Rhode Island Freshwater Wetlands Monitoring and Assessment Program:

MAPPING AND VERIFICATION OF VERNAL POOLS

Quality Assurance Project Plan (QAPP)
December 14, 2022

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1.0 PROJECT MANAGEMENT

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1.2 Table of Contents (EPA QA/R-5 A2) **-** See pages 2 - 3.

1.3 Distribution List (EPA QA/R-5 A3)

- Signatories (Title Page)
- EPA Region 1 RI State Wetland Coordinator
- RINHS Wetland Scientist

1.4 Project Organization (EPA QA/R-5 A4)

The Department of Environmental Management (DEM) Office of Water Resources will be the lead agency to implement this work. DEM has contracted with the RI Natural History Survey (RINHS) and the RINHS has recruited and hired staff. Qualified and experienced personnel are available to execute the work. The following people will implement or participate in this project:

- Susan Kiernan, Administrator, RI DEM Office of Water Resources: Responsible for contract agreement and fiscal grant management and general program oversight.
- Carolyn Murphy, Principal Environmental Scientist, RI DEM Office of Water Resources: technical project oversight and quality assurance and communication. Vernal Pool Team member.
- Richard Enander, RI DEM Quality Assurance Officer
- David Gregg, Exec. Dir., RINHS: Responsible for contract agreement management and hiring and supervision of RINHS staff.
- Donna Smith-Williams, EPA Region 1, Wetland Program Development Grant Project Officer
- Erica Sachs Lambert, EPA Region 1, RI wetlands coordinator. Responsible for technical consultation and assistance and training of spring field staff. Vernal Pool Team member. Point of project contact at EPA Region 1.
- Thomas Kutcher, Wetland Scientist, RINHS: Responsible for formation of and communication with the Vernal Pool Team, research, office and field data collection, data entry and analysis, QAPP and report writing, and supervision of field staff.

1.5 Problem Definition/Background (EPA QA/R-5 A5)

Background

The DEM Office of Water Resources, in partnership with the Rhode Island Natural History Survey (RINHS), has been developing methods to characterize freshwater wetlands and inform the goals and objectives of the Rhode Island Freshwater Wetland Monitoring and Assessment Plan (WMAP; NEIWPCC and DEM 2006) with support and guidance from the United States Environmental Protection

Agency (U.S. EPA 2006). Vernal Pools are listed in the WMAP as among wetlands that are vulnerable to loss and degradation, and have been recognized in Rhode Island as wetlands of high ecological value (Leeson et al. 2018). Vernal pools are seasonal ponds that support certain obligate amphibians and invertebrates, and they are afforded specific protections under new state wetland rules (250-RICR-150-15-3) fully effective on July 1, 2022. DEM has identified statewide mapping and verification of vernal pools as a priority for wetland program development and has contracted with RINHS to assemble a team of mapping and vernal-pool experts (hereafter the *VP Team* or *team*) to recommend mapping and verification methods to be piloted by RINHS and other contractors and partners in 2022.

RINHS worked with DEM to assemble the VP Team, and a list of team members and their affiliations was delivered to DEM in a series of memoranda titled "Proposed technical team to advise vernal pool mapping in Rhode Island" (see App. A for the current list). DEM and RINHS hosted three virtual meetings (via Zoom) in the fall of 2021, each focusing on specific technical aspects of mapping potential vernal pools (PVPs) remotely, using a geographic information system (GIS), which is typically the first step in a vernal pool mapping and verification process. The meetings resulted in a set of recommendations for a vernal pool mapping and verification project (hereafter the Project), some of which is the subject of this Quality Assurance Project Plan (QAPP).

The Project includes three interconnected tasks: (1) developing and piloting efficient and effective methods to map potential vernal pools (PVPs) by others via remote sensing, using a geographic information system (GIS), (2) testing and refining vernal pool verification field methods that were previously developed and applied in an earlier project (DEM 2011), and (3) developing and testing dry-phase vernal pool verification methods for identifying or verifying vernal pools outside of the spring season when VP-dependent amphibians are actively using the pool for breeding and metamorphosis. This QAPP provides a quality-assurance and documentation plan for data collected in support of the Project.

1.6 Project/Task Description and Schedule (EPA QA/R-5 A6)

The Project will be conducted from February 2022 through May of 2023. The task descriptions and schedules are planned as follows.

1.6.1 Task 1. PVP Mapping: Pilot LiDAR modeling and digital photointerpretation by others (January through December 2022)

Research has indicated that LiDAR modeling can be more efficient and effective than photointerpretation for identifying PVPs with lower errors of commission and omission (Julian et al. 2009, Wu et al. 2014, Bourgeau-Chavez et al. 2016, Dibello et al. 2016, Varin et al. 2021).
VP Team member, Dr. Jason Parent (URI) has agreed to work with a top student from his GIS lab to develop a LiDAR model for mapping PVPs in RI. The LiDAR model and mapping products will be developed independent of EPA funding, however; they will be the subject of error assessments and quality assurance using verification data collected under this QAPP. The LiDAR model will need to be trained by others to recognize specific landscape attributes of vernal pools, such as depressions and

reflectance of water. DEM has supplied the Parent Lab with the GIS dataset of potential and verified vernal pool features from a former mapping effort conducted under the approved QAPP (March 2008) available at http://www.dem.ri.gov/pubs/qapp/qappvp08.pdf (the Wood-Pawcatuck (WP) project; Final Report DEM 2011). The Parent Lab intends to use the WP data to train and develop a model that uses existing state LiDAR (RIGIS 2011, 2020) and supporting satellite or existing two-dimensional (2-D) aerial imagery to identify PVPs in Rhode Island.

