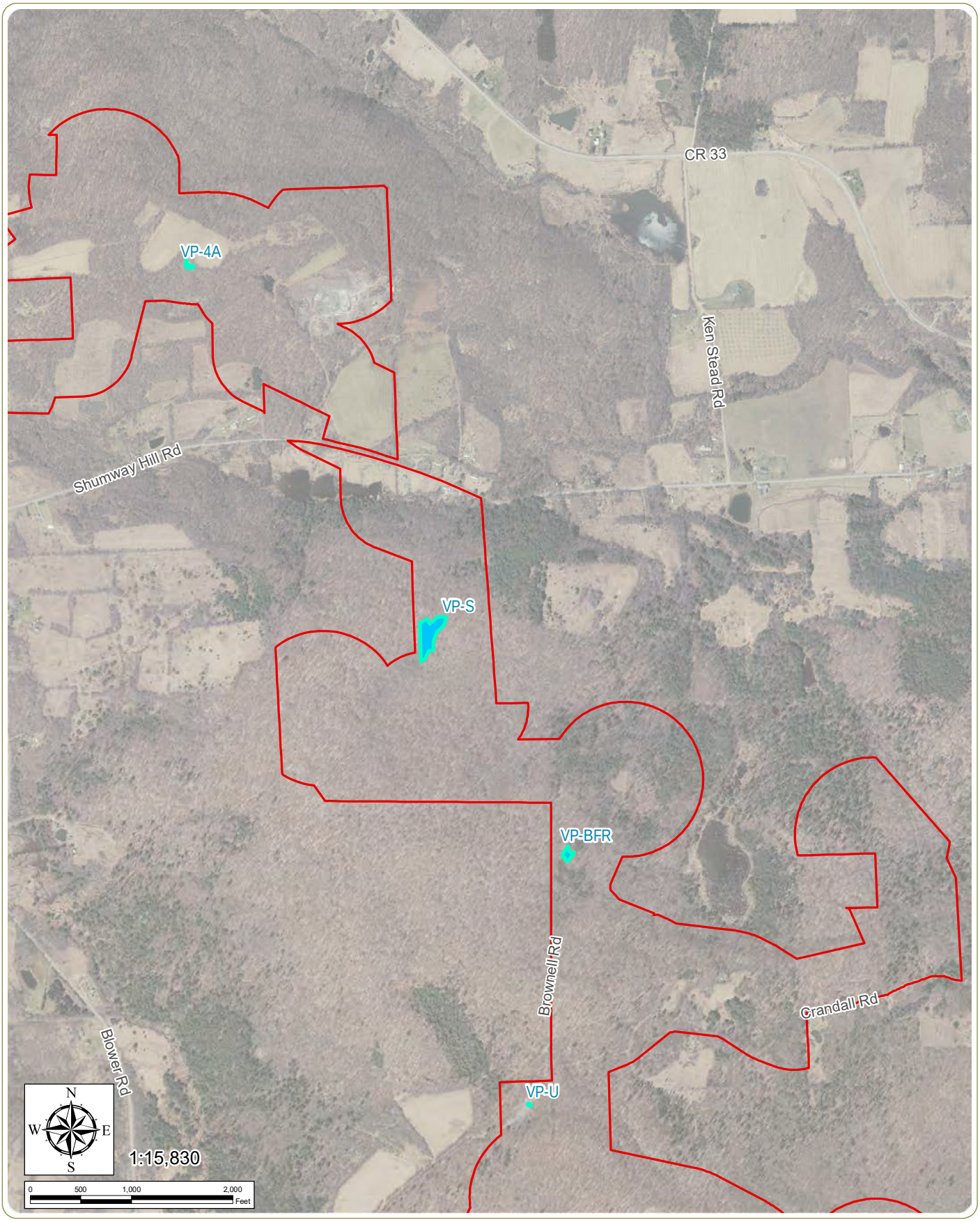
Wetland Study Area



Sheet 3 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



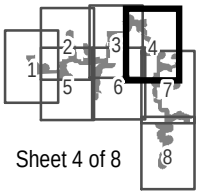
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

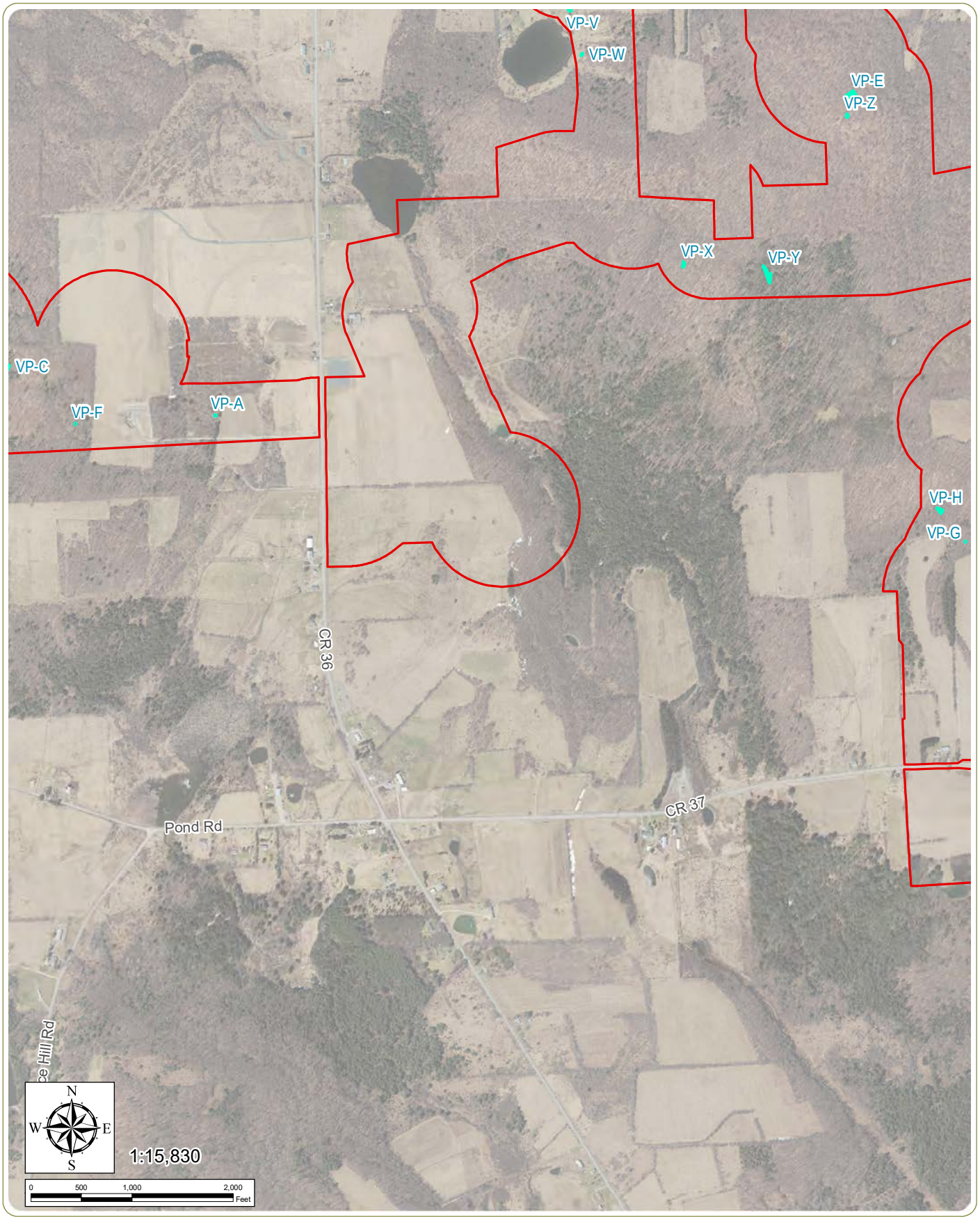
Wetland Study Area



Sheet 4 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



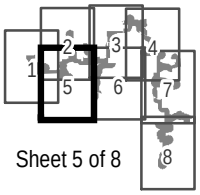
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

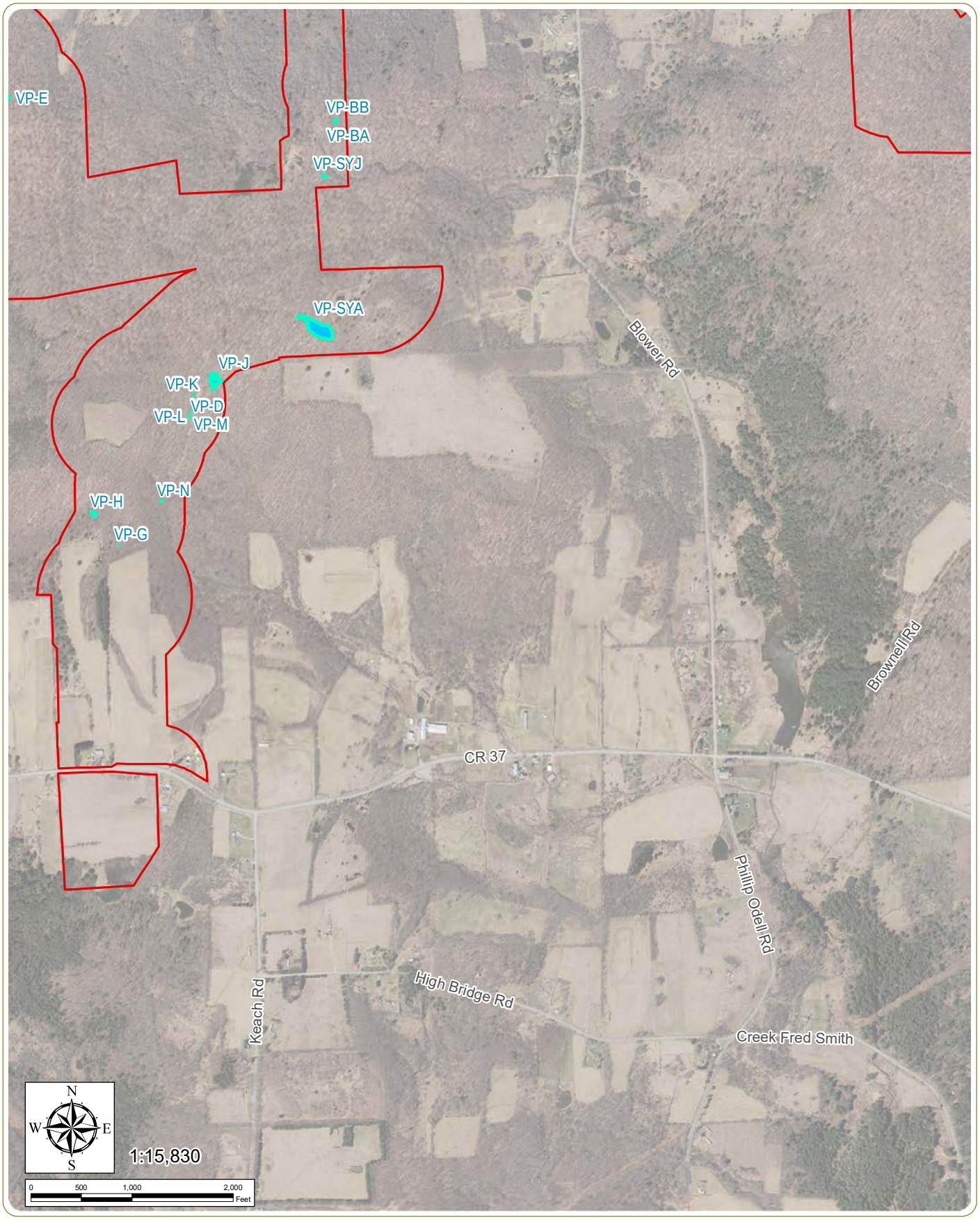
Wetland Study Area



Sheet 5 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



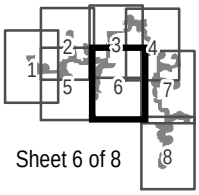
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

