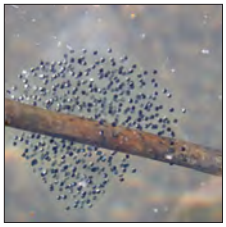


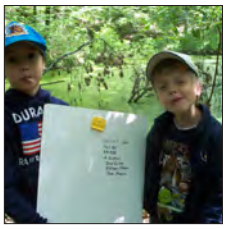
MICHIGAN STATE UNIVERSITY | Extension

MICHIGAN NATURAL FEATURES INVENTORY

Vernal Pool Patrol Program

Michigan's Vernal Pool Mapping and Monitoring Program

Manual for Citizen Scientists - Grades 4-12



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DEQ

Great Lakes Fishery Trust

Vernal Pools

What is a vernal pool?

Vernal pools (also called seasonal or ephemeral pools) are small, shallow depressions that contain water for only part of the year. These wetlands typically fill with water between late fall and spring, and most dry up by late summer or early fall (although some pools do not dry up every year or during very wet years). Vernal pools can fill with water from rainfall, snowmelt, groundwater, flooding from adjacent rivers and streams, and/or temporary streams. Vernal pools often occur in isolated depressions, but sometimes can be connected to other wetlands. They have no permanent inlets, outlets, or surface water connections to permanent water. Because they regularly dry up, vernal pools do not support breeding fish populations.


John Fody

Where do vernal pools occur?

Vernal pools occur throughout Michigan. They also occur in other states in the Midwest and other parts of the world, including the northeastern and western U.S. , Canada, and the Mediterranean region. Vernal pools in Michigan generally occur in forested landscapes. They may be isolated and surrounded by dry upland forest, or located within or adjacent to other wetlands such as forested swamps and river floodplains. Vernal pools also can occur in open settings (e.g., old fields). Vernal pools require the "right" combination of topography, geology, soils, vegetation, water sources, and climate to form. As a result, vernal pools are not evenly distributed across the state. They are most abundant in areas with bedrock or soils that hold water (e.g., clay) and/or where the water table or water under the ground is high.


Pool on May 2, 2013


Same pool on June 23, 2013

Are all vernal pools the same?

Each vernal pool is the result of *biotic* (living) and *abiotic* (non-living) factors interacting with each other. These factors include landform (e.g., hill or valley), geology, climate, weather, water source(s), depth and duration (how long pool is wet), water and soil chemistry, soil type, pool shape, plants and animals living in the pools, and the surrounding environment. Because these factors vary across the landscape, each vernal pool is unique.

Vernal pools can be highly variable. They vary in size and depth. Most pools are less than one-half acre in area and less than three feet deep, but some pools are larger and deeper. The plants within vernal pools can vary greatly. Some vernal pools may have little to no plants growing in them, while other pools may contain trees, shrubs, and/or grasses. In some pools, plants may emerge or become established after the pool dries up. The length of time that water is present in vernal pools varies from pool to pool. Some pools hold water for only three or four months while others can hold water for nine months or longer. How long individual pools hold water also can vary from year to year.

Forested vernal pool

Shrubby vernal pool

Vernal pool in June

Same vernal pool in October

Why are vernal pools important?

Critical Habitat for Wildlife

Even though they are small and wet for only part of the year, vernal pools can be incredibly diverse and productive ecosystems. Vernal pools provide important habitat for many wildlife species, especially invertebrates and amphibians. Other wildlife also use vernal pools including snakes, turtles, waterfowl, wetland birds, songbirds, and mammals. Over 550 animal species have been found in vernal pools in the northeastern U.S. (Colburn 2004). Many animal species use vernal pools for food and water throughout the growing season, as breeding and nursery areas for development of their young, and as resting areas and stepping stones to travel to other areas with suitable habitat (Gibbs 1993, Semlitsch and Bodie 1998, Gibbs 2000, Mitchell et al. 2008). Several rare species in Michigan use vernal pools extensively including the Smallmouth Salamander (state endangered), Copperbelly Watersnake (federally threatened, state endangered), Spotted Turtle (state threatened), and Blanding's turtle (state special concern). The large number and biomass (combined weight) of amphibians and invertebrates that live and/or breed in vernal pools and the surrounding forest ecosystems provide an important source of food and nutrients for other animals, plants, and the forest ecosystem.

Smallmouth salamander (*Ambystoma texanum*)

Blanding's Turtle *(Emydoidea blandingii)*

Spotted Turtle *(Clemmys guttata)*

Vernal Pool Indicator Species

Many of the animal species that live in vernal pools have developed special *adaptations* or ways for dealing with the highly variable and temporary nature of these wetlands. Some of these species would not be successful in permanent waters or wetlands. Species that require or depend on vernal pools for part or all of their life cycle (for example, for reproduction and development of their young) are called vernal pool indicator species. In Michigan, these include amphibians such as the wood frog, spotted salamander, and blue-spotted salamander, and invertebrates such as fairy shrimp. Many of these species only survive or do better in vernal pools because there are no fish predators.

Fairy shrimp only occur in waters that are free of fish populations. Fairy shrimp spend their entire lives in a single vernal pool. Their eggs require drying, flooding, and potentially freezing to successfully hatch. Their eggs can survive in the soil in the bottom of the pool for several years, and hatch when the conditions are right. Although wood frogs, spotted salamanders, and blue-spotted salamanders can breed in other wetlands, their eggs and young can survive much better and are more successful in vernal pools than in wetlands or water bodies with fish or other predators such as bullfrogs and green frogs. Vernal pools provide critical habitat for these indicator species.

Vernal Pool Indicator Species

Wood frog

Spotted Salamander

Blue spotted Salamander

Fairy shrimp

Important Ecosystem Benefits

In addition to providing habitat for plants and animals, vernal pools provide other important benefits to the forest ecosystem and to people. Vernal pools are an important source of food, energy, and nutrients for the surrounding forest ecosystem. Plants and animals decompose or break down faster in vernal pools because of their wet-dry cycle. Vernal pools help recharge the groundwater and help with flood control by capturing, storing, and slowly releasing water underground and to the adjacent forest or landscape over a period of time. They also help improve water quality by storing and filtering water, and trapping sediments and chemicals.

Program Overview

Due to recent increased awareness of the ecological significance of vernal pools, there has been growing interest in identifying, monitoring, and protecting these small but valuable ecosystems. To adequately protect these critical habitats, it is essential to know where they occur, what condition they are, and how they function. However, due to their small size and temporary and isolated nature, vernal pools can be difficult to identify and map, and have not been well-documented in Michigan. Vernal pools also are highly vulnerable to disturbance or destruction due to a number of factors including development, converting them to permanent ponds, climate change, and invasive species. Vernal pools are currently not protected under federal and state laws.