The LiDAR model will subsequently be piloted in accessible, diverse, and meaningful study areas during 2022. VP field verifications will be conducted on previously mapped but non-verified PVPs in the WP watershed at Fisherville Brook and Eppley Wildlife Refuges owned by the Audubon Society of Rhode Island, and in a new study area, the Big River Management Area (Big RMA), selected according to the criteria in this section, to support evaluation and refinement of the LiDAR model. The study areas have diverse topography and vegetation cover. Studies have found that PVP mapping is more accurate in open and deciduous-forested areas than in coniferous-forested areas (e.g., DiBello 2014). Also, a LiDAR model may perform differently in various terrain types (e.g., flat outwash compared with hilly till). The study areas will be meaningful to DEM for the regulation and conservation of vernal pools and other resources.

If deemed necessary to support, complement, or replace the LiDAR modeling effort and the supporting 2-D aerial imagery, DEM may purchase three-dimensional (3D)-capable digital imagery from a 2020 flight for 3D digital photointerpretation (PI). The 3D PI will be conducted by RINHS for comparison to the LiDAR modeling data and may be used by the Parent Lab to further assess or refine the LiDAR model. If this method is also employed, it will involve interpretation of the aerial imagery assisted by 3D imaging software, although the details of this method have not been worked out in terms of software and hardware needed, or searching protocols. If the 3-D PI method is used by the RINHS, an SOP for the work will be developed based on further research and available software and hardware. The SOP will be distributed as an addendum to this QAPP and the secondary data created using these PI methods will be subject to the quality-assurance procedures of this QAPP.

1.6.2 Task 2. Develop and test existing verification methods (March 2022 through May 2023)

In a prior project, DEM and partners developed and applied a VP field-verification method on photo interpreted PVPs mapped in the Wood-Pawcatuck watershed by the RI Chapter of the Nature Conservancy (DEM 2011). That effort resulted in a verification method that will be assessed and further refined (as needed) during the Project, as it is applied to verifying PVPs mapped as part of the Project. Field verifications conducted in 2022 will provide information to refine the models and methods of PVP mapping and verification for further piloting on a larger scale. The larger pilot project will be conducted in 2023 in a study area following criteria listed above, or as otherwise selected by DEM and recommendations of the VP Team. PVP mapping and verification methods, refined from work in 2022, can be applied to mapping and verifying vernal pools in the larger 2023 study area. Study-design specifics for the larger effort will be developed by DEM and RINHS, with input from the VP Team, over the course of the Project period. Data collected during all of the field verifications will be subject to the quality assurance procedures specified in this QAPP.

As deemed necessary by the VP Team for evaluating errors of omission, transects will be established within the Big RMA to improve the analysis of mapping error of the mapping methods. Following Calhoun et al. (2004), RINHS will run transects within the Big RMA mapping area to standardize the way mapping error is calculated. Investigators will visually search the land on each side of the transects. All potential vernal pools seen from the transects will be inspected and verified. Measurements will be taken perpendicular to the transects, every 50-m, to determine the width of the area that could be seen from the transect, giving the investigators an average width and subsequently an area of the land inspected; this transect-area and the number of vernal pools confirmed in the area will be used to calculate the density of vernal pools in that area. The density of vernal pools within the transect areas will then be compared with the density of vernal pools identified by the LiDAR PVP mapping methods to calculate a reliable measure of omission error.

1.6.3 Task 3. Develop and test dry-phase VP verification methods (summer and fall of 2022)

Dry-phase vernal pool verification would be useful for the DEM Wetlands Program to allow vernal pools to be confirmed or identified when they are dry or when breeding-season verification is not practical. Dennis Skidds and Jon Mitchell have both previously worked with URI on developing preliminary dry-phase vernal pool indicators (Skidds et al. 2007) and they are both advising VP-Team members. The VP Team has voiced confidence in developing a dry-phase VP verification method that would be useful for DEM. RINHS will work with DEM and the VP Team to develop a dry-phase VP verification method and study-design to test in the summer and fall of 2022. Dry-phase verification outcomes will be compared to springtime verification outcomes to test the dry-phase method for accuracy. The method may then be refined to best reflect springtime verification status across the study pools.