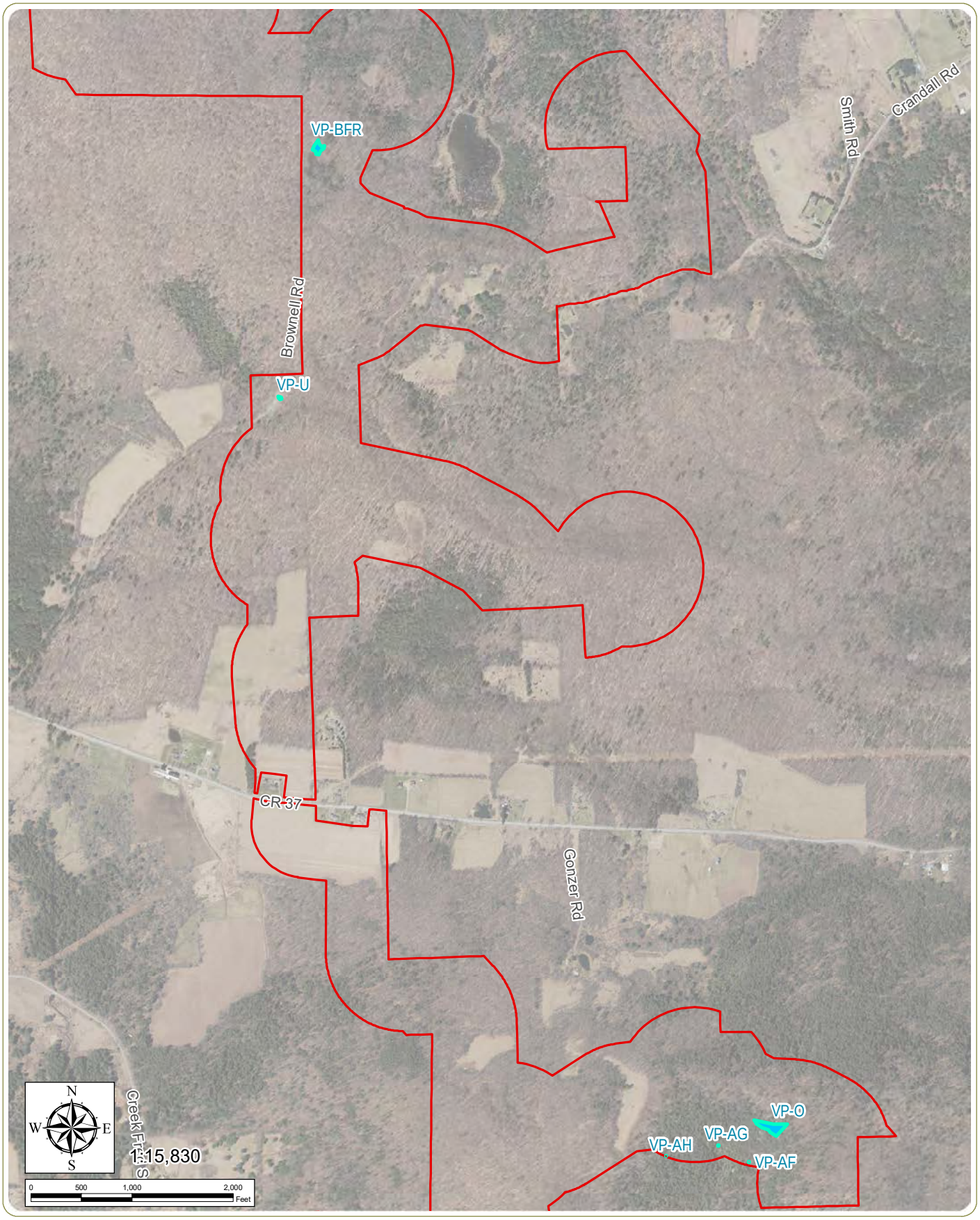
Wetland Study Area



Sheet 6 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



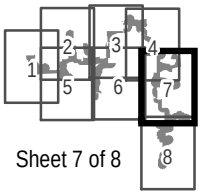
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

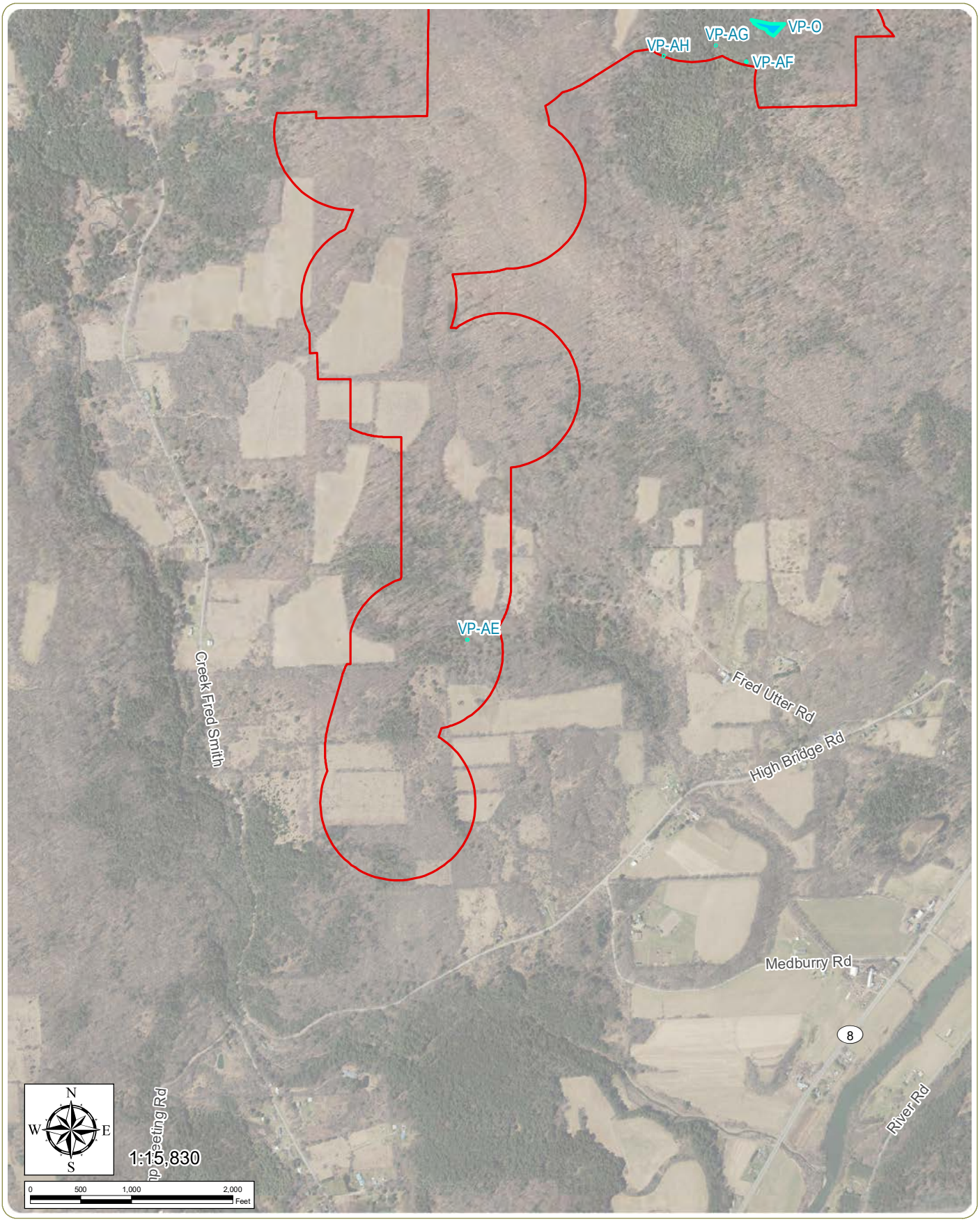
Wetland Study Area



Sheet 7 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com



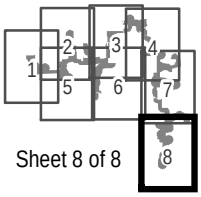
High Bridge Wind Project

Town of Guilford, Chenango County, New York

Figure 4: Vernal Pools

Vernal Pool

Wetland Study Area



Sheet 8 of 8

Notes: 1. Basemap: NYSDOP "2018" orthoimagery map service. 2. This map was generated in ArcMap on July 30, 2019. 3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

www.edrdpc.com

APPENDIX A

Vernal Pool Guidelines

Vernal Pool

Vernal pool at Saratoga National Historical Park

Photo credits: *Gregory J. Edinger*

System	Palustrine
Subsystem	Forested Mineral Soil Wetlands

Did you know?
Many animals depend on vernal pools, especially for breeding. Most of these animals such as frogs, toads, turtles, and salamanders spend a majority of their life in nearby wetlands but migrate to breed or feed in productive vernal pools. Fingernail clams and air-breathing snails live their entire life in vernal pools and must burrow beneath leaves and mud when the pool dries until the water returns. Fairy shrimp produce eggs that remain in the dry pool after the adult's death and hatch after the pool refills.

Summary

Protection Not listed in New York State, not listed federally.

Rarity G4, S3S4

A global rarity rank of G4 means: Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
A state rarity rank of S3S4 means: Vulnerable in New York, or Apparently Secure - Vulnerable to becoming imperiled in New York, with relatively few populations or locations, few individuals, and/or restricted range; or uncommon but not rare in New York; may be rare in some parts of the state; possibly some cause for long-term concern due to declines or other factors. More information is needed to assign a single conservation status.

Conservation Status in New York

There are probably a few thousand occurrences statewide. Vernal pools are typically small (i.e., generally under one acre) and may be overlooked as wetlands after the water draws down. A few documented occurrences have good viability and are protected on public land or private conservation land. This community has statewide distribution, and likely includes several high quality examples. The current trend of this community is probably stable for occurrences on public land, or declining slightly elsewhere due to moderate threats related to development pressure, alteration to the natural hydrology, and reduced protection regulations for isolated wetlands. This community has probably declined moderately from historical numbers likely correlated with logging and development of the surrounding landscape.

Short-term Trends

The number and acreage of vernal pools in New York have probably declined in recent decades as a result of reduced protection regulations for isolated wetlands. Their relatively small size and seasonal hydroperiod may have contributed to the decline with many occurrences going undetected as regulated wetlands.

Long-term Trends

The number and acreage of vernal pools in New York have declined moderately from historical numbers likely correlated to the alteration to the natural hydrology and direct destruction, in both forested and urban areas.

Larger occurrences of this natural community (>12.5 acres) are protected under NY State wetland laws.

Conservation and Management

Threats

In 2001, the federal Supreme Court ruled that the US Congress did not give authority to the US Army Corps of Engineers (US ACE) under section 404 of the Clean Water Act to regulate the filling of isolated wetlands. This decision led US EPA and US ACE officials to issue guidance in January 2003 that made it more difficult for regulators to protect isolated wetlands, such as vernal pools (Brooks and Paton 2005). Vernal pools are threatened by development (e.g., agriculture, residential, roads) and its associated run-off (e.g., septic, silt, nutrients), habitat alteration (e.g., excessive logging, pollution, trash dumping), and recreational overuse (e.g., ATVs). Alteration to the natural hydrological regime is also a threat to this community (e.g., ditching, impoundments).

Conservation Strategies and Management Practices

Where practical, establish and maintain a natural wetland buffer to reduce storm-water, pollution, and nutrient run-off, while simultaneously capturing sediments before they reach the vernal pool. Buffer width should take into account the erodibility of the surrounding soils, slope steepness, and use of the surrounding upland by vernal pool fauna. Wetlands protected under Article 24 are known as New York State "regulated" wetlands. The regulated area includes the wetlands themselves, as well as a protective buffer or "adjacent area" extending 100 feet landward of the wetland boundary (NYS DEC 1995). Vernal pools seldom meet the size criteria for state regulated wetland. If possible, minimize the number and size of impervious surfaces in the surrounding landscape. Avoid habitat alteration within the wetland and surrounding landscape. For example, roads and trails should be routed around vernal pools, and ideally should not pass through the buffer area. Restore vernal pools that have been unnaturally disturbed (e.g., remove obsolete impoundments and ditches in order to restore the natural hydrology). Prevent the spread of invasive exotic species into the wetland through appropriate direct management, and by minimizing potential dispersal corridors, such as roads.

Specific management recommendations for vernal pools can be found in the following: 1) Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States (Calhoun and Klemens 2002), and 2) Forestry Habitat Management Guidelines for Vernal Pool Wildlife (Calhoun

and deMaynadier 2004).

Development and Mitigation Considerations

When considering road construction and other development activities minimize actions that will change what water carries and how water travels to this community, both on the surface and underground. Water traveling over-the-ground as run-off usually carries an abundance of silt, clay, and other particulates during (and often after) a construction project. While still suspended in the water, these particulates make it difficult for aquatic animals to find food; after settling to the bottom of the wetland, these particulates bury small plants and animals and alter the natural functions of the community in many other ways. Thus, road construction and development activities near this community type should strive to minimize particulate-laden run-off into this community. Water traveling on the ground or seeping through the ground also carries dissolved minerals and chemicals. Road salt, for example, is becoming an increasing problem both to natural communities and as a contaminant in household wells. Fertilizers, detergents, and other chemicals that increase the nutrient levels in wetlands cause algae blooms and eventually an oxygen-depleted environment where few animals can live. Herbicides and pesticides often travel far from where they are applied and have lasting effects on the quality of the natural community. So, road construction and other development activities should strive to consider: 1. how water moves through the ground, 2. the types of dissolved substances these development activities may release, and 3. how to minimize the potential for these dissolved substances to reach this natural community.