To get more information and a better understanding of the status, distribution, and ecology of vernal pools in Michigan, the Michigan Natural Features Inventory (MNFI), a program of Michigan State University Extension, has partnered with a number of organizations to launch the "Vernal Pool Patrol" program. The "Vernal Pool Patrol" program is a a statewide vernal pool mapping and monitoring program working with citizen scientists (adults and youth) and state and local community partners to identify, map, monitor, and provide data on vernal pools across the state. Program partners have included the Michigan Department of Environmental Quality, Michigan Department of Natural Resources, Michigan Nature Association, Great Lakes Fishery Trust, Great Lakes Stewardship Initiative, Michigan SeaGrant, U.S. Fish and Wildlife Service, Huron Pines, Grand Traverse Regional Land Conservancy, Little Traverse Conservancy, and Michigan Tech Research Institute. Information collected by the Vernal Pool Patrol program's citizen scientists will be entered into a statewide vernal pool database. This information will be used to help inform and guide management and conservation of vernal pools and associated plants and animals in Michigan.

Program Goals and Objectives

The program's overall goals are to:

1. Enhance our information and knowledge about vernal pool status, distribution, and ecology in Michigan.
2. Increase awareness and understanding of vernal pools and their importance to wetland and forest ecosystems.
3. Increase public/youth engagement in natural resource science and stewardship.

The primary objectives are:

1. Identify and map the location of potential vernal pools in forested landscapes across the state using remote sensing including aerial photo interpretation, radar, and/or GIS (Geographic Information Systems) modeling.
2. Conduct field sampling to verify the presence and location of vernal pools in the field, collect data on their physical and biological characteristics, and monitor their status and condition over time with the help of adult and youth citizen scientists.
3. Develop and maintain a spatial database of the locations of potential and verified vernal pools and biological and physical characteristics of verified pools to assess and track vernal pools across the state over time.
4. Provide information on vernal pools to natural resource managers, policymakers, planners, conservation groups, local communities, and other stakeholders to raise awareness about vernal pools and help inform and guide management and conservation of vernal pools in Michigan.

Instructions for Mapping and Monitoring Vernal Pools

1) Identify vernal pool/potential vernal pool for mapping and/or monitoring.

2) Participate in vernal pool training in the fall and spring prior to field visits.

3) Review vernal pool manual, monitoring data form, and other materials prior to field visits. Conduct independent research, if interested.

4) Visit vernal pool at least 3 times, if possible, within a school year. Conduct first visit in the fall, and two visits the following spring - see instructions for each visit below. You may make additional visits to the pool if you would like.

5) Fill out the vernal pool monitoring data form during each visit to the pool following the protocol or instructions provided in this manual. Take photos of the pool and the plants and animals found in the pool during each visit.

6) Enter data online using a Google form at the following web address/link: https://docs.google.com/forms/d/1Q9OXA1A1ozGTj2jm048NbPSXgdscX3BdNOYlaK9SSvI/viewform?usp=send_form. You only need to enter data once for the whole pool for each visit. You can view and compare data collected on vernal pools by other classes using this web address/link: https://docs.google.com/spreadsheets/d/1jNlqjBpCq2M6BzewYKMa13YsgQvvwzfx5QknoWEI0so/edit?usp=sharing.

7) Share results and findings with the broader school and/or local community if possible.

8) Summarize and enter data using MNFI vernal pool data form for each visit (one form per visit), and submit forms and photos to MNFI at the end of the school year.

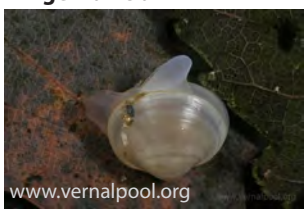
Pool Visit 1 - Fall

(Late Aug/Sept - Oct/early Nov)

This visit is to document the vernal pool drying up and to collect data about the plants and animals in the pool and physical and chemical characteristics of the pool when it is dry. Some pools may contain water for longer periods of time and dry up later in the year or only in some years. If the pool still contains water, you can still conduct the field monitoring and fill out the form, noting the water level and water depth. An additional visit in the fall and/or during following year(s) may be needed to confirm pool drying. You may find plants and animals that normally live on dry land or drier habitats, such as millipedes, slugs, beetles, and spiders, in the pool during this visit as well as species that live in vernal pools year-round, such as fingernail clams and snails.

Dry vernal pool

Fingernail clam



Snail

Millipede

Fairy shrimp

Christian Fischer, Wikimedia Commons

Wood frog egg mass

Simon Pierre Barrette, Wikimedia Commons

Spotted salamander egg mass

Wood frog tadpoles

Pool Visit 2—Early spring

(S. MI - mid-March – mid-April; N. MI - mid-April – early May, depending on the spring)

The first spring visit / second pool visit overall should be conducted soon after ice melt when the vernal pools are filled with surface water and just after the peak of Wood Frog breeding to document Wood Frog egg masses. Other vernal pool indicator species such as fairy shrimp, and spotted salamander and blue-spotted salamander adults and/or egg masses also can be observed if present.

The timing of peak wood frog activity will vary across the state and will differ from pool to pool depending on geographic location, weather, tree cover/exposure to sunlight, and pool depth. Wood frogs typically begin calling in mid-late March in the southern Lower Peninsula, early to mid-April in the northern Lower Peninsula, and mid-late April in the Upper Peninsula, but these dates can shift earlier or later depending on the weather. Amphibian emergence from hibernation occurs after the first warm spring rains or substantial snowmelt, and migration to breeding pools usually occurs on warm (40-50°F), rainy or misty evenings.

Pool Visit 3 —Mid-spring

(S. MI - early/mid-April – mid-May; N. MI - mid-late April – late May)

The second spring visit / third pool visit overall should be conducted about 2-3 weeks after the first visit to document and do a final count of blue-spotted and spotted salamander egg masses. Fairy shrimp may still be present in some pools, and wood frog tadpoles may be observed during this visit. This is also when biodiversity is generally highest in the vernal pools, so a number of other animal species, including rare species such as the Blanding's turtle, may be observed during this visit.

Photo Documenting the Vernal Pool

Please take photos to document and monitor the habitat conditions and the plants and animals in the vernal pool and the surrounding landscape over time. Please take photos of the entire vernal pool and the surrounding habitat from outside the pool in all four cardinal directions (from the north, south, east, and west sides of the pool, 4 photos total), if possible, during each survey visit. ***Please make sure we can see the entire pool and the habitat conditions within and around the pool in the photos.*** Please take photos of the pool from the same locations during each visit, if possible. Please also take photos of plants and animals found in and around the vernal pool during each survey visit. ***Photo documenting vernal pool indicator species and rare species is required.***

Labelling and organizing photos

In the field, please label your photos (or at least first photo) by including a small chalkboard, white-board, or sheet of paper in each photo or the first photo of the series with the following information:

1) the pool's ID #;

2) the school's name, or the site or property name;

3) the survey date including the year;

4) the teacher's last name;

5) what is in the picture (e.g., habitat looking to the south, wood frog eggs).