1.7 Quality Objectives and Criteria for Measurement Data (EPA QA/R-5 A7)

1.7.1 Springtime Vernal Pool Verification

The objective of data collection will be to (1) evaluate the accuracy of the remote mapping of potential vernal pools (PVPs), (2) identify new PVPs via implementation of field transects, and (3) build a GIS dataset of vernal pools classified into verification categories consistent with the definition of vernal pool established in the Freshwater Wetlands Rules [§ 250-RICR-150-15-3.4(A)(79)]. The classification as described in DEM 2011 and outlined in Table 1 will be consulted. The remote PVP-mapping methods will be evaluated through the field verifications conducted using the vernal pool field-verification data sheet (App. B).

As an additional quality control procedure, and to increase data-collection and upload efficiency, the paper field data sheet will be transposed to ESRI® ARCGIS Survey123, an electronic data-collection platform for collecting data using a tablet or smartphone. Survey123 uses dropdown menus for the input of categorical data, which will reduce chances of user error during data collection and electronic upload to the dataset. Continuous data (e.g., field measurements) are entered using the tablet or smartphone's keyboard in the field. Data entered into Survey123 will be automatically uploaded to a secure web

server owned by ESRI Corporation and will populate an electronic dataset designed and managed by the DEM Division of Planning in conjunction with the DEM Office of Water Resources. The Wetland Scientist will be able to access the data for quality assurance and analysis. Field investigators will be able to use either paper or electronic (i.e., Survey 123) versions of the 2022 field data sheet, as they will generate completely compatible and interoperable data.

Most of the data entered into the field data sheet 2022 are observational or estimated, and are therefore largely subject to the judgement of the qualified and trained investigator, such as observing the presence of fairy shrimp and other wildlife (App B, Sec 2), and documenting physical criteria (Sec 3), landscape characteristics (Sec 5), certain pool characteristics (Sec 4), weather conditions (Sec 1), and pool stressors (Sec 6).

Discrete measurements involved with VP verification are limited to the counting of amphibian adults and metamorphs (including indicator species as indicated with an asterisk in App B, Sec 2), and the counting of wood-frog and spotted-salamander egg masses and tadpoles. The investigator will count the specimens to the extent practical given the typical challenges of finding the animals in deep, dark, or cold water. The exact number of animals or egg masses found is not as important as their presence and an estimate of abundance, therefore the project managers will trust the investigators to make their best efforts to count species as accurately as possible. All discrete measurements will therefore be considered estimates.

All investigators will be qualified to identify and interpret all attributes of the field data sheet (i.e., formal training as a wetland scientist), and trained to fill out all sections of the field-verification form, as described in Section 1.8 of this QAPP. The Quality Objectives are to fill out the field-verification data sheet as completely and accurately as conditions and knowledge allow. At a minimum, the investigators will be required to complete all the required, gray-shaded Key Assessment Data (see App B) necessary for classification. Section 6, Stressors, is considered supplementary, although the investigator will be asked to fill it out as time and conditions allow.

1.7.2 Dry-phase Vernal Pool Verification

Dry-phase vernal pool verification methods will be developed and tested during summer and fall of 2022. We expect the dry-phase methods to consider earlier work by Skidds and Golet (2005) and Mitchell (2005), and include measurements of basin depth and plant identification in the PVP or VP depressions. Other data analysis may be added, such as time lapse analysis of aerial imagery. As the methods are developed and refined, a field data sheet will be developed to support the dry-phase field work (App. D). The field data sheet will be subject to peer-review of the VP Team and DEM, and quality assurance measures for data collection will be followed. Field investigators will be qualified according to Sec. 1.8 of this QAPP. Other data quality assurance procedures (transfer of data, data storage, etc.) will follow the procedures detailed in this QAPP.

1.8 Special Training Requirements/Certification (EPA QA/R-5 A8)

Erica Sachs-Lambert, EPA Region 1, and Kate McPherson, PWS, Save the Bay, will train Tom Kutcher, the seasonal Field Assistant, and participating VP Team members at the Eppley Wildlife Refuge on April 4, 2022. Paul Jordan, Data Analyst II/Geographic Information System for DEM Office of Planning and Development, will train Kutcher and other field investigators on using Survey123. Tom Kutcher will subsequently conduct or oversee all field work conducted by the RINHS and the trained VP Team members. Kutcher holds an MS in Biological and Ecological Sciences from the University of RI, where his graduate worked focused on bioindicator development for freshwater wetlands. In the prior vernal pool verification project (DEM 2011), Carolyn Murphy, Sachs-Lambert, Kutcher, and McPherson developed, managed, and/or trained wetland scientists on the various aspects of the project, including the spring verification methods that will be applied and refined in this Project (App. B). All field workers will be trained wetland professionals (minimum BS in environmental science or a related field). Training will cover vernal-pool species identification and interpretation of landscape and vegetative features to accurately fill out the paper field-verification data sheet or Survey 123 for eventual potential vernal pool classification.

Dry-phase verification methods will be developed by Kutcher and experts in dry-phase vernal pool identification from the VP Team (e.g., Dennis Skidds; NPS; Jon Mitchell, NBNERR; Nancy Karraker, URI), as they are available to participate. Data collection will only be conducted by professional wetland scientists who are members of the Team.