Inventory Needs

Survey for occurrences statewide to advance documentation and classification of vernal pools. Finding occurrences with several pools forming a complex should be a priority. A statewide review of vernal pools is desirable.

Research Needs

Research is needed to fill information gaps about vernal pools, especially to advance our understanding of their classification, hydrology, floristic variation, and characteristic fauna. Research is needed to see if vernal pool species assemblages are related to the underlying bedrock (e.g., acidic vs. alkaline) and/or the surrounding forest type (e.g., needle-leaf evergreen vs. broad-leaf deciduous).

Rare Species

False Hop Sedge (*Carex lupuliformis*)
Cat-tail Sedge (*Carex typhina*)
Brown Bog Sedge (*Carex buxbaumii*)
Featherfoil (*Hottonia inflata*)
Tiger Salamander (*Ambystoma tigrinum*)
Little Brown Bat (*Myotis lucifugus*)
Lance Aplexa (*Aplexa elongata*)
Lyre-tipped Spreadwing (*Lestes unguiculatus*)

Identification Comments

Vernal pools are intermittently to ephemerally ponded, small, shallow depressions usually located within an upland forest. They are typically flooded in spring or after a heavy rainfall, but are usually dry during summer. Many vernal pools are filled again in autumn. The substrate is dense leaf litter over hydric soils. Vernal pools typically occupy a confined basin (i.e., a standing waterbody without a flowing outlet), but may have an intermittent stream flowing out of it during high water. Since vernal pools cannot support fish populations, there is no threat of fish predation on amphibian eggs or invertebrate larvae. Characteristic animals of vernal pools include species of amphibians, reptiles, crustaceans, mollusks, annelids, and insects. Vernal pool amphibians include spotted salamander (Ambystoma maculatum), blue-spotted salamander (A. laterale), Jefferson's salamander (A. jeffersonianum), marbled salamander (A. opacum), and wood frog (Rana sylvatica). Fairy shrimp (Anostraca) are obligate vernal pool crustaceans, with Eubranchipus spp. being the most common.

The Best Time to See

Vernal pools are best observed after spring thaw when they are filled with melt water and breeding wood frogs start calling. April is generally a good month to visit vernal pools in New York (earlier to the south and later to the north). Repeat visits to the same vernal pool as the water draws down increases the chances of seeing the full array of characteristic vernal pool species at different stages of their life cycle.

Characteristics Most Useful for Identification

Individual vernal pools are typically small (<0.5 acre), are surrounded by upland forest with trees that overhang the pool, providing a continuous leaf litter substrate, and are generally sparsely vegetated and fishless. The presence of animals categorized as obligate vernal pool species (species that depend upon vernal pool habitat for their survival) helps confirm the identification.

Elevation Range

Known examples of this community have been found at elevations between 50 feet and 1890 feet.

Similar Ecological Communities

Coastal plain pond: In New York, coastal plain ponds are restricted to Long Island and are most common in the Central Pine Barrens. The ponds are generally larger than vernal pools and reveal a distinct zonation of vegetation on the pond shore as the water draws down. Coastal plain ponds may hold water throughout the year and larger examples may support fish. Vernal pools are typically small (<0.5 acre), are surrounded by upland forest with trees that overhang the pool, and are generally sparsely vegetated and fishless.

Pine barrens vernal pond: Individual vernal pools are typically small (1 acre), surrounded by fire-adapted pine barren communities, and the vegetation is usually well-developed and distinct from vernal pool vegetation. The two communities are similar in that they provide habitat for many of the same animals that depend on seasonally flooded depressions to breed.

Intermittent stream: Vernal pools form in depressions with no inlet or outlet. Intermittent streams flow down hill in a linear streambed. Both are ephemeral aquatic communities that usually dry up as the season progresses and they share many species that depend on intermittent flooding.

Eutrophic pond: Eutrophic ponds are permanently flooded and usually never completely draw down. Eutrophic ponds usually have an inlet and outlet, and support fish.

Characteristic Species

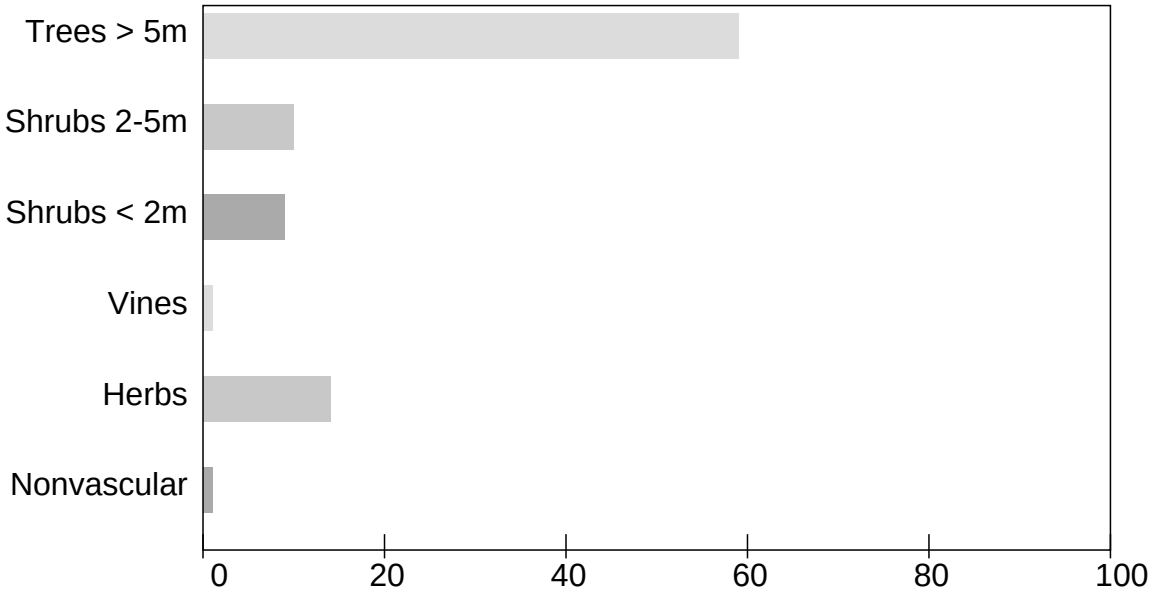
Trees > 5m
Red Maple (*Acer rubrum*)
Yellow Birch (*Betula alleghaniensis*)
White Ash (*Fraxinus americana*)
Green Ash (*Fraxinus pennsylvanica*)
White Oak (*Quercus alba*)
Swamp White Oak (*Quercus bicolor*)
Pin Oak (*Quercus palustris*)
Eastern Hemlock (*Tsuga canadensis*)
Slippery Elm (*Ulmus rubra*)

Shrubs 2-5m
Spicebush (*Lindera benzoin*)
Pitch Pine (*Pinus rigida*)
Highbush Blueberry (*Vaccinium corymbosum*)

Shrubs < 2m
Common Buttonbush (*Cephalanthus occidentalis*)
Sheep-laurel (*Kalmia angustifolia*)
Mountain Holly (*Nemopanthus mucronatus*)

Herbs
False Nettle (*Boehmeria cylindrica*)
Hoary Sedge (*Carex canescens*)
Tussock Sedge (*Carex stricta*)
Needle Spikerush (*Eleocharis acicularis*)
Lesser Duckweed (*Lemna minor*)
Sensitive Fern (*Onoclea sensibilis*)
Canada Clearweed (*Pilea pumila*)
Marsh Fern (*Thelypteris palustris*)

Nonvascular
Leucobryum glaucum
Sphagnum spp.



This figure helps visualize the structure and "look" or "feel" of a typical vernal pool. Each bar represents the amount of "coverage" for all the species growing at that height. Because layers overlap (shrubs may grow under trees, for example), the shaded regions can add up to more than 100%.

International Vegetation Classification System Associations

This New York natural community encompasses all or part of the concept of the following International Vegetation Classification (IVC) natural community associations. These are often described at finer resolution than New York's natural communities. The IVC is developed and maintained by NatureServe.

Eastern Woodland Vernal Pool (CEGL006453)

Additional Resources

Links

Woodland Pool Conservation (NYS DEC)
http://www.dec.ny.gov/lands/52325.html
Vernal Pools (EPA)
https://www.epa.gov/wetlands/vernal-pools
Vernal Pool Association
http://www.vernalpool.org/vernal_1.htm

References

Barbour, S. 1999. Northern Shawangunks Vernal Pools Inventory. Final Report to the Shawangunk Biodiversity Partnership. Unpublished report. Eastern New York Chapter of The Nature Conservency, Troy, New York.

Brooks, R. P., T. J. O'Connell, D. H. Wardrop. L. E. Jackson. 1998. Towards a regional index of biological integrity: The example of forested riparian ecosystems. Environmental Monitoring and Assesments 51: 131-143.

Brooks, R.T. and P.W.C. Paton. 2005. Introduction to the symposium: woodland vernal pools in

northern temperate forests. Wetland Ecology and Management 13:211-212.

Brooks, R.T., J. Stone, and P. Lyons. 1998. An inventory of seasonal forest ponds on the Quabbin Reservoir Watershed, Massachusetts. Northeastern Naturalist 5(3):219-230.

Burne, M.R. and C.R. Griffin. 2005. Habitat associations of pool-breeding amphibians in eastern Massachusetts, USA. Wetlands Ecology and Management 13:247-259.

Burne, M.R. and C.R. Griffin. 2005. Protecting vernal pools:a model from Massachusetts, USA. Wetlands Ecology and Management 13:367-375.

Calhoun, A.J.K. and M.W. Klemens. 2002. Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Calhoun, A.J.K. and P. DeMaynadier. 2004. Forestry habitat management guidelines for vernal pool wildlife. MCA Technical Paper No. 6, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Calhoun, A.J.K. and P.G. deMaynadier. 2008. Science and Conservation of Vernal Pools in Northeastern North America. CRC Press, Taylor and Francis Group, Boca Raton, FL.

Colburn, E.A. (editor). 1997. A Citizen's Step-by-Step Guide to Protecting Vernal Pools. Seventh edition, Winter 1997. Massachusetts Audubon Society, Lincoln, MA.

Colburn, E.A. 2004. Vernal Pools: Natural History and Conservation. The McDonald and Woodward Publishing Company, Blacksburg, VA. 426 pp.

Comer, P. K. Goodin, G. Hammerson, S. Menard, M. Pyne, M.Reid, M. Robles, M. Russo, L. Sneddon, K. Sno, A. Tomaino, and M. Tuffy. 2005. Biodiversity Values of Geographically Isolated Wetlands: An Analysis of 20 U.S. States. NatureServe, Arlington, VA.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. La Roe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service. Washington, D.C. 131 pp.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero (editors). 2014. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke’s Ecological Communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY. http://www.dec.ny.gov/docs/wildlife_pdf/ecocomm2014.pdf

Edinger, Gregory J., D.J. Evans, Shane Gebauer, Timothy G. Howard, David M. Hunt, and Adele M. Olivero (editors). 2002. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation. Albany, NY. 136 pp.

Flatebo, G., C.R. Foss, and S.K. Pelletier. 1999. Biodiversity in the Forests of Maine: Guidlelines for Land Management. University of Maine Cooperative Extension, Orono, ME.

Huth, P. and D. Smiley. 1981. Shawangunk Vernal Pool Report. Daniel Smiley Research Center. Mohonk Preserve, Inc. New Paltz, New York.

Kenney, L.P. and M.R. Burne. 2000. A Field Guide to the Animals of Vernal Pools. Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program and Vernal Pool Association, Westborough, MA.

Keys, Jr.,J.; Carpenter, C.; Hooks, S.; Koenig, F.; McNab, W.H.; Russell, W.;Smith, M.L. 1995.

Ecological units of the eastern United States - first approximation (cd-rom), Atlanta, GA: U.S. Department of Agriculture, Forest Service. GIS coverage in ARCINFO format, selected imagery, and map unit tables.

NatureServe. 2005. NatureServe Central Databases. Arlington, Virginia. USA

New York State Department of Environmental Conservation. 1995. Freshwater Wetlands: Delineation Manual. July 1995. New York State Department of Environmental Conservation. Division of Fish, Wildlife, and Marine Resources. Bureau of Habitat. Albany, NY.

Paton, P.W.C. and W.B. Crouch III. 2002. Using the phenology of pond-breeding amphibians to develop conservation strategies. Conservation Biology 16(1):194-204.

Reschke, Carol. 1990. Ecological communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation. Latham, NY. 96 pp. plus xi.