Examples of labelling photos in the field

Don Gillis

In the classroom, please create a file folder to organize and store photos for each vernal pool and year on your computer. Please label the file folder using the following scheme:

Pool ID #_county_school name_teacher's last name_year.

Example: MNFI1-228_Roscommon_Roscommon MS_Brown_2015

Please label the photo files of the vernal pool, indicator species, and other species using the following file name format: Pool ID # (if pool ID # not known, use teacher's last name)_subject of photo_visit #_date including year (yyyymmdd)

Examples: MNFI1-228_Wood frog egg mass_Visit 1_20151103.jpg
MNFI1-228_Habitat looking north_Visit 2_20160424.jpg

Instructions—Vernal Pool Monitoring Data Form

The following are instructions for filling out the revised vernal pool monitoring data form for the Vernal Pool Patrol program for K-12 students. Students can use the revised data form to record data in the field during the fall and spring visits. Students and/or the teacher can later transfer the information to the standard vernal pool monitoring data form in the classroom, or students can use the standard data form in the field. Instructions for the standard volunteer vernal pool monitoring data form are provided in a different version of this manual.

In order to make valid comparisions across pools and across years, the same data must be collected using similar methods. Therefore, it is important to collect data and fill out the data form following the instructions in this manual. It also is important to note that the vernal pool monitoring protocol and data form may be revised in the future. Please make sure you are using the most up-to-date version of the protocol and form.

1. Observer / Surveyor and Location Information

1a) Observer / Surveyor Information

Surveyor's Name(s) - First and last name(s) of the surveyor(s).

Survey Date - Month, date, and year (mm/dd/yyyy) of the survey visit.

Teacher's Name / Hour - Teacher's name and the class name or hour, if applicable.

Visit # - Visit number - visit #1 (fall), visit #2 (first spring visit), visit #3 (second spring visit).

1b) Vernal Pool Location Information

County – County in which the vernal pool you are monitoring is located.

Pool ID # – Unique pool identification (ID) number assigned to your pool, if known or available. If not known or available, fill this in later.

Preserve / other location name (if available) - Name of the property on which the pool is located - e.g., name of the nature preserve, park, state or national forest, etc.

2. Pool Type

2a) Is this a vernal pool? Check Yes, No, or Not Sure.

2b) What type? Circle one below.

Use the "Vernal Pool Types" handout / picture guide to help you determine pool type. If a pool is split between two types, please circle more than one type and briefly explain.

Open Pool – Less than 10% of the pool is covered with live trees, shrubs and/or herbaceous or non-woody plants when the pool is flooded or filled with water.

Sparsely Vegetated Pool – Between 10% and 29% of the pool is covered with live trees, shrubs and/or herbaceous or non-woody plants when the pool is flooded or wet.

Forested Pool – 30% or more of the pool is covered with rooted, live trees when the pool is flooded or wet. Shrubs and/or herbaceous plants may be present, but cover 30% or less of the pool and/or do not represent the uppermost or tallest vegetation/plants in the pool. The trees are the tallest plants in the pool.

Shrubby Pool – 30% or more of the pool is covered with shrubs when the pool is flooded or filled with water. Trees and/or herbaceous plants may be present, but cover 30% or less of the pool and/or do not represent tallest vegetation/plants in the pool. The shrubs are the tallest plants in the pool.

Marsh Pool – 30% or more of the pool is covered with herbaceous (non-woody) plants when the pool is flooded or filled with water. This includes emergent plants, which are plants that grow in water and stick up out of the water. Trees and shrubs may be present, but cover less than 30% of the pool and do not represent the tallest plants in the pool. The herbaceous plants form the uppermost or tallest plant layer in the pool.

• Note: If emergent plants cover over 50% of the pool basin and there is no clear open water area when the pool is flooded or filled with water, the wetland may be an emergent wetland (for example, cattail marsh, sedge meadow) and **NOT** a vernal pool.

Other – If the vernal pool does not fit one of the above pool types, please describe the pool in the space provided, particularly how pool differs from other pool types.

3. Pool Isolation / Connectivity

3a) Is the pool isolated or connected to another wetland or water feature? Check if:

Isolated - Pool is surrounded by upland forest and not connected to or part of another vernal pool or other wetland type or water feature (above ground).

Connected to another wetland/water feature - Pool is temporarily or permanently connected to or part of another vernal pool or other wetland or water feature. Please describe the wetland(s) or water feature(s) to which the vernal pool is connected.

Isolated pool

Pool connected to an emergent wetland

4. Presence of Inlet or Outlet

4a) Does the pool have an inlet/outlet or a channel with water flowing into or out of the pool on the surface? You may have to walk around the entire pool to answer this question.

Please check one of the following:

Yes, there is an inlet or outlet/channel and there is water flowing in it right now.

Yes, there is an inlet or outlet / channel but it is dry right now.

No, there is no inlet or outlet / channel.

Not sure if there is an inlet/outlet.

Vernal pools can have a temporary inlet/outlet or channel with water above ground entering or exiting the pool but the water in the channel does not flow continuously throughout the year(s). Many vernal pools, for example, have an outlet that functions if the water level in the pool reaches a certain level.

If there is an inlet/outlet or channel with water above ground entering or exiting the pool and if the channel has water continuously running into or out of the pool, then the pool has a permanent inlet/outlet. These sites are typically not vernal pools.

Example of a temporary pool inlet that was wet in spring and dry in fall

5. Pool Photos

5a) Pool photo numbers - Please take a photo of the pool from each side of the pool in all four cardinal directions (from the north, south, east, and west side of the pool) for a total of four photos. You also can take photos of the habitat surrounding the pool. Record the numbers of the pool photos in the camera.

Please see section on photo documenting vernal pools in this manual for instructions on how to label photos in the field and in the classroom.

6. Surrounding Habitat (within 100 feet of pool)

6a) Circle the type of forest or other habitat that best describes the surrounding landscape or habitat around the vernal pool within 100 feet of the pool. If multiple types of forest or habitats occur within 100 feet of the pool, you can circle **ALL** forest types or habitats that apply. See picture guide for examples of different types of forests and other habitats.

Deciduous Forest – Forest primarily comprised of or dominated by deciduous or hardwood trees. Trees often found in upland (see definition below) deciduous or hardwood forests include black oak, white oak, red oak, hickories, cherries, beech, aspen, and sugar maple. Trees often found in lowland (see definition below) deciduous or hardwood forests include black ash, green ash, silver maple, red maple, basswood, sycamore, cottonwood, American elm, swamp white oak, pin oak, and yellow birch.