Table 1. Biological and physical criteria used for classifying potential vernal pools (PVPs) by DEM in an earlier effort (DEM 2011). These criteria will be adapted as needed to suit the data needs of DEM and this Project consistent with the recently promulgated statewide Freshwater Wetlands Rules, Part 3.

Biological Criteria

- Observed presence of fairy shrimp or amphibian indicators, which include egg masses, tadpoles, or adult wood frogs, spotted salamanders, marbled salamanders, and eastern spadefoot toads

Physical Criteria

- Ephemeral hydrology (thus lacks viable fish population)
  - Temporarily, seasonally, or semi-permanently flooded water regime[1]
  - No perennial connection to permanent surface water
- Comprises a clearly defined, natural or naturalized[2], isolated[3] basin or pool

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1. Confirmed (+) Isolated Vernal Pool:

- Meets biological criteria
- Meets both physical criteria

2. Confirmed (+) Wetland Breeding Pool:

- Meets biological criteria
- Does not meet one or both physical criteria

3. Likely Vernal Pool:

- Does not meet biological criteria
- Meets both physical criteria

4. Confirmed (-) Non-Vernal Pool:

- Does not meet biological criteria
- Does not meet one or both physical criteria

5. Potential Vernal Pool:

- Pool was not field verified

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[1]As defined by Cowardin et al. (1979)
[2]Manmade and supporting vascular hydrophilic vegetation
[3]Not contained within or contiguous with a larger wetland basin or complex

1.9 Documents and Records (EPA QA/R-5 A9)

The format for all data reporting packages will be consistent with the requirements and procedures used for data validation and data assessment described in this QAPP.

1.9.1 QA Project Plan Distribution

This QAPP will be distributed to all appropriate persons within the RI DEM, EPA Region 1, and the RI Natural History Survey. It will also be posted on the RI DEM web page: http://www.dem.ri.gov.

1.9.2 Field Documentation and Records

When using the paper field data sheets, data will be hand recorded by completely filling out the data sheet (App. B); waterproof paper will be used in rainy weather. Field data will be housed at the RINHS office until analysis and reporting are complete. The field data records will then be transferred to DEM to be held as detailed below. When using Survey 123 for data collection, all data will be automatically uploaded from the user's device to a remote ESRI server via the cellular network. Daily activities (location, mileage, sites, tasks) of RINHS staff and contractors will be documented in diaries, timesheets, and logs as required by EPA grant conditions on relevant OMB circulars cited therein.

1.9.3 Laboratory Documentation and Records

Field data collected using field data sheets will be entered directly into the Survey123 data-collection platform by the RINHS Wetland Scientist or seasonal Wetland Field Assistant, where they will be automatically uploaded to the ESRI database server via the cellular or internet network. The data will be checked weekly to assure proper function of the devices, software, and upload process. The dataset will be managed remotely and backed up locally at DEM by the DEM office of Planning and Development. As needed for Project analysis and reporting, the data will be exported as Microsoft® Excel files by RINHS until analysis and reporting are complete, at which time they will be transferred to the RI DEM Project Manager/Quality Assurance Officer along with any secondary and derived data. The project will implement proper document control procedures consistent with DEM's Quality Management Plan. The Project Manager/Quality Assurance Officer will have ultimate responsibility for any and all changes to records and documents after submittal to RI DEM.

The RI DEM Project Manager/Project Quality Assurance Officer shall retain the QAPP and all updated versions and will be responsible for any distribution of the current version. The Program Manager shall retain copies of all contract- and grant-management documents, and the Project Manager/Quality Assurance Officer shall retain all reports, memoranda, and technical correspondence between RI DEM and all project personnel identified in section 1.4, including email correspondence.

Records and documents that will be produced or adapted by the RINHS in conjunction with specific projects covered by this QAPP include:

- Completed vernal pool field-verification forms
- Excel spreadsheet files for data storage and analysis
- GIS shapefiles of mapping/verification areas and features
- This QAPP
- Quarterly reports
- Draft project report and appendices
- Final project report and appendices

Storage of project information.

One copy of technical files, compiled data, including field data, notes and memorandum, presentations, draft and final reports and publications, paper and electronic records, and other media such as photographs will be retained by the RI DEM Office of Water Resources as a permanent record after the completion of the work and delivery of RINHS products to the RI DEM Project Manager/Quality Assurance Officer.

Backup of electronic files.

Electronic files will be retained on the RI DEM network server by the RI DEM Project Manager/Quality Assurance Officer. As a normal procedure, files on the network server are backed up by the state.

1.9.4 Quarterly and/or Final Reports

The draft and revised Final Reports will include

- a summary and background of the project
- a detailed description of methods employed
- data analyses and demonstrations as listed in section 1.6 and detailed below
- a site map depicting vernal pool locations
- tables and figures as necessary to illustrate the work, analyses, and results
- interpretations of results
- recommendations for next steps

The RI DEM will coordinate review of draft Reports and provide summary comments. The Final Reports will incorporate responses to or revisions based on the summary comments.