New York Natural Heritage Program
625 Broadway, 5th Floor,
Albany, NY 12233-4757
Phone: (518) 402-8935
acris@nynhp.org

This project is made possible with funding from:
- New York State Department of Environmental Conservation Hudson River Estuary Program
- Division of Lands & Forests, Department of Environmental Conservation
- New York State Office of Parks, Recreation and Historic Preservation

Information for this guide was last updated on Apr 07, 2017
This guide was authored by D.J. Evans

Woodland Pool Wildlife

a photo identification guide

New York State Department of Environmental Conservation

This guide includes the group of wildlife that depends on woodland pools for breeding (mole salamanders, wood frog and fairy shrimp) and a number of other animals that use pool habitat for different life activities. More comprehensive guides to wildlife, vernal pools and wetland plants may be needed to identify the rich diversity of life that thrives in this habitat.

Mole Salamanders

These pool-breeding salamanders live in the forest and spend much of their time underground.

Spotted salamander

Ambystoma maculatum

Gray to black with yellow spots in 2 rows along back

Size: adult length is usually 5.0-8.0 inches in total length (TL)

Eggs: firm masses of 50-200 clear or white eggs, attached to twigs or stems

Jefferson salamander

Ambystoma jeffersonianum

Gray to brown with pale blue to white flecked underside

Size: adult length is usually 4.0-7.0 inches in TL, large and robust

Eggs: masses of 20-30 eggs, often sausage shaped

NOTE: Hybrids of Jefferson and blue-spotted salamanders are common and have features of both species.

Blue-spotted salamander

Ambystoma laterale

Coloring resembles enamelware pots, black with blue-silver flecks

Size: adult length is usually 3.0-5.0 inches in TL, slender bodied

Eggs: laid singly, in small clusters, or in sheets on pool bottom

Marbled salamander

Ambystoma opacum

Dark with silver-gray (females) to white (males) with bands on back

Size: adult length is usually 3.5-4.0 inches in TL, stout bodied

Eggs: between 50-200 laid in fall in dry pool bed

The Woodland Pool Conservation Program is part of a larger NYSDEC Hudson River Estuary Program initiative to partner with local communities to conserve the diversity of plants, animals and habitats that sustain the health and resiliency of the entire estuary watershed. For more information, contact: Laura Heady, Biodiversity Outreach Coordinator, at 845-256-3061 (lheady@gw.dec.state.ny.us), or visit **http://www.dec.ny.gov/lands/52325.html**.

Cornell University

Hudson River Estuary

Wood frog

Rana sylvatica

by Michael Barnhart

by Steve Chorvas

Orange to dark brown with dark "mask" from each eye to tympanum

Size: adult length is usually 1.5-3.0 inches

Eggs: > 1,000 in a 2.5-4.0--inch diameter mass, often laid communally in "rafts"

Fairy shrimp

Anostracan species

by Laura Heady

by Meredith Taylor

Variable in color with stalked eyes; swim upside down in pools from late winter to early spring

Size: adult length is usually 0.5-1.5 inches

Eggs: carried in a brood pouch, eventually released

Signs of Pool Breeding

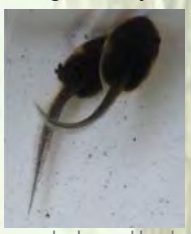
The presence of spermatophores, egg masses and developing amphibians in woodland pools indicate breeding activity.

by Mike Rubbo

Spermatophores are tiny "sperm packets" left by male salamanders on the bottoms of pools.

by Laura Heady

Wood frog egg masses do not have an outer matrix like salamander egg masses.



by Laura Heady

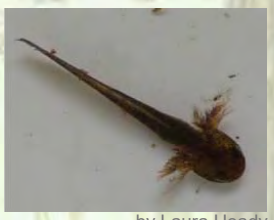
Wood frog larvae hatch early and are often the only frog tadpoles seen in pools in the spring.

by Laura Heady

Spotted salamander egg masses are very firm.

by Mike Rubbo

Jefferson salamander egg masses are often long and attached to vegetation.



by Laura Heady

Salamander larvae have external gills, unlike frog larvae.

More Woodland Pool Wildlife

These species may use woodland pools for foraging, resting, and/or breeding in addition to using other habitat types.

Spotted turtle

by Mike Rubbo

Spring peeper

by Ray Sussmann

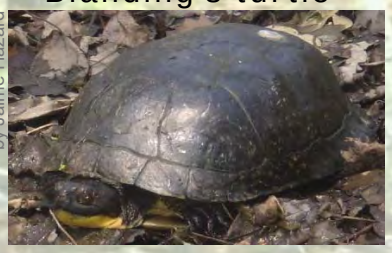
American toad

by Laura Heady

Four-toed salamander

by Laura Heady

Blanding's turtle*



by Jaime Hazard

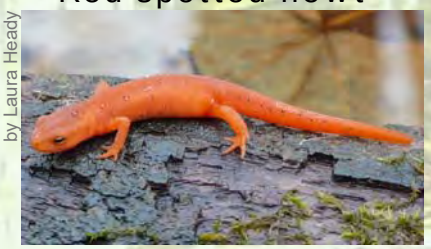
Spadefoot toad**

by Jesse W. Jaycox

Wood duck

by Mike Pogue

Red-spotted newt



by Laura Heady

* In the Hudson Valley, found in Dutchess County. ** In the Hudson Valley, found in Dutchess and Albany counties.

For more information: *The Amphibians and Reptiles of New York State* (Gibbs et al. 2007)
A Field Guide to the Animals of Vernal Pools (Kenney and Burne 2001).

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director* **March 2009**

Natural Heritage & Endangered Species Program's

Guidelines for the Certification of Vernal Pool Habitat

Table of Contents:

Section I. - NHESP Vernal Pool Fact Sheet

Section II. - NHESP Certification Criteria & Documentation Requirements

Section III. - NHESP Vernal Pool Field Observation Form

Background Information

The NHESP& Vernal Pool Certification*:*

The goal of the Natural Heritage & Endangered Species Program (NHESP) is to protect the state's native biological diversity with its highest priority being the protection of the state's roughly 435 native vertebrate, invertebrate, and plant species officially listed as Endangered, Threatened, or of Special Concern under the Massachusetts Endangered Species Act (M.G.L. c. 131A and implementing regulations 321 CMR 10.00).

The NHESP also administers the state's official vernal pool certification program. NHESP staff does not routinely survey and monitor vernal pools outside of rare species work and special vernal pool projects, but accepts certain biological and physical documentation submitted by outside scientists, resource managers, and other interested individuals and organizations as the basis for the possible certification of vernal pool habitat.

Why were the *Guidelines for the Certification of Vernal Pool Habitat* Revised in 2009?

Revisions to the *Guidelines* are designed to ensure consistency between the *NHESP certification criteria* and the *biological and physical criteria of 'vernal pool habitat'* in the WPA regulations (310 CMR 10.04, 10.57(1)(a)(3), 10.57(1)(b)(4), and 10.58(1)). The *Guidelines* have been modified to increase the confidence that pools that become certified provide essential breeding habitat for certain amphibians that require vernal pools. This is necessary, for example, because facultative vernal pool species use a variety of temporary and permanent wetlands and are not always reliable indicators of hydroperiod (two months inundation) or vernal pool habitat. The revised *Guidelines* address this by reducing the number of facultative species that can be used for certification. In addition, they enhance the requirements for documenting the physical and biological characteristics of a vernal pool (see sections II. and III. for specific changes). Overall, the revised *Guidelines* contribute to the defensible certification of vernal pool habitat in the variety of wetlands where they, in fact, occur.

Natural Heritage & Endangered Species Program

1 Rabbit Hill Road, Westborough, MA 01581 **Tel:** (508) 389-6360 **Fax:** (508) 389-7890

Help Save Endangered Wildlife!

Contribute to the Natural Heritage & Endangered Species Fund.

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director* **March 2009**

NHESP Guidelines for the Certification of Vernal Pool Habitat

I. VERNAL POOL FACT SHEET

What Are Vernal Pools?

Vernal pools are temporary bodies of fresh water that provide important habitat for many vertebrate and invertebrate species. "Vernal" means spring, and indeed, many vernal pools are filled by spring rains and snowmelt, and then dry during the summer. However, many vernal pools are filled by autumn rains (i.e., "autumnal pools") and persist through the winter and others are semi-permanent and do not dry every year. Vernal pools are quite often very small and shallow; vernal pools that support rich communities of vertebrate and invertebrate animals may measure only a few yards across. However, vernal pools of several acres also occur throughout Massachusetts.

Where Are Vernal Pools Found?

Vernal pools are common in Massachusetts and occur in almost every town in the state. Vernal pools are found across the landscape where small woodland depressions, swales, or kettle holes collect spring runoff or intercept seasonally high groundwater tables. Although many people associate vernal pools with dry woodland areas, vernal pools also occur in meadows, river floodplains, interdunal swales, and large vegetated wetland complexes. Vernal pool habitat can occur where water is contained for more than two months in the spring and summer of most years and where no reproducing fish populations are present.

Why Are Vernal Pools Valuable?

Some state-listed species that may be found in vernal pools:

Species	Status[1]
Marbled salamander (*Ambystoma opacum*)	T
Blue-spotted salamander (*A. laterale*)	SC
Jefferson salamander (*A. jeffersonianum*)	SC
Eastern spadefoot toad (*Scaphiopus holbroookii*)	T
Blanding's turtle (*Emydoidea blandingii*)	T
Wood turtle (*Glyptemys insculpta*)	SC

[1]Status pursuant to the MA Endangered Species Act: T = Threatened; SC = Special Concern.

Vernal pools constitute a unique and increasingly vulnerable type of wetland. Vernal pools are inhabited by many species of wildlife, some of which are totally dependent on vernal pools for their survival. Vernal pools do not support fish because they dry out annually or at least periodically. Some may contain water year round, but are free of fish as a result of significant drawdowns that result in extremely low dissolved oxygen levels. The wood frog (*Lithobates sylvaticus*) and the four local species of mole salamander (*Ambystoma* spp.) have evolved breeding strategies intolerant of fish predation on their eggs and larvae; the lack of established reproducing fish populations is essential to the breeding success of these species.

Other amphibian species, including the American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer*), and gray treefrog (*Hyla versicolor*), often exploit the fish-free waters of vernal pools but use a variety of different wetland types. Vernal pools also support rich and diverse invertebrate faunas. Some

invertebrates, such as the fairy shrimp (*Eubranchipus* spp.), are also dependent upon vernal pools. Invertebrates are both important predators and prey in vernal pool ecosystems. Vernal pools are an important habitat resource for many birds, mammals, reptiles and amphibians, including many species listed under the MA Endangered Species Act (M.G.L c.131A).

Vernal Pool Protection

Vernal pools became eligible for protection when the **Massachusetts Wetlands Protection Act regulations (WPA)** (310 CMR 10.00) were revised in 1987 to include 'wildlife habitat' as an interest protected under the WPA. Vernal pools became protected not as a specific wetland type, but rather a wetland function that provides important 'wildlife habitat'. In accordance with the WPA, vernal pools are presumed present in jurisdictional wetland 'Resource Areas' only when mapped and certified by the Natural Heritage & Endangered Species Program (NHESP). Thus, the vernal pool certification program was established to register the locations of *all vernal pools, regardless of jurisdiction, that meet the biological and physical features of 'Vernal Pool Habitat' in the WPA*; i.e., those that provide essential breeding habitat for certain amphibians that require vernal pools (310 CMR 10.04, 10.57(1)(a)(3), 10.57(1)(b)(4), and 10.58(1)). Although the NHESP certifies vernal pool habitat, local conservation commissions and the Massachusetts Department of Environmental Protection (DEP) are responsible for the regulatory protection of vernal pools.

Other regulations have subsequently incorporated protections for *certified* vernal pools including: the **Massachusetts Surface Water Quality Standards** (314 CMR 4.00), **Massachusetts Environmental Code: Title 5** (310 CMR 15.00), **Massachusetts Forest Cutting Practices Act Regulations** (304 CMR 11.00), **Massachusetts 401 Water Quality Certification Regulations** (314 CMR 9.00), and some **local wetland bylaws**. These regulations extend protections to many certified vernal pools (CVPs) that may not be jurisdictional under the WPA. In addition, the WPA and Forest Cutting Practices Act regulations also provide protection to vernal pools that have not been certified if their occurrence is adequately documented during permit review.

The Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) protect certified vernal pools and *up to* 100 feet beyond the pool boundary by preventing alterations which would result in impairment of the wildlife habitat function of the CVP. In order to receive protection through the WPA, however, CVPs **must occur within a jurisdictional wetland *'Resource Area'***. If in a 'Resource Area', protection extends to the CVP itself, as well as to the portion of the 100-foot zone surrounding the CVP (referred to as 'Vernal Pool Habitat') that is within a Resource Area. WPA protection of 'Vernal Pool Habitat' does not extend into non-jurisdictional upland or the buffer zone of a resource area. In summary, conservation commissions are empowered to prevent the impairment of the capacity of Vernal Pool Habitat to function as wildlife habitat.