Coniferous Forest – Forest primarily comprised of or dominated by coniferous or evergreen trees. Trees often found in upland coniferous forests include jack pine, red pine, white pine, white spruce, balsam fir, hemlock, and cedar. Trees often found in lowland coniferous forests include tamarack, northern white cedar, black spruce, white spruce, hemlock, balsam fir, and white pine.

Mixed Forest - Forest comprised of a mix of or dominated by both deciduous/hardwood and coniferous/evergreen trees.

Other - Other types of habitats that could be found include open or emergent wetlands (e.g., marsh, wet meadow, wet prairie, fen, bog), grasslands or savannas (e.g., prairie, old field, pine barrens, oak barrens), floodplain along a river/stream, or other habitats including open sand dunes, beaches, cobble shore, bedrock lakeshore, alvar, and wooded dune and swale complex).

6b) Circle whether the surrounding habitat is upland or lowland. If both types of habitats occur within 100 feet of the pool, circle both categories.

Upland - Higher ground; land elevated above other land; land elevated above where water flows or where flooding occurs; soils range from dry to moist.

Lowland - Relatively low ground; flat or level land or depression where land sinks down lower than adjacent land; land and soils that are often wet or contains standing water.

6c) Briefly describe in words and draw a sketch of the habitat around the pool.

The description and sketch might include the specific type of forest, the topography, surrounding landscape, and any other unique or distinct natural landmarks or features around the pool. For example - "The pool is located in a depression at the bottom of a valley surrounded by steep, rolling hills with mature beech-sugar maple upland forest. There is a large downed tree next to the pool."

6d) List types of plants and animals identified in the surrounding habitat.

6e) Any human activities or non-natural disturbances in the surrounding habitat? Circle Yes / No. If yes, describe here. Disturbances could include farm fields, roads (paved or dirt/gravel), powerline, logging, houses, and other types of development. Photos and/or sketches showing type and general location(s) of disturbance(s) relative to the pool are encouraged.

7. Pool Size, Depth, and Temperature

7a) Pool Length (feet)

Record the length of the pool when it is completely full or at maximum capacity at its longest points or maximum length. You can measure the length of the pool using a measuring tape or rangefinder, or by pacing after you have determined the length of your pace, or two steps. Please record how pool length was measured (with a measuring tape, rangefinder, or by pacing), or if pool length was visually estimated. Please make sure pool length is based the pool's high water mark when it is completely full (see 7e).

7b) Pool Width (feet)

Record the width of the pool when it is completely full or at maximum capacity at its widest points or maximum width. You can measure the width of the pool using a measuring tape or rangefinder, or by pacing. Please record how pool width was measured (with a measuring tape, rangefinder, or by pacing), or if pool width was visually estimated. Please make sure pool width is based on the pool's high water mark when it is completely full (see 7e).

Note: Pool length and width are needed to calculate approximate pool size or area. If you have a GPS unit, you can determine pool size/area by walking and recording a track along the perimeter of the pool with the GPS unit when the pool is full or along its high water mark.

7c) Approximate Maximum Pool Depth

This is water depth at the deepest part of the pool (usually in or near the center of the pool but not always). You can use a meter or yard stick (or other measuring device) to measure maximum pool depth. You can estimate from the pool edge if you cannot wade into the deepest part. If you don't know where the deepest part of the pool is located, you may have to take several pool depth measurements to determine maximum depth.

7d) Water Temperature

Take three water temperature (°F) readings with a thermometer along the length of the pool (two at either end of the pool and one at or close to the center of the pool). Take the temperature readings about 4 inches deep from the surface or top of the water. Record the three water temperature readings on the field form, and calculate and record the average of the three water temperature readings. If the pool is dry or too shallow, leave this blank.

7e) Water Level at Time of Survey

Please circle one of the water level choices. This is an estimate of the water level in the pool, or how much of the pool basin is filled with water relative to the pool's high water mark (indication of the highest level water reaches in the pool when the pool is full), at the time of the survey. Evidence or signs of the high water mark or the boundary of a vernal pool include sudden change in the herbaceous plants and/or ground level, presence of water-stained leaves, sediment deposits on the leaf litter, water marks or moss on tree trunks, and mucky/squishy soil (see photos). If water level varies across the pool basin, please average for entire basin and explain answer, if needed.

Evidence of high water mark and/or boundary of a vernal pool

High water mark indicated by pool boundary

High water mark indicated by change in plants

High water mark indicated by change in plants and topography, pool depression, and black, matted leaves

High water mark/pool boundary based on change in plants and depression (also water marks on trees)

8. Pool Substrate / Soils (when pool is dry) (optional)

8a) Soil pH (optional)

Measure soil pH using a soil testing kit (for example, LaMotte Soil Test Kit). Using a small shovel or spade, take a small sample of the soil below the leaf litter and other plant matter and debris on top of the soil. Test pH of the soil following directions in the soil kit.

8b) Soil moisture

Circle whether the the soil at the bottom of a dry pool is wet, moist, or dry.

8c) Substrate / soil type -

Circle ALL substrate or soil types in the pool basin when dry. To determine the soil type, take a small sample of soil (below the leaf litter if present, 1-2 inches deep if possible), add a little water, rub it between your fingers to feel the soil texture, and determine soil type based on the types defined below and in the soil type/texture handout.

Silt-Clay – Very small, fine-grained sediments. Soil does not feel gritty and feels smooth and/or sticky. Soil sample when wet is able to be squeezed into a strong ribbon (>2 inches long).

Muck-Peat – Muck is an organic soil containing a high percentage (between 20 percent and 50 percent) of organic matter consisting of highly decomposed materials such as plants, animals, and their waste products. Muck has a "greasy" feel. Peat is an organic soil consisting of materials that are only slightly or partially decomposed (i.e., plant residues are recognizable/can see plant fibers). Both are very dark in color, especially muck.

Sand - Small, loose, coarse-grained sediment, typically pale yellowish brown, resulting from the erosion or disintegration of rocks. Soil feels very gritty, and will not remain in a ball when wet and squeezed.

Loam – Soil made up of sand, silt, and clay in relatively even concentrations. Soil feels a little gritty and a little sticky or smooth, depending on how much sand, silt, and/or clay are present. Soil sample when wet is able to be squeezed into forming a weak or medium ribbon (<2 inches long).

Gravel – Loose mixture of small rocks and pebbles.

Bedrock – Solid rock underlying loose deposits such as soil or exposed on the surface.

Unknown – Circle this if you are not sure of the substrate/soil type.