2.0 DATA GENERATION AND ACQUISITION

2.1 Sampling Design (Experimental Design) (EPA QA/R-5 B1)

GIS Data Products

Site identification and delineation, PVP mapping, and supplemental data gathering will be done using publicly available georeferenced datasets from the Rhode Island Geographic Information System (RIGIS). The following datasets (publication dates in parentheses) and other RIGIS data may be used as needed:

- *RIGIS Statewide LiDAR (2011, 2020)*
- *RI Ecological Communities* (2011),
- *Digital Aerial Photography* (2008, 2011, 2018, 2020, 2021)
- *Impervious Surfaces* (2008),
- *Conservation Lands: Municipal and NGO* (2020),
- *Conservation Lands: State of Rhode Island* (2019),
- *Land Use – 2003/2004* (2007),
- *Soil Survey (SSURGO) Soil Polygons* (2013),

Federal Geographic Data Committee (FGDC) compliant metadata for each set is available at the RIGIS website (RIGIS 2016). The National Wetlands Inventory Plus (2014) dataset is compliant with the FGDC Wetlands Mapping Standard (2009). The most project-appropriate (typically recent, leaf-off, high-resolution) digital aerial photography is accessed directly from the RIGIS server each time, but all other datasets are downloaded and stored locally.

Site Identification
The RINHS and RI DEM Project Manager/Quality Assurance Officer will select PVP mapping areas with advice of the VP Team.

2.2 Sampling Methods (EPA QA/R-5 B2)

Springtime Vernal Pool Verifications
Field verifications will be conducted by completely filling out one vernal pool field-information data sheet (App. B or electronic version) for each PVP according to field training. Study sites will be accessed with written or oral permission from the Audubon Society of Rhode Island and from the Rhode Island Water Resources Board. The verifications will be conducted by the RINHS Wetland Scientist with assistance from a seasonal Wetland Field Assistant or by a qualified and trained member of the VP Team.

Paper or electronic field maps of each PVP, produced using GIS, will be used for field orientation and determining the pool and surrounding landscape characteristics. Each map will contain a backdrop of recent leaf-off, color aerial photography *(Digital Aerial Photography)* at a scale sufficient to illustrate wetland habitats and surrounding land use and include a centroid point of the PVP. Field investigations will be supplemented by GPS mapping software and GIS analyses to identify the latitude and longitude of the PVP centroid and identify landscape and pool characteristics and habitat stressors. Whenever possible, a real-time-corrected GPS unit (Bad Elf® GNSS) will be used to help locate PVPs and transect parameters (including length, width, and vernal pool occurrences) to improve field accuracy (approaching or within 1-m horizontal accuracy if enough satellite and cellular data are accessible).
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Dry-phase Vernal Pool Verifications
Vegetation and basin-depth data, as applicable, will be collected by the Wetlands Scientist with assistance from the seasonal Wetland Field Assistant using belt transects following the protocols developed by Skidds (2005) and Mitchell (2005). For vegetation sampling, it is estimated that three 4-m belt transects will be conducted per assessment unit, one running the longest distance that intersects the unit center, one running perpendicular to the first at one-third the distance from its start, and one running perpendicular to the first at two-thirds the distance from its start (Mitchell 2005). All species identified within two meters either side of transect center will be identified. For each transect, broad cover classes will be estimated in the field; these are scarce (<10%), common (10-60%), and dominant (>60%). The modal or median cover class will be used to estimate total cover for each species. The second or third transects may be modified in the field to incorporate wetland classes/subclasses that would otherwise clearly be unrepresented or underrepresented in the sample; in such cases, the transect will be modified

by moving the start or end point, or both, as necessary to cross the class/subclass type. Incidental observations will be incorporated into the inventory. The goal is to identify the species present in each PVP or VP and their broad relative abundance, with the degree of effort standardization necessary for the described methods.

2.3 Sample Handling and Custody (EPA QA/R-5 B3)

Vernal-pool verification does not require sample collection. For dry-phase verifications, plant identification will be done in the field and as property management policies do not allow for any samples to be collected or taken from the Audubon Refuges or the Big RMA properties no specimens will be collected.

2.4 Analytical Methods (EPA QA/R-5 B4)

Analyses will be restricted to field observation, estimation, and statistical analysis described in Sec. 2.4.3; no physical plant or animal samples will be collected.

2.4.1 Field Measurements Methods

Measurements will be limited to estimation, counting amphibians and their egg masses and tadpoles, and using a tape measure to determine basin depth, as described in Sec. 2.2. Qualified professionals will use simple tools and best professional judgment to make these determinations.

2.4.2 Field Analyses Methods

Refer to Sec. 2.2

2.4.3 Laboratory Analysis Methods (Off-Site)

- Conventional statistical analyses may be applied to the collected data as determined after the field work in conjunction with RI DEM and based on project goals. Analyses are typically applied to vernal-pool data as follows:
- Errors of commission may be calculated as the proportion of mapped PVPs that are not verified vernal pools (those meeting physical criteria, biological criteria, or both).
- Errors of omission may be calculated as the proportion of known verified vernal pools in a given area (those meeting physical criteria, biological criteria, or both) missed by PVP mapping.
- The occurrence of various indicator and other amphibians may be calculated across the study sample.