Vernal pools that are not certified may also be protected by local conservation commissions or the DEP if credible scientific evidence is presented prior to the end of the appeals period for a Superseding Order of Conditions (OOC) issued by the DEP. A conservation commission, or the DEP on appeal, can incorporate protective conditions into an OOC that would prevent the impairment of the wildlife habitat value of the pool and its 100 foot 'Vernal Pool Habitat' if the pool is not certified.

> The WPA is administered by local conservation commissions under the jurisdiction of the DEP, either of which **should be contacted** for all questions related to the regulatory protection of certified and potential vernal pools.

Each DEP Regional Office has Vernal Pool Liaison(s) who can be contacted at these locations:

NORTHEAST REGIONAL OFFICE	SOUTHEAST REGIONAL OFFICE	CENTRAL REGIONAL OFFICE	WESTERN REGIONAL OFFICE
Wayne Lozzi 203B Lowell Street Wilmington, MA 0l887 (978) 694-3200	Daniel Gilmore OR Christopher Ross 20 Riverside Drive Lakeville, MA 02347 (508) 946-2700	Jennifer Gensel 627 Main Street Worcester, MA 01608 (508) 792-7650	Karen Hirschberg OR Tim McKenna 436 Dwight Street Springfield, MA 01103 (413) 748-1100

The Massachusetts Surface Water Quality Standards (SWQS) (314 CMR 4.00), administered by the DEP, implement Section 401 of the federal Clean Water Act at the state level. When a project proposes discharges of solid or liquid fill in a wetland under federal jurisdiction, a permit must be obtained from the Army Corps of Engineers. In accordance with the SWQS, the project proponent must first obtain a Water Quality Certification from the DEP, under the **Massachusetts 401 Water Quality Certification Regulations** (314 CMR 9.00), that states that the discharge complies with the federal Clean Water Act. The SWQS classify CVPs as Outstanding Resource Waters (ORW) for which no new or increased discharge of pollutants, including solid fill or storm water, is allowed, and any existing discharge must cease, or be treated with the highest and best practical methods. Generally, a CVP will be protected from the discharge of fill as an ORW, even if the CVP is not subject to WPA jurisdiction as a state wetland.

The Massachusetts Environmental Title 5 (310 CMR 15.00) regulates the siting and construction of subsurface sewage disposal (septic) systems in the state. A system's septic tank and distribution box must be located a minimum of 50 feet, and the leaching field a minimum of 100 feet, from the boundary of a CVP. The setback for the leach fields can be reduced if hydrogeologic data demonstrates the pool is hydraulically up-gradient from the proposed system.

The Massachusetts Forest Cutting Practices Act Regulations (304 CMR 11.00) protect CVPs from certain forestry impacts. Harvesting requirements limit cutting to no more than 50% of the trees within 50 feet of a CVP. They also require that trees or tree tops not be felled in CVPs, and restrict the use of pools as staging areas or skidder trails. Guidelines, similar to the regulations, are established for activities planned near uncertified vernal pools identified by consulting foresters.

Town Wetlands and Zoning By-laws are used by many municipalities to enhance protections to vernal pools. While the details of by-laws are town specific, they are generally intended to increase protection to vernal pools beyond that afforded by the WPA.

The Vernal Pool Boundary

The shallow edges of vernal pool habitat represent one of the most ecologically valuable portions of these habitats. These areas are generally the first to thaw in the spring and provide access to the pool for the earliest breeding species. These shallow water zones also tend to be significantly warmer than the deeper portions of a vernal pool throughout the spring. Egg masses of early breeding amphibians benefit from the warmer water temperatures at the pool edges that promote rapid egg development.

The boundary of vernal pool habitat must incorporate these shallowest reaches of the pool. When there is no distinct and clear topographic break at the edge of a pool, the maximum observed or recorded extent of flooding represents the ecological boundary of the vernal pool. This boundary is evident and should be delineated by leaf staining and other indicators of hydrology outside of the mean annual high water period (March through early April in most cases).

The NHESP does not establish a **physical, on-the-ground vernal pool boundary during the certification process.** The WPA allows a project proponent to submit an opinion as to the extent of a CVP that is based upon a total run-off from a statistical 2.6 inch rainfall in 24 hours, but it should also include groundwater inputs to the basin at the beginning of the spring amphibian breeding season (see DEP DWW Policy 85-2). The DEP has stated in its policies that groundwater inputs should not be overlooked in these calculations because otherwise it could result in a total volume considerably smaller than the basin holds in any given spring.

How Can Vernal Pools Be Certified?

The NHESP administers the official vernal pool certification program and accepts certain biological and physical documentation submitted by outside scientists, resource managers, and other interested

individuals and organizations as the basis for the possible certification of vernal pool habitat. People interested in vernal pool certification should:

> The NHESP strongly recommends that landowner permission be obtained prior to collecting certification documentation. It is the sole responsibility of an individual providing vernal pool certification information to ensure that all activities associated with gathering said information comply with law.

1. Download the NHESP *Guidelines for the Certification of Vernal Pool Habitat, March 2009* and the Vernal Pool Field Observation Form from www.nhesp.org. Please *read and understand the Guidelines before* collecting data and completing the form.

   Certification is based on evidence that a pool provides important wildlife habitat consistent with 'Vernal Pool Habitat' in the WPA. Wildlife that use vernal pools are generally divided into two groups:

   Obligate Species: vertebrate and invertebrate species that require vernal pools for all or a portion of their life cycle and are unable to successfully complete their life cycle without vernal pools.

   Facultative Species: vertebrate and invertebrate species that frequently use vernal pools for all or a portion of their life cycle, but are able to successfully complete their life cycle in other types of wetlands.

   Obligate species serve as *direct* indicators of vernal pool habitat because they require at least two months of flooded conditions and the absence of established, reproducing fish populations. When breeding evidence of obligate species is documented, it is not necessary to prove there is no established fish population.

   Facultative amphibian species serve as *indirect* indicators of vernal pool habitat. Documentation of the appropriate facultative amphibian species does not ensure certification; evidence documenting there is no established, reproducing fish population must also be submitted. Additionally, the physical documentation (e.g., pool photos, descriptive notes) submitted must demonstrate the pool possesses the physical characteristics necessary to sustain a vernal pool environment (e.g., depth, size, vegetation).

2. Fill out a Vernal Pool Field Observation Form. Attach the physical and biological documentation and the maps as required by the *Guidelines*. Submit the packet to the NHESP for review.

   The NHESP does not field visit pools prior to certification but relies on the submittal of accurate information and clear documentation of both the biological and physical evidence. If the documentation is inconclusive additional documentation may be requested or the pool may not be certified. Once it is determined that a vernal pool meets the certification criteria in the *Guidelines*, it will be officially certified by NHESP and the observer, conservation commission, DEP regional office, and landowner (if known) are formally notified.

Certified Vernal Pool Maps

- **GIS Data layers** of Certified Vernal Pools (updated biannually) and Potential Vernal Pools are available through the MassGIS Online Data Viewer ('Oliver') at www.mass.gov/mgis/mapping.htm →"Oliver" - The MassGIS Online Data Viewer→Launch Oliver or Install Java→Login→Zoom to area of interest→Add Layers→Conservation/Recreation→Natural Heritage Data→NHESP Certified Vernal Pools→Potential Vernal Pools.
- NHESP's town-wide **'Prioirty Habitat & Estimated Habitat'** maps (published biennially) include CVPs and are available for public viewing at the offices of conservation commissions, planning boards, and building inspectors, and at MassGIS at www.mass.gov/mgis/cvp.htm.
- NHESP's **Massachusetts Natural Heritage Atlas** (updated biennially) is available at most town libraries and from NHESP at cost.

NHESP - Vernal Pool Certification
MA Division of Fisheries & Wildlife
1 Rabbit Hill Road
Westborough, MA 01581
For Certification Questions call 508-389-6360

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director* **March 2009**

NHESP Guidelines for the Certification of Vernal Pool Habitat

II. CERTIFICATION CRITERIA & DOCUMENTATION REQUIREMENTS

Please read and understand the **CERTIFICATION CRITERIA** and **DOCUMENTATION REQUIREMENTS** in the following sections before submitting Vernal Pool Field Observation Form(s) and supporting documentation.

Certification Criteria

Vernal pool certification is possible only after the appropriate **biological** AND **physical** criteria have been met and documented by one of the two certification methods described below:

A) OBLIGATE SPECIES METHOD

Biological Criteria

- Breeding evidence of obligate amphibian species OR the presence of fairy shrimp (see table on pg. II.2).

AND

Physical Criteria

- Evidence of a pool with no permanently flowing outlet (i.e., photo of the pool holding water).

B) FACULTATIVE AMPHIBIAN SPECIES METHOD

Biological Criteria

- Breeding evidence of 2 or more facultative amphibian species (see table on pg. II.2).

AND

Physical Criteria

- Evidence of a pool with no permanently flowing outlet (i.e., photo of the pool holding water).

AND

- Evidence that there is no established, reproducing fish population (i.e., photo of the pool dry).

The **Obligate Species Method** is the most direct way to certify a vernal pool. If documentation submitted is inconclusive, or if the physical documentation appears to show inappropriate habitat, the pool may not be certified or additional documentation may be requested. Since **facultative amphibians** can use a variety of wetland habitats it is especially important when using this method that the pool photos demonstrate the physical characteristics necessary to sustain a vernal pool environment (e.g., depth, size, vegetation). If there is any doubt, the NHESP may require additional evidence.

THE NHESP STRONGLY RECOMMENDS THAT LANDOWNER PERMISSION BE OBTAINED PRIOR TO COLLECTING CERTIFICATION DOCUMENTATION. IT IS THE SOLE RESPONSIBILITY OF AN INDIVIDUAL PROVIDING VERNAL POOL CERTIFICATION INFORMATION TO ENSURE THAT ALL ACTIVITIES ASSOCIATED WITH GATHERING SAID INFORMATION COMPLY WITH LAW.

A. Obligate Species Method ~ Biological and Physical Criteria & Evidence Accepted for Certification:

BIOLOGICAL CRITERIA		PHYSICAL CRITERIA	
Obligate Species Accepted - one or more of the following	**Breeding Evidence Accepted -** one or more of the following from at least one obligate species must be documented by photos, video, or audio (chorusing)	**Physical Features Accepted**	**Physical Evidence Accepted**
Wood frog *(Lithobates sylvaticus)* **Spotted salamander** *(Ambystoma maculatum)* **Blue-spotted salamander *** *(A. laterale)* **Jefferson salamander *** *(A. jeffersonianum)* **Marbled salamander *** *(A. opacum)*	**Adult wood frogs -** • Full chorus (calls constant, continuous, & overlapping) - map location of chorus (pool) and site where recording was taken; **OR** • 5+ mated pairs **OR** **Adult salamanders -** • Congressing **OR** • Spermatophores **OR** • Marbled salamander attending a nest **OR** **Egg masses -** • TOTAL of 5 egg masses - any combination, regardless of species **OR** • 1 egg mass of a MESA-listed salamander or nest and eggs of marbled salamander **OR** **Larvae -** • Any number of larvae **OR** **Transforming juveniles -** • Still in pool with tail and/or gill remnants.	Pool with no permanently flowing outlet.	Good quality photos or video of the entire pool holding water including any inlets or outlets (e.g., any streams, culverts, etc). *See 'Tips for Photographing Evidence Required for Vernal Pool Certification' on page 4.*
Fairy shrimp *(Anostraca: Eubranchipus)*	Photo or video of adult specimen(s).	Same as above.	Same as above.

*Species listed under the Massachusetts Endangered Species Act Regulations (MESA) (321 CMR 10.90). If observed, please document and fill out a *Rare Animal Observation Form* (available at www.nhesp.org) to be submitted to the NHESP.

B. Facultative Amphibian Species Method ~ Biological and Physical Criteria & Evidence Accepted for Certification:

BIOLOGICAL CRITERIA		PHYSICAL CRITERIA	
Facultative Species Accepted - two or more of the following	**Breeding Evidence Accepted -** one or more of the following from at least two facultative species must be documented by photos, video, or audio (chorusing)	**Physical Features Accepted**	**Physical Evidence Accepted**
Spring peeper *(Pseudacris crucifer)* **Gray treefrog** *(Hyla versicolor)* **American toad** *(Anaxyrus americanus)* **Fowler's toad** *(Anaxyrus fowleri)*	**Adults –** • Full chorus (calls constant, continuous, & overlapping) - map location of chorus (pool) and site where recording was taken; **OR** • 5+ mated pairs **OR** **Egg masses –** • Any number of egg masses **OR** **Larvae –** • Any number of larvae **OR** **Transforming juveniles –** • Still in pool with tail remnants.	Pool with no permanently flowing outlet. **AND** Evidence that there is no established, reproducing fish population.	Good quality photos or video of the entire pool holding water including any inlets or outlets (e.g., any streams, culverts, etc.). **AND** Good quality photos or video of the entire pool dry. *See 'Tips for Photographing Evidence Required for Vernal Pool Certification' on page 4.*

Documentation Requirements

Documentation of the biological and physical evidence listed in the **CERTIFICATION CRITERIA** (pg. II.2, A and/or B) must be submitted for official certification of a vernal pool. Photographic prints are the preferred method of documentation but video of evidence or audio recording of chorusing frogs or toads are acceptable. Field notes are encouraged and helpful, but are not accepted as the sole source of evidence.