Other (describe below) – Circle this if other substrate/soil types not listed here are present, and please describe.

9. Pool Vegetation (Plants)

9a) Are trees present in or along the pool?

Indicate if trees are present inside the pool basin or only along the edge of the pool. Only include trees with trunks > 4 inches DBH (diameter at breast height (about 4.5 feet above the ground)) If trees are present in the pool basin, please count or estimate the number of trees in the pool basin.

9b) How much of the pool is covered by the following types of vegetation?

Visually estimate how much of the pool basin is covered by the following types of vegetation or plants using the following categories: 0% 1-9% 10-25% 26-50% >50%

Floating plants - Plants that float in the water or on the surface of the water in a vernal pool, such as duckweed.

Emergent plants - Plants that are rooted in soil in the pool bottom, grow in water, and extend above the surface of the water (e.g., grasses, sedges, reeds, bulrushes, iris)

Shrubs - Woody plants that are smaller than a tree and usually have several main stems growing out of the ground. Trees with trunks < 4 inches DBH (diameter at breast height (about 4.5 ft above ground)) can be included with shrubs. Shrubs often found in vernal pools include buttonbush, winterberry, willow, dogwood, and tag alder.

Trees / tree canopy - Estimate canopy cover over the pool when the leaves on the trees are fully out by standing in the middle of the pool and looking up and estimating how much of the sky above the pool is covered by tree canopy/leaves on the trees.

Examples of vernal pools with floating plants (left), emergent plants (center), and shrubs (right).



9c) Additional Cover for Animals

Circle **ALL** of the following addtional materials in the pool that can provide egg attachment sites and cover for adults, larvae, and/or eggs of vernal pool indicator species and other amphibians and invertebrates.

Leaf Litter - Decomposing leaves that have fallen on the ground in the pool bottom.

Logs - Fallen and decomposing trees, tree trunks, and large branches > 4 inches in diameter

Branches/twigs - Fallen and decomposing tree branches and twigs < 4 inches in diameter

Moss - Small flowerless green plants that lack true roots and reproduce by releasing spores from capsules, such as sphagnum moss.

Algae - Simple, nonflowering plants that include seaweeds and many single-celled plants. Algae contain chlorophyll but lack true stems, roots, leaves, and vascular tissue.

Submergent Plants - Herbaceous plants that grow entirely submerged under the water surface.

Other (describe below) - Please describe additional materials in the pool that provide cover for animals.

Vernal pool with leaf litter, logs, branches, and moss

Close-up of sphagnum moss

10. Pool Disturbance

10a) Do you see any human disturbance or invasive plants in or along the edge of the pool? Circle Yes / No. If yes, please describe here.

Please indicate any disturbances in or next to the pool. These could include garbage dumping, ditches or drains, runoff from agriculture, roads, or other development, farm fields or farm animals, digging or filling in of the pool, vehicle tracks or ruts, rock piles, and/or invasive plants (plants that are not native whose introduction does or is likely to cause harm to natural ecosystems and/or people). Invasive plants that could be found in or around vernal pools include purple loosestrife, reed canary grass, and garlic mustard.

11. Sketch of pool

11a) Sketch the vernal pool including labels and details as necessary to show its features.

Please draw sketch of the vernal pool showing the general shape of the vernal pool, any landmarks in or around the pool basin, area(s) where indicator species are observed, locations of any rare species observed, and other distinctive things to note.

12. Indicator Species and Additional Species

12a) List animal species observed or collected. Put a *star by those species that are vernal pool indicator species (fairy shrimp, wood frog, spotted salamander, blue-spotted salamander, fingernail clams in dry pools). Photograph all species observed.

Species observed – Identify and record vernal pool indicator species found in the pool. Presence of other amphibian and invertebrate species and other wildlife species also should be recorded. Please refer to the vernal pool indicator species section of this manual and other handouts.

Age class – Please record if adults, larvae, and/or eggs of indicator species and other animal species are observed.

Fish, Green Frogs, and Bullfrogs - Please record if predators such as fish, green frogs, or bullfrogs are found in the pool.

12b) Create a detailed sketch of at least one of the species collected and label your drawing with the correct name of the species. If you have time, use the back of this sheet to sketch and label more of the species collected.

Data Form and Photo Submission

Please compile and submit your completed vernal pool monitoring data forms (i.e., standard data form for the program (Appendix 1), one for each pool visit) and labelled photos to the Michigan Natural Features Inventory (MNFI) **by June 30th.** You can submit the forms and photos (hard copies or on a CD or flash drive) by mail to the address below, or you can upload the forms and photos to a specified file location (TBA). Please complete program evaluation by June 30th as well.

Michigan Natural Features Inventory
c/o Michigan Vernal Pools Program
P. O. Box 13036
Lansing, MI 48901-3036

If you have any questions, please contact the following MNFI staff:

Daria Hyde at hydeda@msu.edu, 517-284-6189

Yu Man Lee at leeyum@msu.edu, 517-284-6201

You can also access vernal pool information and resource materials, including the vernal pool manual and the monitoring data form through our vernal pool website at **http://mnfi.anr.msu.edu/vernalpools/**.

Thank you for participating in the Vernal Pool Patrol Program!!!!

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Glossary

Adaptation: a change in structure or function of an organism or any of its parts that enables a plant or animal to survive better in its environment

Aerial Photo Interpretation: examining photographic images for the purpose of identifying objects and judging their significance

Amphibian: cold-blooded vertebrate animal of a class that comprises the frogs, toads, newts, and salamanders; distinguished by having an aquatic gill-breathing larval stage followed (typically) by a terrestrial lung-breathing adult stage.

Annual: a plant that germinates, flowers, and sets seed in a single growing season (lacking perennial roots, rhizomes, or other such parts). A winter annual begins its year in the fall and completes its cycle after winter

Bedrock: solid rock underlying loose deposits such as soil

Biennial: a plant that lives for two years; such plants often produce a rosette of leaves the first year and a flowering stem the second year.

Biodiversity: the variety of life in the world or in a particular habitat or ecosystem

Bog: wet, spongy ground with soil composed mainly of decayed vegetable matter; an area having a wet, spongy, acidic substrate composed chiefly of sphagnum moss and peat in which characteristic shrubs and herbs and sometimes trees usually grow

Canopy: the cover formed by the leafy upper branches of the trees in a forest

Channelized connection: water bodies connected by a channel that water flows through

Citizen Scientist: amateurs or not-professional scientists that conduct scientific research

Conifer tree: a tree that bears cones and evergreen needlelike or scalelike leaves. Conifers are of major importance as the source of softwood, and also supply resins and turpentine.