2.5 Quality Control Requirements (EPA QA/R-5 B5)

RINHS and RI DEM will work together to ensure that all sampling and assessment activities are conducted within the criteria set for the Project, specifically as described in the above sections.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance (EPA QA/R-5 B6)

Scientific tape measures and meter sticks may be used for measuring depth of pool and distance to trees for springtime and dry-phase verifications. These will be professional quality tools produced by reputable manufacturers and will be kept in good working order.

2.7 Instrument/Equipment Calibration and Frequency (EPA QA/R-5 B7)

Not applicable. No field measuring equipment will be used.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables (EPA QA/R-5 B8)

Not applicable. No critical consumables will be used.

2.9 Data Acquisition Requirements (Non-Direct Measurements) (EPA QA/R-5 B9)

Geospatial data from RIGIS will be used for site selection, as detailed in the above sections of this document, and will be used for LiDAR modeling and for Photointerpretation, as needed. RIGIS data represent the best electronic imagery currently available for RI, meet FGDC general mapping standards, and are widely utilized by state, federal, and local scientists conducting geospatial analysis in Rhode Island.

2.10 Data Management (EPA QA/R-5 B10)

Field data will be collected and stored in a metal file cabinet in the locked office in the RINHS. All data will be transposed to electronic format through upload to the ESRI Survey123 remote server. The data will be exported to Excel files for quality assurance and analysis. The Excel files will be coded by date and corrections to the file will be coded by the revision or correction date followed by the suffix *correction*. Duplicate versions of the datasets will be coded specifically for analysis and kept in a separate folder. Analysis data files will be stored in the RINHS laboratory at East Farm, URI on no less than two separate drives. GIS data generated during this study will be stored in file folders as shapefiles, which will be housed on two separate hard drives within the RINHS.

Field and electronic data will be quality checked for errors by the RINHS Wetland Scientist and by the Wetland Field Assistant following data collection, following data upload into Survey123. Any corrections will be handled as noted above. The Wetland Scientist will be responsible for data management of all quality-assurance and analysis files until the data are transferred to RI DEM Project Manager/Quality Assurance Officer at the end of the analysis and reporting period, at which time the RI DEM will be responsible for the data.

3.0 ASSESSMENT AND OVERSIGHT

3.1 Assessments/Oversight and Response Actions (EPA QA/R-5 C1)

Project oversight will be provided through regular correspondence between the RI DEM Project Manager/Quality Assurance Officer and RINHS no less than once per month. Correspondence will be in the forms of email and telephone correspondence, review meetings, memoranda, and the exchange of key data and documents according to the schedule herein. Assessment-oversight will involve review of all aspects of the project and its progress. Technical advisors, including the VP Team, academic experts, RI DEM scientists, EPA scientists, and other expert stakeholders will be consulted throughout the project. According to the schedule herein, RI DEM and RINHS will respond to input as necessary to ensure the efficient use of project resources in order to meet State reporting requirements and WMAP objectives. The RI DEM Wetland Program Manager has the authority to issue a stop work order if something is not going right and to document corrective actions that need to be taken.

3.2 Reports to Management (EPA QA/R-5 C2)

Brief quarterly memoranda and final reports will be submitted by the RINHS to the DEM Project Manager/Quality Assurance Officer at the following project milestones: (1) the completion of field work and prior to the initiation of data analysis, (2) the completion of data analysis, (3) the draft Report, (4) the Final Report. Memoranda may be appended to or incorporated into the draft and final reports.

4.0 DATA REVIEW AND USABILITY

4.1 Data Review, Verification, and Validation Requirements (EPA QA/R-5 D1)

The validity and utility of data collected in the field is dependent upon the completeness and accuracy of the data collected. Accuracy of the data depends upon the qualifications and training of the field assessors and the care with which the verification process is carried out. Completeness of the data can be verified through the quality assurance procedure described below.

Data will be collected by qualified and trained personnel (Sec. 1.8). Field forms will be checked for completeness by the Wetland Scientist and the Field Assistant when entering the data into the Survey 123 database. The Survey123 data-entry form will be formatted to prompt entry of valid data by using dropdown categories where possible. Completeness and accuracy of the data will again be verified when the Wetland Scientist aggregates and analyzes the data. Inaccurate data will be flagged and removed from analysis. Incomplete-but-accurate data will be used to the extent possible.

4.2 Verification and Validation Methods (EPA QA/R-5 D2)

Vernal Pool field-verification data quality will be verified by the Wetlands Scientist reviewing field data sheets and electronic data. The Wetlands Scientist will review the data for inconsistencies. For example, a pool with a density of amphibians that is not within the typical densities seen at other pools will be

flagged and the paper and electronic data will be investigated. Any inconsistencies found will be corrected in the paper (line through incorrect data and replacement with corrected data) and electronic datasets. Any data outliers or other logical inconsistencies that cannot be corrected through this review process will be removed from the dataset prior to analysis, and this action will be documented in the Project reports.