A. BIOLOGICAL DOCUMENTATION – Photos, Video, or Audio of Amphibian Breeding Evidence or Fairy Shrimp:

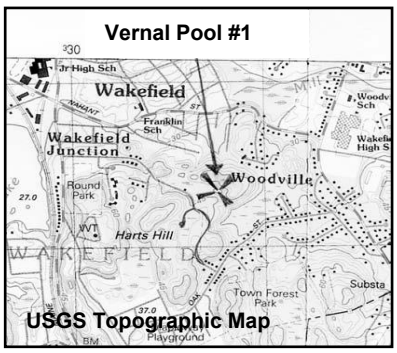
- Photos, video, or audio must be of suitable quality (resolution, focus, clarity, indicators of scale (e.g., coin, lens cap, ruler)) so species identification can be confirmed. Please see *"Tips for Photographing Evidence Required for Vernal Pool Certification"* (pg. II.4).
- Photos, video, or audio must be labeled with pool location (town), pool name or tracking # (e.g. VP#1, Elm St. VP), date taken, & observer's name.
- Each individual egg mass or mated pair required for certification (e.g., all 5 wood frog egg masses) must be photographed or videotaped. If more than the minimum required number is observed, photo the required number, and count or estimate the total number and indicate this on the Vernal Pool Field Observation Form.
- Only audio tapes of full amphibian choruses (calls are constant, continuous & overlapping) are accepted (see Protocol Description at: http://www.pwrc.usgs.gov/naamp/) provided the location of chorusing (i.e., exact pool location) and the location of your recording site are accurately mapped.
- Documentation must be collected within 3 years prior to submittal to NHESP.

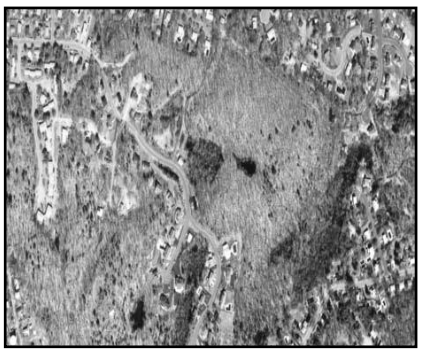
B. PHYSICAL DOCUMENTATION – Photos or Video of Pool Holding Water and Dry:

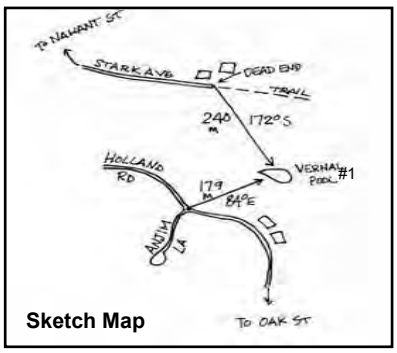
- Photograph(s) or video of the entire pool including any inlets or outlets (e.g., any streams, culverts) are required and must be of suitable quality (resolution, focus, scale) so pool features can be reliably assessed. One or more identifying landmarks (e.g., stand of trees, stumps, boulders, rock walls, etc.) to authenticate the pool location must be included. If unable to photograph the entire pool in a single photo, take a "panorama" series. Please see *"Tips for Photographing Evidence Required for Vernal Pool Certification"* (pg. II.4).
- Photo(s) or video must be labeled with pool location (town), pool name or tracking # (e.g. VP#1, Elm St. VP), date taken, & observer's name.
- Documentation must be collected within 3 years prior to submittal date to NHESP.

C. MAPPING REQUIREMENTS - THREE types of maps are required for certification and the pool locus must be clearly delineated and identified (your pool name or tracking #) on each map:

1. **U.S. Geological Survey topographic map** (copy) (1:24,000 or 1:25,000 scale) - topos can be downloaded from MassGIS at www.mass.gov/mgis/mapping.htm - scroll down to "Browser Based Mapping Applications", then to "Quick Links" and select "USGS Topographic Maps".
2. **Color orthophotos** (copy) (1:12,000 scale or better) - orthophotos can be downloaded from MassGIS at www.mass.gov/mgis/mapping.htm - scroll down as described above and select "Color Ortho Imagery 2005".
3. **One additional map or form of location data** to help clarify the pool's location, as follows:
   - **Sketch map -** directions and distances from landmark(s), readily identifiable in the field, should be marked and clearly described on the map; if submitting a breeding chorus, the location of the chorus (pool) and recording site can be delineated on this map, **OR**
   - **Assessors map -** available from local tax assessor's offices, include the map and parcel #'s, **OR**
   - **Professional survey, OR**
   - **GPS longitude/latitude coordinates.**







Tips for Photographing Evidence Required for Vernal Pool Certification[1]

The biological and physical evidence required for vernal pool certification must be documented by photos and/or video (or audio for frog/toad chorusing) of suitable quality (resolution, focus, indicators of scale) so species identification can be confirmed and pool features be reliably assessed. Because this often requires close-up photographs in generally poor lighting conditions, some general **"rules of thumb"** are included below to help you produce good photos/video:

- Cameras that compensate for low light conditions and close-up focusing provide the best photos; most digital cameras are capable of this but fixed focus cameras (i.e., "point and shoot") typically do not focus closer than 2-4 feet (if used carefully they usually produce suitable photos).
- Hold the camera as steady as possible or use a tripod to avoid blurred images.
- Take several photos, or extra photos using different backgrounds and light settings, to be certain you end up with a clear photo.
- Process or view your photos immediately so you can return to the pool for better photos, if needed.

POOL Photos (Physical Evidence)

Photographs of the vernal pool need to be clear and show as much of the pool as possible.

- They must include a landmark to authenticate the pool location (e.g., stand of trees, stump, a boulder, rock wall, etc.).
- If unable to photograph the entire pool in a single photo, try to photograph the pool in a "panorama" series.
- When photographing pools 'holding water', also include photos of any inlets or outlets (e.g., streams, culverts) observed entering or leaving the pool.

ORGANISM Photos (Biological Evidence)

Biological evidence from the pool needs to be documented by photographs/video that confirms **amphibian *breeding*** (i.e., mated pairs of frogs/toads, congressing salamanders, spermatophores, egg masses, larvae, or transforming juveniles) or the presence of **fairy shrimp** (see Certification Criteria for specific requirements).

- **Mated pairs** of wood frogs and **congressing salamanders** typically need to be photographed at night. A flash can sometimes illuminate the water surface, impeding the view underwater, so a flashlight can be used to illuminate subjects underwater.
- **Spermatophores** are found on the bottom of the pool. Reflections on the surface can sometimes block underwater images and can be eliminated in two ways: 1) position an object (or person) to cast a shadow over the area you are photographing, or 2) use a polarizing filter on your camera.
- To photograph **egg masses**, place a light-colored background (e.g., yellow foam meat tray, Frisbee, white board) behind the masses so they are clearly visible against the dark water and more easily identifiable; they should not be removed from the water and only minimally disturbed. Also try and include something in the photo for scale (e.g., backing tray with measurement markings, a hand, net, etc.).
- **Larvae** and **fairy shrimp** usually need to be briefly removed from the pool to be photographed. Place larvae or fairy shrimp in a small container (e.g., margarine tub, foam meat tray, clear plastic baggie) *filled with pool water* or photograph in your hand.

    a. **Salamander larvae** - place in container filled with pool water and photograph from above to clearly show the gills and, if possible, a side view of the body.

    b. **Wood frog tadpoles** - photograph in or out of water but positioned to show the belly (i.e., gut coiling) and gold flecking over the belly and sides.

    c. **Fairy shrimp** - place in white or clear container filled with pool water and photograph.

    d. **Transforming juveniles** – photograph so tail and/or gill remnants are visible; photos should be taken from above and/or a side view for proper identification.

[1]Based on *Wicked Big Puddles: A Guide to the Study and Certification of Vernal Pools,* 3rd Edition (March 2003) by Leo P. Kenney, Vernal Pool Association (www.vernalpool.org) and is used with permission.

Natural Heritage & Endangered Species Program
Massachusetts Division of Fisheries & Wildlife

II. Vernal Pool Field Observation Form

or use with the *Guidelines for the Certification of Vernal Pool Habitat, March 2009.*

For Office Use Only

THE NHESP STRONGLY RECOMMENDS THAT LANDOWNER PERMISSION BE OBTAINED PRIOR TO COLLECTING CERTIFICATION DOCUMENTATION. IT IS THE SOLE RESPONSIBILITY OF AN INDIVIDUAL PROVIDING VERNAL POOL CERTIFICATION INFORMATION TO ENSURE THAT ALL ACTIVITIES ASSOCIATED WITH GATHERING SAID INFORMATION COMPLY WITH THE LAW.

INSTRUCTIONS:
Please provide all information requested. Attach additional pages if needed. All required biological & physical evidence must be documented by photos, video, or audio of suitable quality (resolution, focus, indicators of scale) so species ID can be confirmed & pool features assessed. Documentation must be labeled. Sign/date the form; incomplete forms will be returned.

Additional Instructions for *Specific* Numbered Boxes:
1. Include an identifying name or tracking # for your pool & use it to label photos, maps, & any other documentation. If you used the Potential Vernal Pool (PVP) datalayer (available at MassGIS), include the PVP #. Written directions must be included with landmarks to help navigate to the pool.
3. 3A & 3B are for certification by the Obligate Species Method. Provide photos, video, or audio (chorusing) of the required breeding evidence or fairy shrimp **AND** photo(s) or video of the pool holding water.

1. Pool Location (Please complete a separate form for each pool).

Town_____Potential Vernal Pool # (if known)_____

Pool Name or Tracking # (e.g., Elm St. VP, VP#1)_____

Written Directions to Pool (required):_____

_____

_____

_____

_____

_____

_____

_____

2. Pool/Species Observation Dates (month/day/year):

First date pool observed_____Last date pool observed _____

First date species observed _____Last date species observed_____

3B. Biological Evidence: *Fairy Shrimp*

Date Observed (m/d/y)_____

3A. Biological Evidence: *Obligate Amphibians*

Indicate breeding evidence and date observed for each species. Evidence must include ≥1 of the following for certification: congressing salamanders **OR** ≥5 pairs wood frogs in amplexus **OR** salamander spermatophores **OR** a full wood frog chorus (calls constant, continuous, & overlapping) **OR** a total of ≥5 egg masses, regardless of species **OR** ≥1 MESA-listed salamander egg mass(es). Each individual egg mass or mated pair required for certification (e.g., all 5 wood frog egg masses) must be photographed or videotaped. If more than the minimum required number is observed, photo the required number, and count or estimate the total number and indicate in the table below.

SPECIES *State-listed species	Dates	COURTING ADULTS	Dates	SPERMATOPHORES	Dates	# EGG MASSES	Dates	SALAMANDER LARVAE	Dates	TRANSFORMING JUVENILES
Spotted salamander										
Blue-spotted salamander *										
Jefferson salamander *										
Marbled salamander *										
Unidentified Mole salamander										

SPECIES	Dates	# MATED PAIRS (≥ 5 pairs)	Dates	Full Chorus (calls continuous & overlapping)	Dates	# EGG MASSES	Dates	TADPOLES	Dates	TRANSFORMING JUVENILES
Wood frog										
TOTAL(S)										

Instructions (continued)

4. Certification by the Facultative Amphibian Method - provide photo, video, or audio (chorusing) of the required breeding evidence and photo(s) or video of the pool holding water **AND** dry.
6. Provide information to help distinguish the pool & assess its features.
7. All required biological & physical evidence must be documented by good quality photos, video, or audio.
8. Indicate the 3 required maps submitted.

4. Biological Evidence: *Facultative Amphibians*

Breeding evidence[1] of ≥ 2 species must be documented by photos, video, or audio.

BREEDING AMPHIBIANS	DATE OBSERVED month/day/year	BREEDING EVIDENCE[1] OBSERVED
Spring peeper		
Gray treefrog		
American toad		
Fowler's toad		

Breeding evidence[1] includes: full breeding choruses (call constant & overlapping), ≥ 5 adults in amplexus, any # of egg masses, tadpoles, and/or transforming juveniles in pool.

5. Rare Wetland Species

Were MESA-listed species observed using this pool?

☐ Yes ☐ No

If yes, please submit a Rare Animal Observation Form with photo & map to the NHESP (available at www.nhesp.org).