Conservation: preservation, protection, or restoration of the natural environment, natural ecosystems, vegetation, and wildlife

Data: facts and statistics collected together for reference or analysis

Deciduous tree: tree with leaves that fall off naturally at the end of the growing season; [can also refer to flower parts that are shed readily]

Decomposition: the process of decay; the separation of a substance into simpler substances or basic elements; can be brought about by exposure to heat, light, or chemical or biological activity

Depression: a sunken place or lower area on the ground

Detritus: organic matter produced by the decomposition of organisms

Disturbance: a temporary change in environmental conditions that causes a pronounced change in an ecosystem

Ecology: branch of biology that deals with the relations of organisms to one another and to their physical surroundings

Ecosystem: a biological community of interacting organisms and their physical environment

Ecosystem Structure: all of the pieces, both living and non-living, that make up a particular ecosystem

Egg mass: mass of small **eggs** laid by animals like fish, frogs, mollusks

Emergent Plant: Plants living in water but part of them extends up above the water

Ephemeral: lasting for a short time

Evergreen tree: a plant that has leaves throughout the year, always green. This contrasts with deciduous plants, which completely lose their foliage during the winter or dry season. There are many different kinds of evergreen plants, both trees and shrubs.

Field Sampling: gathering information in the field needed to answer research questions, such as the status of a population

Flood Control: methods used to reduce or prevent the detrimental effects of flood waters

Floodplain: a nearly flat plain along the course of a stream or river that is naturally subject to flooding

Forb: an herbaceous flowering plant other than a grass

Floating Plant: plants that live on the surface of the water (floating leaves neither rise above the surface nor live entirely under the surface)

Geographic Information Systems (GIS) Modeling: a system designed to capture, store, manipulate, analyze, manage, predict, and present all types of spatial or geographical data. GIS modeling is used to predict the occurrence of vernal pools on the landscape.

Global Positioning System: is a satellite-based navigation system that allows land, sea, and airborne users to determine their exact location, velocity, and time 24 hours a day, in all weather conditions, anywhere in the world

Gravel: small stones and pebbles, or a mixture of these with sand

Ground Truth: data gathered through direct observation rather than through inference from remote sensing

Ground flora: the herbaceous plants and low shrubs in a forest, considered as a whole; any of a variety of low-growing or trailing plants used to cover the ground; a general term describing plants of the ground layer

Groundwater: water held underground in the soil or in pores and crevices in rock

Groundwater recharge: hydrologic process where water moves downward from surface water to groundwater

Habitat: the natural home or environment of an animal, plant, or other organism

Hardwood tree: the wood from a broadleaved tree (such as oak, ash, or beech) as distinguished from that of conifers (pines, spruce, firs, cedars)

Herb: any seed-bearing plant that does not have a woody stem and dies down to the ground after flowering

Herbaceous: relating to herbs

Hibernation: a state of inactivity and metabolic depression in warm-blooded animals (endotherms) characterized by low body temperature, slow breathing and heart rate, and low metabolic rate

Hydrology: science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere

Indicator species: a species whose abundance in a given area is believed to indicate certain environmental or ecological conditions or suitable conditions for a group of other species

Inlet: a long narrow area or channel with water flowing into an area or a vernal pool in this case. Inlets may be permanent or temporary. Vernal pools have no inlets or temporary inlets (inlets with temporary surface water).

Invertebrate species: any animal lacking a backbone, including all species not classified as vertebrates

Isolated pool: no evidence of above ground connection to another wetland or water body

Larva: an immature form of other animals that undergo some metamorphosis, e.g., a tadpole

Larvae: plural form of larva; more than one larva

Latitude: The measurement, in degrees, of a place's distance north or south of the equator (e.g. 51° N")

Litter: decomposing plant material, such as **leaves**, bark, needles, and twigs, that have fallen to the ground

Loam: a soil with roughly equal proportions of sand, silt, and clay

Longitude: distance measured in degrees east or west from an imaginary line (called the prime meridian) that goes from the North Pole to the South Pole and that passes through Greenwich, England (e.g. 2° W")

Marsh: a wetland dominated by coarse, non-woody vegetation (not trees or shrubs)

Metamorphs: animals that are in the process of changing from aquatic to terrestrial form, such as a tadpole with legs

Monitoring: observing and checking the progress or quality of (something) over a period of time

Mollusc/ Mollusk - a type of invertebrate animal that includes snails, slugs, mussels, and clams.

Moss: a small flowerless green plant that lacks true roots; reproducing by means of spores released from stalked capsules

Muck: soil containing a high percentage (between 20 percent and 50 percent) of organic matter (composed of compounds from the remains of organisms such as plants and animals and their waste products in the environment); dark fertile **soil** containing decaying vegetable matter

National Wetland Inventory: is a Fish and Wildlife Service program started in the 1970s to inventory and map all wetlands, primarily for scientific purposes

Obligate Vernal Pool Species: a species that can only live in vernal pools

Old Field: is a term used in ecology to describe lands formerly farmed or grazed but later abandoned. The dominant vegetation includes grasses and herbaceous plants, with encroaching woody vegetation.

Outlet: a long narrow area or channel with water flowing out of an area or vernal pool in this case. Outlets may be permanent or temporary. Vernal pools have no outlets or temporary outlets or outlets with temporary surface water flow.

Peat: brown, soil-like material characteristic of boggy, acid ground, consisting of partly decomposed vegetable matter

Perennial Plant: persists for many growing seasons; generally the top portion of the plant dies back each winter and regrows the following spring from the same root system

Perimeter: the outer edge

Photo documentation: documenting a species or other items by taking a photo

Vernal pool basin: the depression that the pool is in

Potential Vernal Pool: a wetland that has been identified be remote sensing, GIS, or radar modeling as a possible vernal pool. Requires a site visit to confirm.

Prairie: areas dominated by native grasses that contain less than one mature tree per acre

Radar modeling: an approach for identifying and mapping potential vernal pools using radar imagery which comes from sending out pulses of high-frequency electromagnetic waves that can go through tree canopy/ leaves and are reflected off the ground and/or tree and back to the source.

Remote mapping: creating maps through manual interpretation of aerial imagery or other available data sources.

Sand: loose granular substance, typically pale yellowish brown, resulting from the erosion of siliceous and other rocks and forming a major constituent of beaches, riverbeds, the seabed, and deserts

Saturated: holding as much water or moisture as can be absorbed; thoroughly soaked soil

Seasonal pools: also called vernal ponds or ephemeral pools, are temporary pools of water that provide habitat for distinctive plants and animals. They are a distinctive type of wetland that are usually at their maximum depth in the spring. They usually lack fish, which allows the safe development of amphibian and insect species that are unable to withstand competition or predation by fish.