Protocols for data analysis, development, and implementation methodologies may be adjusted for future applications of vernal pool field verification based on comments from the technical advisors and the project participants. The RI DEM holds ultimate authority in the adjustment of the protocols according to review feedback. Any adjustments to vernal-pool verification methods based on validation analysis outcomes and internal and workgroup feedback will be documented in the Final Project Report.

4.3 Reconciliation with User Requirements (EPA QA/R-5 D3)

RINHS and DEM have previously tested the applicability of the springtime verification methods across a range of conditions in the Wood-Pawcatuck watershed and found them to be useful for assessing mapping accuracy and classifying vernal pools into classes to support conservation and regulation (DEM 2011). Because of the complex nature of freshwater wetland ecology, it is expected that the application of the vernal-pool verification tools described herein, and the interpretation and application of resulting paper and electronic datasets from this Project, will be primarily limited to wetland professionals, policy analysts, and managers (the users). However, it is anticipated and intended that data resulting from a broader, tested vernal-pool mapping and verification effort will be useful for generating maps, reports, graphics, and other outreach materials aimed at secondary and tertiary consumers of this information.

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Appendix A: Technical team to advise vernal pool mapping in Rhode Island

Date: Updated December 9, 2021
From: Tom Kutcher, RINHS Wetlands Scientist
To: Sue Kiernan, DEM OWR; Carol Murphy, RIDEM OWR
Copy: David Gregg, RINHS Executive Director

Team	Affiliation	Contact	Confirmed
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*Managing members

Appendix B

Field Data Sheet Vernal Pool Information

and

Instructions for Filling Out the Field Data Sheet

Pilot Project 2022

FIELD DATA	VERNAL POOL INFORMATION	Site ID:	Date: (mm/dd/yyyy)

REQUIRED **INFORMATION IN SHADED BOXES IS KEY ASSESSMENT DATA** *Please provide as much additional information as time allows*

1. LOCATION OF FEATURE

(Record position in decimal degrees)	**Observers:**	**Contact Info:** *Email: Phone:*
Latitude:		
Longitude:	**Town:**	**Landowner:**

GPS Point at Feature Center ☐ Yes ☐ No

If not at center: Distance to Center ____ Bearing to Center ____

AQUATIC FEATURE PRESENT ☐ YES *(Complete entire form)* ☐ NO *(Complete this part only)**

select one ☐ Undeveloped Upland ☐ Developed Feature ☐ Other: ____

WEATHER CONDITIONS *(select one)*

☐ Rain Light ☐ Rain Intermittent ☐ Rain Heavy ☐ Snow Light ☐ Snow Intermittent ☐ Snow Heavy ☐ Sunny ☐ Partly Sunny ☐ Other: ____ ☐ Cloudy

Days Since Last Rain or Snow Event: *(if known)* ____

2. OBSERVED BIOLOGICAL INDICATORS

REQUIRED

EGG MASSES PRESENT ☐ Yes ☐ No

*Indicate all species observed (check unidentified or other if uncertain)**

	How Many?	Estimated	Counted
☐ Wood Frog		☐	☐
☐ Spotted Salamander		☐	☐
☐ Other:*		☐	☐

FAIRY SHRIMP OBSERVED ☐ Yes ☐ No

AMPHIBIANS OBSERVED ☐ Yes ☐ No

Indicator Species:

	Adult	Juvenile		Adult	Juvenile
Wood Frog	☐	☐	**Marbled Salamander**	☐	☐
Spotted Salamander	☐	☐	**Eastern Spadefoot Toad**	☐	☐

Other Amphibian Species Observed: *(Include audible amphibian calls)*

Spring Peeper	☐	☐	American Toad	☐	☐
Gray Tree-Frog	☐	☐	Fowlers Toad	☐	☐
Green Frog	☐	☐	Four Toed Salamander	☐	☐
American Bullfrog	☐	☐	Red-Spotted Newt	☐	☐
Northern Leopard Frog	☐	☐	*Unidentified Frog/Toad	☐	☐
Pickerel Frog	☐	☐	*Unidentified Salamander	☐	☐

Tadpoles less than 2" long ☐ Yes ☐ No

Other Vernal Pool Species Observed: *(check all that apply)*

☐ Fingernail Clams ☐ Caddisfly Larvae ☐ None Observed ☐ Turtles ☐ Snakes ☐ Other: ____ ☐ Amphibious Snails ☐ Dragonfly nymph ☐ Damselfly nymph ☐ Dragonfly nymph ☐ Damselfly nymph ☐ Whirlagig beetle ☐ Leeches ☐ Predaceous diving beetle

3. FEATURE CHARACTERISTICS

REQUIRED **FEATURE ORIGIN** ☐ **Natural** ☐ **Human-Constructed Naturalized*** ☐ **Human-Constructed NOT Naturalized**