6. Description of Pool and Surroundings ~ Please describe to the best of your ability and knowledge.

Dimensions (please include measurements or estimates):

Approx. Length:_____ Approx. Width:_____ Approx. Maximum Depth:_____

Describe distinctive features (roads, structures, boulders, foot trails, vegetation types, etc.) which are visible from or near the pool that would help someone recognize it.

Origin of the pool (check): ☐ Natural depression ☐ Human-made pool/ditch ☐ Created wetland/pool ☐ Other or Unknown (describe)_____

The pool's hydroperiod is most likely: ☐ Seasonal (drying out in most years) ☐ Semi-permanent (drying partially in most years) ☐ Permanent

Describe any inlet or outlets to/from the pool and their permanence (e.g., streams, culverts, etc).

Land use in vicinity of pool (approx. 100 ft from pool edge – check all that apply): ☐ upland forest ☐ forested wetlands ☐ emergent marsh/scrub-shrub wetland ☐ agricultural/grassland/meadow ☐ residential/commercial ☐ other_____

7. Documentation Submitted – Label with pool name or tracking #, town, date taken, observer's name.

☐ Photo(s) ☐ Video ☐ Audio

☐ Obligate Species ☐ Facultative Species ☐ Pool Holding Water ☐ Dry Pool

8. Maps Submitted

Pool locus must be delineated & identified with your pool name or tracking #.

3 REQUIRED MAPS:

☐ USGS Topographic Map - 1:24,000 or 1:25,000 or better

☐ Color orthophoto - 1:12,000 or better

and ≥1 of the following:

☐ Assessor's map (Map and Plot #)

☐ Professional survey

☐ Sketch map - with directions and distances from permanent landmarks

☐ GPS longitude/latitude coordinates:

Latitude = _____

Longitude = _____

9. Property Owner Information - Landowner information is optional & is available from local tax assessor's offices.

Name_____

Address_____

Town_____State_____Zip_____Assessors Map/Pcl#_____(if known)

10. Observer Information & Signature – Must be filled out & signed.

Name_____

Address_____

Town_____State_____Zip_____

Telephone_____E-mail_____

I hereby certify under the pains and penalties of perjury that the information contained in this report is true and complete to the best of my knowledge.

Signature_____Date_____

Signature of Adult, if Observer is under 18 years of age_____

All submissions and supporting documents will be retained by the NHESP and, with the exception of information for MESA-listed species and the identity of minors, are available to interested parties under the Public Records Law.

SEND COMPLETED, SIGNED FORM & SUPPORTING DOCUMENTATION TO:

NHESP - Vernal Pool Certification
MA Division of Fisheries & Wildlife
1 Rabbit Hill Rd.
Westborough, MA 01581

For questions call 508-389-6360

New Jersey's Vernal Pools

by Jason Tesauro
Assistant Zoologist

What Are Vernal Pools?

Vernal pools are confined wetland depressions, either natural or man-made, that hold water for at least two consecutive months out of the year, and are devoid of breeding fish populations. Here in New Jersey, the rural portions of the Skylands, Piedmont, and Coastal Plain landscapes are home to the majority of our vernal pools. These unique ecosystems provide habitat to many species of amphibians, insects, reptiles, plants, and other wildlife.

Vernal pools come in an array of forms: isolated depressions within upland forests, seasonally flooded meadows, floodplain swamps, abandoned gravel pits or quarries, and even derelict swimming pools. However, no matter what the structure or genesis of the pool is, all vernal pools either dry out completely or draw down to very shallow levels that are unsuitable for fish. Fish are highly predatory on amphibian eggs and larvae. Over the course of evolution, several species of salamanders and frogs exploited these fish-less water bodies. Today, these species exhibit "hard-wired" instincts and behaviors that are geared exclusively towards fish-free vernal habitats.

Amphibians that are dependent upon vernal pools are known as "obligate vernal pool breeders". In New Jersey there are seven species - two frogs and five salamanders - that fit this category. Another 14 species of New Jersey's amphibians also use vernal pools for breeding, but unlike the 'obligate' species, these species can successfully reproduce in habitats that contain fish. These species are known as "facultative vernal pool breeders".

Obligate and Facultative Vernal Pool Breeding Amphibians

Obligate Vernal Pool Breeding Amphibians:
Eastern tiger salamander (*Ambystoma t. tigrinum*) *ENDANGERED*
Marbled salamander (*A. opacum*) *SPECIAL CONCERN*
Spotted salamander (*A. maculatum*)
Jefferson salamander (*A. jeffersonianum*) *SPECIAL CONCERN*
Blue-spotted salamander (*A. laterale*) *ENDANGERED*
Wood frog (*Rana sylvatica*)
Eastern spadefoot toad (*Scaphiopus holbrookii*)

Facultative Vernal Pool Breeding Amphibians:
Green frog (*Rana clamitans melanota*)
Bullfrog (*Rana catesbiana*)
Pickerel frog (*Rana palustris*)

Southern leopard frog (*Rana utricularia*)
Carpenter frog (*Rana virgatipes*) *SPECIAL CONCERN*
Northern spring peeper (*Psuedacris crucifer*)
Northern cricket frog (*Acris crepitans*)
New Jersey chorus frog (*Pseudacris triseriata kalmii*)
Upland chorus frog (*Pseudacris triseriata ferarium*)
Northern gray treefrog (*Hyla versicolor*)
Southern gray treefrog (*Hyla chrysocelis*) *ENDANGERED*
Pine barrens treefrog (*Hyla andersonii*) *ENDANGERED*
Four-toed salamander (*Hemidactylium scutatum*)
Long-tailed salamander (*Eurycea l. longicauda*) *THREATENED*

In addition to amphibians, there are several reptiles that inhabit vernal pools on a seasonal basis, primarily to eat the eggs and larvae of amphibians:
Wood turtle (*Clemmys insculpta*) *THREATENED*
Spotted turtle (*Clemmys guttata*) *SPECIAL CONCERN*
Mud turtle (*Kinosternon subrubrum*)
Eastern painted turtle (*Chrysemys p. picta*)
Common snapping turtle (*Chelydra s. serpentina*)

Vernal Pool Protection in New Jersey

New Jersey has recently adopted legislation to protect vernal pools. Although the NJ Freshwater Wetlands Protection Act has been in place since 1989, it has done little to protect vernal pools because wetlands smaller than 1 acre (many vernal pools in NJ are ~ 0.25 acre) are exempt from the regulatory protection. Thus prior to the rule, vernal pools could be filled, drained, or modified with a general permit. The new vernal pool (or 'vernal habitat,' as it is known in regulatory language) regulations protect vernal pools that are known meet the following certification criteria:

- Occurs in a confined basin depression without a permanently flowing outlet.
- Provides documented habitat for obligate or facultative vernal habitat species (these species are identified in N.J.A.C. 7:7A, Appendix 1).
- Maintains ponded water for at least two continuous months between March and September of a normal rainfall year.
- Free of fish populations throughout the year, or dries up at some time during a normal rainfall year.

For further information on New Jersey's vernal pool certification process go to: www.state.nj.us/dep/landuse/announce/announce.html

The Vernal Pool Survey Project

Through grants provided by the U.S. Fish and Wildlife Service and the DEP's Division of Science, Research and Technology, the ENSP initiated the Vernal Pool Survey Project in November of 2000. The main objectives of this project are to map and inventory vernal pools

statewide and determine the status, range and distribution of obligate (dependent upon) vernal pool amphibians. Because staff resources are limited, the ENSP is relying primarily on trained volunteers to conduct herptile surveys at vernal pools. As data is collected on vernal pools, the information is integrated into the land use regulatory databases of the Department of Environmental Protection to implement vernal pool protection.

A Call for Vernal Pool Volunteers

This coming March we will hold our second set of vernal pool training seminars, which will include both a lecture covering vernal pool ecology, protection, and species identification, as well as a field trip to a vernal pool to demonstrate survey techniques. At each training, volunteers can select a survey area, which can be either specific pools or tracts of land containing complexes of pools. ENSP staff will provide maps of selected areas, data collection sheets and a variety of educational materials to help you locate the pool and identify the various amphibians and reptiles you may encounter. Survey efforts will be focused between February and June, which is when amphibian activity at vernal pools is at its peak.

Because the protection of vernal pools depends upon the documentation of certain amphibians and reptiles, we encourage anyone who cares about wildlife and these sensitive, biologically rich wetland habitats to become a volunteer. We at the ENSP can't do it alone! Please stay tuned to this web page to see when and where this year's seminars will take place.

How Does the DEP Implement Vernal Pool Protection?

The primary way in which DEP's Land Use Regulation Program (LURP) is implementing vernal pool protection is through cross-referencing land use permit applications with mapping of certified vernal pools. When a permit is applied for, LURP staff will review maps showing all locations of certified vernal pools.

Projects proposed in vernal pools may need to be redesigned to avoid adversely impacting them or the permit may potentially be denied. However, this protection can only be applied to vernal pools that have been certified. Thus, vernal pool protection in New Jersey is highly dependent upon the generation of a comprehensive map of all the certified vernal pools in the state.

The other method in which DEP intends to protect vernal pools is through Landscape Mapping. This statewide digital mapping, available online since fall 2001, contains critical habitat for all of New Jersey's endangered, threatened, and special concern animals. The intended purpose of this mapping is to guide sensible land use planning at the state, county and municipal level. Once

mapped and inventoried, vernal pools will be incorporated as a data layer into these critical habitat maps.

Identifying Vernal Pools - http://www.dbcrssa.rutgers.edu/ims/vernal

The critical process of locating potential vernal pools for survey begins at the Center for Remote Sensing and Spatial Analysis (CRSSA) lab at Cook College, Rutgers University. Using a collection of computer-aided analysis techniques and field surveys, GIS (Geographic Information Systems) analysts have been delineating potential vernal pool locations in New Jersey. The Center has compiled a number of GIS abiotic data layers (including soils, wetlands, glacial sediment, and bedrock geology information) to be used in conjunction with digital elevation models and color aerial photographs to identify on-screen regions where vernal pools are likely to occur. Vernal pool likelihood is based on existing vernal pool locations. Various GIS methods have been used to identify and rank areas in each data layer based on vernal pool occurrence. This procedure, which seems to identify areas where large vernal pools are likely to occur, is followed by intensive on-screen scanning of 1-meter digital aerial photographs used to locate smaller potential vernal pool locations.

While this research is performed, an interactive Internet mapping site has been developed to enable volunteers and the public to locate potential vernal pools and, in general, introduce those interested to the project. The site features digital aerial photographs as well as other mapping resources aimed at assisting users unfamiliar with aerial imagery. Find this exciting vernal pool information at http://www.dbcrssa.rutgers.edu/ims/vernal.

Initial efforts by CRSSA focused on the northern Ridge and Valley and Highlands (Skylands) regions, with 840 and 728 pools identified, respectively. Since this early estimate, an additional 1,580 potential pools have been identified in the north. The Piedmont province boasts 2,043 possible pools. In the south of the state, the Coastal Plain may be home to 6,853 pools, 4,947 of which are in the Outer Coastal Plain and the remainder in the Inner Coastal Plain. Fieldwork begins with a “groundtruthing” process to find the potential vernal sites and see if they are actually vernal. ENSP biologists, CRSSA staff, and volunteers armed with topographic maps and handheld GPS (Global Positioning System) units have surveyed well over 500 sites across the state. The success rate for groundtruthing is high, with nearly 80% accuracy.

Photo Credits:

Photo Credits:
Marbled salamander - Tony McBride
Pine Barrens Treefrog - Tony McBride
Spotted salamander (juvenile) - Tony McBride
All vernal pools: NJDF&W-ENSP

Pennsylvania Natural Heritage Program

Vernal Pools

Vernal Pool Animals

Vernal pools are unique wetland habitats where some of the state's most recognizable reptiles and amphibians can be found. Vernal pools are small, shallow wetlands that do not have a permanent inlet or outlet of water flow. They fill in the fall or spring when rain or snowmelt drains into shallow depressions, and can retain water due to non-porous soils. Vernal pools only hold water for part of the year and experience a drying phase every year or every few years, usually in late summer.

Because their aquatic habitats are temporary, animals that depend on seasonal pools are adapted for both aquatic and terrestrial habitats at different life stages. These animals also benefit from the dry phase, because it prevents year-round water-dependent animals like fish from living in the pools. Fish prey heavily on eggs and larvae, and without seasonal pools some species would not be able to compete and reproduce. Although there are obvious challenges for an animal using an aquatic environment that disappears for part of the year, the benefit is a habitat free from predation by fish.