Sediment: soil particles are transported by surface water movement and deposited in streams, lakes and wetlands; solid fragments of inorganic or organic material that come from the weathering of rock and are carried and deposited by wind, water, or ice

Sedimentation: the deposition or accumulation of sediment

Shrub: a woody plant that is smaller than a tree and usually has several main stems arising at or near the ground

Spatial database: a database that is optimized to store and query data that represents objects defined in a geometric space. Most spatial databases allow representing simple geometric objects such as points, lines and polygons.

Spermatophore: a capsule, packet, or mass enclosing spermatozoa that is created by males of various animal species, especially salamanders and arthropods, and transferred to the female's reproductive tract during reproduction.

Stakeholder: a person, group or organization that has interest or concern in an organization or issue

Standing water: refers to water on top of soil; any body of stagnant water, including puddles, ponds, rainwater, drain water, reservoirs etc.

Submergent plant: Plants that live under the water surface [and so adapted (not merely flooded)]

Substrate: the material that forms the bottom of the basin and which the water sits on

Surface runoff: water, from rain, snowmelt, or other sources, that flows over the land surface, and is a major component of the water cycle.

Surface water: water that collects or flows on the surface of the ground; the top layer of a body of water

Swamp: A wet (at least seasonally) forested area

Tadpoles: the larval stage in the life cycle of an amphibian, particularly that of a frog or toad. They are usually wholly aquatic, though some species have tadpoles that are terrestrial. Most breathe by means of external or internal gills. They do not usually have arms or legs until the transition to adulthood, and typically have a large, flattened tail with which they swim, similar to most fish.

Topographic Map: a map showing the natural and/or physical features of a landscape including the relief features of the earth's surface, using contour lines to show changes in elevation

Town Range Section: The Public Land Survey System (PLSS) is a way of subdividing and describing land in the United States. The PLSS typically divides land into 6-mile-square townships. Townships are subdivided into 36 one-mile- square sections. Sections can be further subdivided into quarter sections, quarter-quarter sections, or irregular government lots.

Tree: a woody perennial plant, typically having a single stem or trunk growing to a considerable height and bearing lateral branches at some distance from the ground

Understory: the layer of vegetation beneath the main canopy (upper-most trees) of a forest.

Vegetation: live trees, shrubs, and other plants

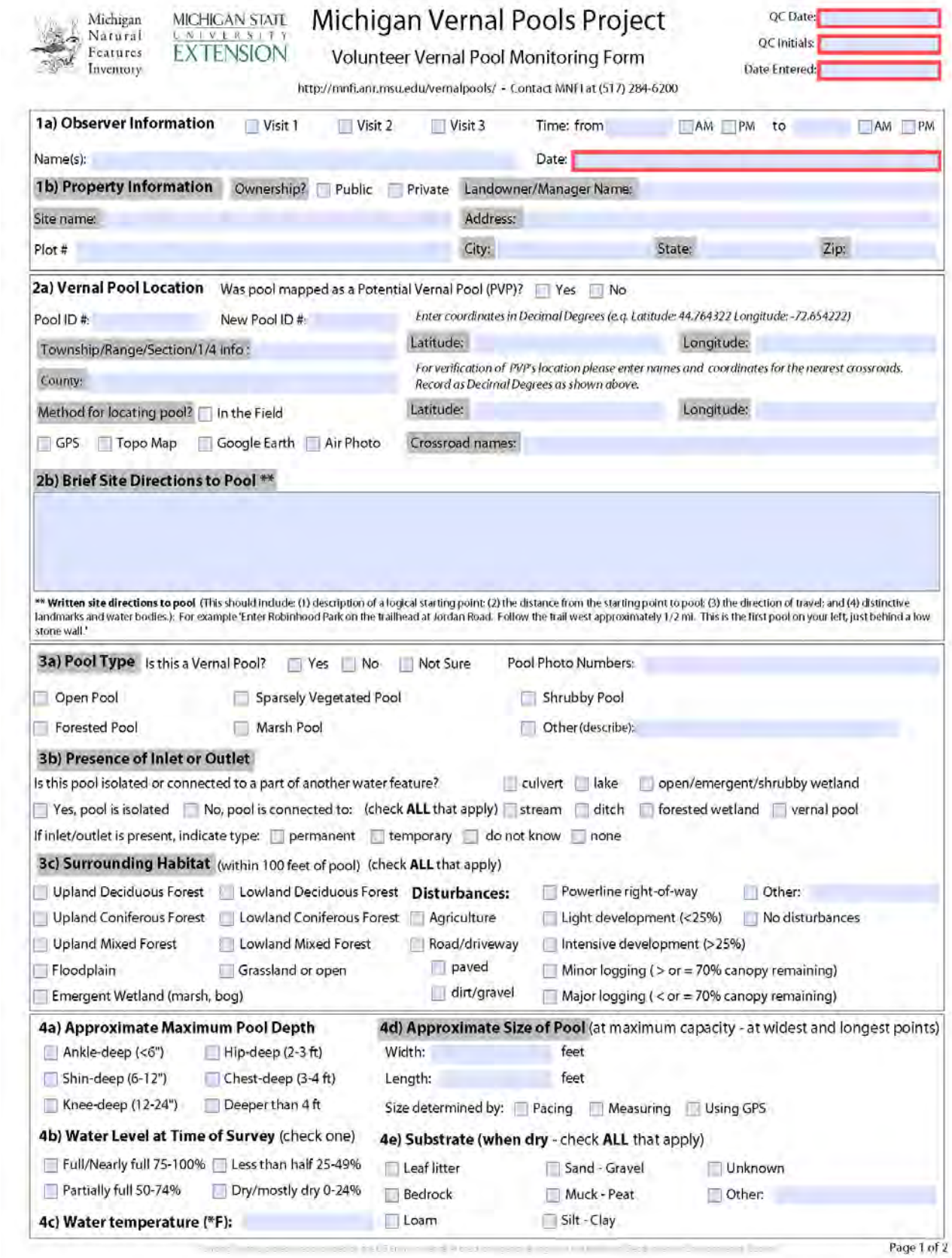
Vertebrate species: an animal that has a backbone and a skeleton, including mammals, birds, reptiles, amphibians, and fishes

Water depth (maximum): how deep the water is at the deepest part

Water level: the percent of the entire pool basin that has water in it

Woody Plant: a perennial tree or shrub; the stem remains above ground during the winter; also develops secondary tissue and increases in stem diameter

Appendix 1. Standard Volunteer Vernal Pool Monitoring Data Form.



Michigan Natural Features Inventory

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Vernal Pools Project

Volunteer Vernal Pool Monitoring Form

http://mnfi.anr.msu.edu/vernalpools/ - Contact MNFI at (517) 284-6200

QC Date:
QC Initials:
Date Entered:

1a) Observer Information ☐ Visit 1 ☐ Visit 2 ☐ Visit 3 Time: from ☐AM ☐PM to ☐AM ☐PM

Name(s): Date:

1b) Property Information Ownership? ☐ Public ☐ Private Landowner/Manager Name:

Site name: Address:

Plot # City: State: Zip:

2a) Vernal Pool Location Was pool mapped as a Potential Vernal Pool (PVP)? ☐ Yes ☐ No

Pool ID #: New Pool ID #:

Township/Range/Section/1/4 info:

County:

Method for locating pool? ☐ In the Field

☐ GPS ☐ Topo Map ☐ Google Earth ☐ Air Photo

Enter coordinates in Decimal Degrees (e.g. Latitude: 44.764322 Longitude: -72.654222)

Latitude: Longitude:

For verification of PVP's location please enter names and coordinates for the nearest crossroads. Record as Decimal Degrees as shown above.

Latitude: Longitude:

Crossroad names:

2b) Brief Site Directions to Pool **

**** Written site directions to pool** (This should include: (1) description of a logical starting point; (2) the distance from the starting point to pool; (3) the direction of travel; and (4) distinctive landmarks and water bodies.): For example 'Enter Robinhood Park on the trailhead at Jordan Road. Follow the trail west approximately 1/2 mi. This is the first pool on your left, just behind a low stone wall.'

3a) Pool Type Is this a Vernal Pool? ☐ Yes ☐ No ☐ Not Sure Pool Photo Numbers:

☐ Open Pool ☐ Sparsely Vegetated Pool ☐ Shrubby Pool

☐ Forested Pool ☐ Marsh Pool ☐ Other (describe):

3b) Presence of Inlet or Outlet

Is this pool isolated or connected to a part of another water feature? ☐ culvert ☐ lake ☐ open/emergent/shrubby wetland

☐ Yes, pool is isolated ☐ No, pool is connected to: (check **ALL** that apply) ☐ stream ☐ ditch ☐ forested wetland ☐ vernal pool

If inlet/outlet is present, indicate type: ☐ permanent ☐ temporary ☐ do not know ☐ none

3c) Surrounding Habitat (within 100 feet of pool) (check **ALL** that apply)

☐ Upland Deciduous Forest ☐ Lowland Deciduous Forest

☐ Upland Coniferous Forest ☐ Lowland Coniferous Forest

☐ Upland Mixed Forest ☐ Lowland Mixed Forest

☐ Floodplain ☐ Grassland or open

☐ Emergent Wetland (marsh, bog)

Disturbances:

☐ Agriculture ☐ Road/driveway ☐ paved ☐ dirt/gravel

☐ Powerline right-of-way ☐ Other:

☐ Light development (<25%) ☐ No disturbances

☐ Intensive development (>25%)

☐ Minor logging (> or = 70% canopy remaining)

☐ Major logging (< or = 70% canopy remaining)

4a) Approximate Maximum Pool Depth

☐ Ankle-deep (<6") ☐ Hip-deep (2-3 ft)

☐ Shin-deep (6-12") ☐ Chest-deep (3-4 ft)

☐ Knee-deep (12-24") ☐ Deeper than 4 ft

4b) Water Level at Time of Survey (check one)

☐ Full/Nearly full 75-100% ☐ Less than half 25-49%

☐ Partially full 50-74% ☐ Dry/mostly dry 0-24%

4c) Water temperature (°F):

4d) Approximate Size of Pool (at maximum capacity - at widest and longest points)

Width: feet

Length: feet

Size determined by: ☐ Pacing ☐ Measuring ☐ Using GPS

4e) Substrate (when dry - check **ALL** that apply)

☐ Leaf litter ☐ Sand - Gravel ☐ Unknown

☐ Bedrock ☐ Muck - Peat ☐ Other:

☐ Loam ☐ Silt - Clay

Page 1 of 2

4f) Vegetation in Pool

Are trees (trees = or > 4" in diameter) present in the basin? (check one)

☐ No ☐ Yes, within pool basin ☐ Yes, but only at the edge

# of trees only within the pool basin? ☐ live and/or ☐ dead/snags

% Cover within the pool (check one):

Floating vegetation: ☐ 0% ☐ 1 to 9% ☐ 10 to 25% ☐ 26 to 50% ☐ >50%

Emergent vegetation: ☐ 0% ☐ 1 to 9% ☐ 10 to 25% ☐ 26 to 50% ☐ >50%

Shrubs: ☐ 0% ☐ 1 to 9% ☐ 10 to 25% ☐ 26 to 50% ☐ >50%

4h) Cover (Any material in the pool that can provide egg attachment sites and offer concealment to adults and/or larvae; check all that apply):

☐ Shrubs ☐ Submergent vegetation

☐ Branches, twigs ☐ Logs or large woody debris

☐ Sphagnum moss ☐ Emergent vegetation (grasses, cattails)

☐ Algae ☐ Other:

☐ Leaf litter

Tree canopy over pool basin (when leaves are fully out): ☐ 0% ☐ 1 to 9% ☐ 10 to 25% ☐ 26 to 50% ☐ >50%

4g) Pool Disturbance (in pool, immediately adjacent or along shore of pool - check all that apply)

☐ Dumping - Refuse ☐ Filling ☐ Invasive Species Present

☐ Ditching - Draining ☐ Sediment ☐ Purple loosestrife ☐ Garlic mustard

☐ Agricultural runoff ☐ Vehicle ruts ☐ Reed canary grass ☐ Other:

☐ Cultivation - Livestock ☐ Presence of rock pile or other anthropogenic disturbance ☐ No disturbances

5) Indicator Species and Additional Species (if other species are observed please list below in blank fields under Fingernail Clams)

Provide a photograph of each indicator species (adults, juveniles/larvae, or egg masses) observed. **Photos of species observed are required.**

Species Observed	Adults	Tadpoles/Larvae	Egg Masses			Photo? Yes	Notes/Photo ID#
			Number	Estimated	Counted		
Wood Frog				☐	☐	☐	
Spotted Salamander				☐	☐	☐	
Blue-spotted Salamander				☐	☐	☐	
Fairy Shrimp							
Fingernail Clams							
				☐	☐	☐	
				☐	☐	☐	
				☐	☐	☐	
				☐	☐	☐	
				☐	☐	☐	
				☐	☐	☐	
				☐	☐	☐	

Were any of the following observed? (check **ALL** that apply)

☐ Fish: (indicate all lengths observed) ☐ ≤3" ☐ > 3" ☐ Green frogs: ☐ tadpoles ☐ adults

☐ Bullfrogs: ☐ tadpoles ☐ adults ☐ Other:

Comments:

Draw diagram of pool (include landmarks, location of indicated species, north arrow and area surveyed if entire pool was not surveyed):

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