Mixed shrub herb, Mt. Cydonia. Credit: Betsy Leppo

Marbled salamander (*Ambystoma opacum*) Credit: Jack Ray

Indicator Species

Vernal pools support wildlife that would not be successful in permanent waters. Animals that require temporary aquatic habitats for reproduction and development of their young are called vernal pool indicator species. Some sources refer to them as vernal pool obligates. Pennsylvania's large and secretive mole salamanders are all vernal pool indicators, along with two other frogs and several species of small freshwater crustaceans. These animals use seasonal pools almost exclusively during some stage of their life cycle.

Pennsylvania's Vernal Pool Indicator Animals

- Marbled Salamander (*Ambystoma opacum*)
- Spotted Salamander (*Ambystoma maculatum*)
- Jefferson Salamander (*Ambystoma jeffersonianum*)
- Blue-spotted Salamander (*Ambystoma laterale*)
- Wood Frog (*Lithobates sylvaticus*)
- Eastern Spadefoot (*Scaphiopus holbrooki*)
- Fairy Shrimp (*Eubranchipus* spp.)
- Clam Shrimp: Euroamerican clam shrimp (*Limnadia lenticularis*), diversity clam shrimp (*Eulimnadia diversa*)

Fairy shrimp (*Eubranchipus vernalis*). Credit: Jack Ray

Vernal pool indicators have developed different strategies for coping with the periodic drying of their wetland habitats. Some amphibian species travel to vernal pools to lay their eggs shortly after the first spring rains. Other species, such as fairy shrimp and clam shrimp, leave eggs in the bottom of the pool that can withstand drying out in the summer and freezing in the winter. Young vernal pool invertebrates and amphibians (most are called larvae) must grow quickly once they hatch from the egg in the spring. As spring turns to summer, water evaporates and the pool gradually shrinks in size until it disappears. The larvae must transform into terrestrial adults before the pool dries up.

Eighty five percent of vernal pool amphibians return each year to breed in the pond where they were born (Colburn, 2004). They will bypass other pools that provide suitable habitat and cross obstacles such as roads and other forms of human disturbance in order to return to the pool of their birth. This fidelity by individual amphibians to a particular pool is an important consideration when determining how to protect a species as a whole.

Facultative Species

Many animals take advantage of the resources vernal pools provide, but do not require them for survival. These ‘facultative species’ may breed in seasonal pools, or simply use them as a place to forage for food and find shelter.

Facultative species have physical or behavioral adaptations that allow them to successfully utilize seasonal pools but they can also survive in permanent wetland habitats. Some examples include the red spotted newt, northern spring peeper, American toad, wood turtle, and spotted turtle.

A diagnostic ‘X’ crosses the back of a spring peeper. Credit: Charlie Eichelberger

After the Pool Dries

Adult and recently metamorphosed invertebrates and amphibians will leave the vernal pool and head into the surrounding landscape. Although they need seasonal pools to reproduce and for their young to grow, adults spend the summer, fall, and winter in the uplands around the pools where they find food, shelter, and overwintering sites.

While their exact habitat needs vary, all vernal pool species benefit when a pool and its surrounding uplands (500-1,000 feet or more) are naturally vegetated and have a minimum of human disturbances.

Woody debris on the ground creates foraging sites where amphibians can find food and also provides protection from the heat of summer and cold of winter. Credit: Betsy Leppo

Adult spotted salamander (*Ambystoma maculatum*). Credit: Charlie Eichelberger

PNHP is a partnership between The Department of Conservation and Natural Resources, the Western Pennsylvania Conservancy, the Pennsylvania Game Commission, and the Pennsylvania Fish and Boat Commission.

APPENDIX B

Vernal Pool Data Tables

Appendix B1. Additional Vernal Pool Survey Data

Vernal Pool ID	Date Identified	Parcel ID(s)	Type	Adjacent Land Cover[1]	Amphibians Observed[2]
VP-A	4/24/2019	185.-1-2.4	Natural Depression	Upland forest, cropland, successional shrubland	None
VP-AE	5/14/2019	211.-1-1	Natural Depression	PSS wetland, upland forest	Spotted salamander (egg masses)
VP-AF	5/13/2019	199.-1-36	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses)
VP-AG	5/13/2019	199.-1-24	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses)
VP-AH	5/13/2019	199.-1-24	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses)
VP-B	4/24/2019	185.-1-2.4	Natural Depression	PSS wetland, upland forest	Wood frog (adult)
VP-BA	5/7/2019	186.-1-9.1	Natural Depression	Upland forest	Green frog (adults)
VP-BB	5/7/2019	186.-1-9.1	Natural Depression	Upland forest	Green frog (adults)
VP-BC	5/8/2019	174.-4-17	Natural Depression	Upland forest	None
VP-BFR	4/30/2019	186.-1-17.1	Natural Depression	PEM wetland, upland forest	None
VP-C	4/24/2019	185.-1-2.4	Natural Depression	Upland forest	Spotted salamander (egg masses, tadpoles); Wood frog (egg masses)
VP-D	4/25/2019	186.-1-24	Artificial Pool/Ditch	Upland forest, logging road	None
VP-E	4/25/2019	185.-1-7	Natural Depression	PEM wetland, upland forest	Spotted salamander (egg masses)
VP-F	4/24/2019	185.-1-2.4	Natural Depression	Upland forest	None
VP-G	4/25/2019	186.-1-24	Natural Depression	Upland forest	Unknown tadpoles
VP-H	4/25/2019	186.-1-25	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses); Wood frog (egg masses)
VP-J	4/25/2019	186.-1-24	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses)

Vernal Pool ID	Date Identified	Parcel ID(s)	Type	Adjacent Land Cover[1]	Amphibians Observed[2]
VP-K	4/25/2019	186.-1-24	Artificial Pool/Ditch	Upland forest, successional clearing	Spotted salamander (egg masses); Wood frog (egg masses)
VP-L	4/25/2019	186.-1-24	Artificial Pool/Ditch	Upland forest	Spotted salamander (egg masses)
VP-M	4/25/2019	186.-1-24	Artificial Pool/Ditch	Upland forest	Spotted salamander (egg masses); Wood frog (egg masses)
VP-N	4/25/2019	186.-1-24	Artificial Pool/Ditch	Upland forest	Jefferson/blue-spotted salamander complex (egg masses)[3]
VP-O	4/25/2019	199.-1-60.1	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses); Wood frog (egg masses, adult)
VP-S	4/18/2019	174.-1-11.43	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses)
VP-SYA	4/16/2019	186.-1-7.1, 186.-1-6	Natural Depression	PSS and PFO wetland, upland forest	Spring peeper (chorus)
VP-SYJ	4/17/2019	186.-1-9.1	Natural Depression	Upland forest	Wood frog (egg masses, adult)
VP-T	5/6/2019	185.-1-2.4	Artificial Pool/Ditch	Upland forest	Wood frog (egg masses); American toad (egg masses)
VP-U	5/6/2019	186.-1-19	Artificial Pool/Ditch	Disturbed/developed (quarry), upland forest	Spotted salamander (egg masses); Wood frog (adults); Eastern newt (adult), American toad (egg masses); Unknown frog tadpoles
VP-V	5/7/2019	185.-1-6.1	Artificial Pool/Ditch	Mowed lawn, dirt road	Spotted salamander (egg masses); Jefferson/blue-spotted salamander complex (egg masses)[3]
VP-W	5/7/2019	185.-1-6.1	Artificial Pool/Ditch	PEM wetland, mowed lawn	Jefferson/blue-spotted salamander complex (egg masses)[3]
VP-X	5/7/2019	185.-1-2.4	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses); Jefferson/blue-spotted salamander complex (egg masses)[3]; Eastern newt (eft juvenile)
VP-Y	5/7/2019	185.-1-2.4	Natural Depression	PFO wetland, upland forest	Spotted salamander (egg masses); Jefferson/blue-spotted salamander complex (egg masses)[3]
VP-Z	5/7/2019	185.-1-7	Artificial Pool/Ditch	Upland forest, logging road	Spotted salamander (egg masses); Unknown tadpoles
VP-4A	4/11/2019	174.-1-9.1	Artificial Pool/Ditch	PFO and PEM wetland, hayfield, upland forest	Wood frog (adults, chorus, egg masses)

[1]Wetland community types noted are based upon the Cowardin *et al* (1979) classification system: PEM = Palustrine Emergent; PFO = Palustrine Forested; and PSS = Palustrine Scrub-Shrub.
[2]Common and binomial names for amphibian species observed: American toad (*Anaxyrus americanus*); eastern newt (*Notophthalmus viridescens*); green frog (*Lithobates clamitans*); Jefferson/blue-spotted salamander complex (*Ambystoma jeffersonianum* x *laterale*); spring peeper (*Pseudacris crucifer*); spotted salamander (*Ambystoma maculatum*); and wood frog (*Lithobates sylvaticus*).
[3]Both Jefferson salamander and blue-spotted salamander are listed as species of special concern (SSC) in New York State (http://www.dec.ny.gov/animals/7494.html#Special_Concern).

Appendix B2. Identifying Characteristics for On Site Vernal Pools

Vernal Pool ID	Biological Indicator Species Present	Evidence for Inundation[1]	Hydrologic Isolation[2]	Fish Absent	Standing Water	Sparse/No Vegetation in Pool	Water-stained Leaves	Tree Evidence[3]
VP-A	No	Yes	No	Yes	Yes	Yes	Yes	Yes
VP-AE	Yes (Obligate)	Yes	Yes	Yes	Yes	No	Yes	Yes
VP-AF	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-AG	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-AH	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-B	Yes (Obligate)	Yes	Yes	Yes	Yes	No	Yes	Yes
VP-BA	Yes (Facultative)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VP-BB	Yes (Facultative)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-BC	No	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-BFR	No	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-C	Yes (Obligate and Facultative)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VP-D	No	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-E	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-F	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VP-G	Yes (Facultative)	Yes	No	Yes	Yes	Yes	Yes	Yes
VP-H	Yes (Obligate)	Yes	No	Yes	Yes	Yes	Yes	No
VP-J	Yes (Obligate)	Yes	No	Yes	Yes	No	Yes	Yes
VP-K	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-L	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No

Vernal Pool ID	Biological Indicator Species Present	Evidence for Inundation[1]	Hydrologic Isolation[2]	Fish Absent	Standing Water	Sparse/No Vegetation in Pool	Water-stained Leaves	Tree Evidence[3]
VP-M	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-N	Yes (Obligate)	Yes	Yes	Yes	Yes	No	Yes	No
VP-O	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VP-S	Yes (Obligate)	Yes	No	Yes	Yes	Yes	Yes	Yes
VP-SYA	Yes (Facultative)	Yes	Yes	Yes	Yes	No	Yes	Yes
VP-SYJ	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-T	Yes (Obligate and Facultative)	Yes	No	Yes	Yes	Yes	Yes	No
VP-U	Yes (Obligate and Facultative)	Yes	Yes	Yes	Yes	Yes	No	Yes
VP-V	Yes (Obligate)	Yes	No	Yes	Yes	Yes	Yes	No
VP-W	Yes (Obligate)	Yes	No	Yes	Yes	No	Yes	No
VP-X	Yes (Obligate and Facultative)	Yes	No	Yes	Yes	Yes	Yes	Yes
VP-Y	Yes (Obligate)	Yes	No	Yes	Yes	Yes	Yes	Yes
VP-Z	Yes (Obligate and Facultative)	Yes	Yes	Yes	Yes	Yes	Yes	No
VP-4A	Yes (Obligate)	Yes	Yes	Yes	Yes	Yes	Yes	No

[1]Pool expected to hold water for at least two consecutive months between March and September during most years.
[2] 'Yes' indicates that no inlets or outlets to the pool were observed. With the exception of VP-S, 'No' indicates that seasonal or ephemeral inlets and/or outlets were present. VP-S drains south into a perennial stream.
[3]Tree evidence included moss trim lines, buttressing, and/or watermarks on trees growing near the pool.

APPENDIX C

Representative Photographs

Photo 1

View of vernal pool VP-4A (photograph taken April 11, 2019).

Photo 2

View of vernal pool VP-SYJ (photograph taken April 17, 2019).

Photo 3

View of vernal pool VP-B (photograph taken April 24, 2019).

Photo 4

View of vernal pool VP-I (photograph taken April 25, 2019).

Photo 5

View of vernal pool VP-BFR (photograph taken April 30, 2019).

Photo 6

View of vernal pool VP-T (photograph taken May 6, 2019).

Photo 7

View of vernal pool VP-X (photograph taken May 7, 2019).

Photo 8

View of vernal pool VP-Y (photograph taken May 7, 2019).

Photo 9

View of vernal pool VP-O (photograph taken May 8, 2019).

Photo 10

Egg masses at vernal pool VP-4A (photograph taken April 11, 2019).

Photo 11

Egg masses at vernal pool VP-C (photograph taken April 24, 2019).

Photo 12

Egg masses at vernal pool VP-W (photograph taken May 7, 2019).