FEATURE TYPE *(select one)*

☐ Forested Wetland Depression ☐ Bog Pool ☐ Quarry ☐ Marsh Pool ☐ Other: ____ ☐ Depression in Upland ☐ Stormwater Ditch ☐ Commercial or Industrial Feature ☐ Lined or Ornamental Pool

HYDROPERIOD INDICATORS

Yes	No	
☐	☐	Fish presence observed
☐	☐	Fish presence known
☐	☐	Permanently flooded vegetation observed**
☐	☐	Directly connected to permanent water body
☐	☐	Permanently flooded hydrology known

☐ **None apply, likely seasonal**

OTHER FEATURE CHARACTERISTICS

Yes	No	
☐	☐	Distinct pool depression?
☐	☐	Part of a larger wetland?
☐	☐	Dominated by mounds or tussocks?
☐	☐	Surface water present?
☐	☐	Surrounded by upland?
☐	☐	Dead trees present in pool depression?
☐	☐	Sphagnum present in pool depression?

*Contains hydrophytic vegetation

**Nuphar variegata , Potamogeton natans

FIELD DATA	VERNAL POOL INFORMATION	Site ID:	Date: (mm/dd/yyyy)

4. POOL CHARACTERISTICS

REQUIRED — **POOL BOTTOM:** ☐ Firm ☐ Mucky

Dominant Substrate *(select one)*: ☐ Peat ☐ Gravel ☐ Bedrock ☐ Mud ☐ Cobbles ☐ Leaf Litter ☐ Sand ☐ Other: _____

WATER LEVEL: ☐ Full ☐ Dry ☐ More than 50% ☐ Less than 50%

WATER QUALITY *(select one)*: ☐ Clear ☐ Tea-Colored ☐ Oily ☐ Algae Green ☐ Other: _____

CANOPY COVER:

Vegetation In Pool:	None	1-10%	10-30%	30-60%	> 60%
Tree Stems	☐	☐	☐	☐	☐
Shrubs	☐	☐	☐	☐	☐
Emergent	☐	☐	☐	☐	☐
Floating	☐	☐	☐	☐	☐

INLET OR OUTLET PRESENT

	Yes	No
Inlet	☐	☐
Outlet	☐	☐

Is Water Flowing?

Inlet	☐	☐
Outlet	☐	☐

POOL DIMENSIONS

		Measure	Estimate
Depth	ft.	☐	☐
Width	ft.	☐	☐
Length	ft.	☐	☐
Perimeter	ft.	☐	☐

5. LANDSCAPE CHARACTERISTICS

REQUIRED — **SURROUNDING HABITAT** *(check all that apply)*

☐ Forested Wetland	☐ Forested Upland	☐ Field/Grassland
☐ **Open Wetland**	☐ Deciduous	☐ Deciduous	☐ **Residential**
☐ Emergent	☐ Coniferous	☐ Coniferous	☐ **Commercial**
☐ Scrub-Shrub	☐ Mixed	☐ Mixed	☐ **Highway/Road**

Distance to Nearest:

		Estimated	Measured
Road	ft.	☐	☐
Building	ft.	☐	☐
Mowed or Landscaped Feature	ft.	☐	☐

Road Type Nearby: *(check all that apply)*: ☐ 4-Lane Paved ☐ 2-Lane Paved ☐ Dirt Road

6. HUMAN ACTIVITY AND STRESSORS

SUPPLEMENTARY — *Check all stressors types/subtypes observed: Indicate proximity to pool where appropriate*

HYDROLOGIC INFLUENCES *(check all that apply)*

- ☐ **Storm Drainage System**
  - ☐ In pool
  - ☐ Near Pool
- ☐ **Partial/Complete Drainage**
  - ☐ Ditching in pool
  - ☐ Ditching near pool
- ☐ **Stream Channelization**
- ☐ **Sedimentation**
  - ☐ Siltation in Pool
  - ☐ Sand/Gravel in Pool
  - ☐ Sand/Gravel near Pool
- ☐ **Filling** ☐ In pool ☐ Near Pool
- ☐ **Impoundment**
  - ☐ Culvert restricted/blocked
  - ☐ Dam (Human-Constructed)
  - ☐ Dam (Beaver-Constructed)
- ☐ **Excavation (removal of soil)**
- ☐ **Riprap** ☐ In pool ☐ Near Pool

☐ **NONE PRESENT** ☐ **Other** _____

PLANT COMMUNITY STRESSORS *(check all that apply)*

- ☐ **Invasives Present**
  - ☐ Phragmites
  - ☐ Purple Loosestrife
  - ☐ _____
- ☐ **Vegetation Removal**

	In Pool	Near Pool		In Pool	Near Pool
Cutting	☐	☐	Grazing	☐	☐
Mowing	☐	☐	Logging	☐	☐
Burning	☐	☐	Stumping	☐	☐

☐ **NONE PRESENT** ☐ **Other** _____

HABITAT STRESSORS *(check all that apply)*

- ☐ **Dumping**
  - ☐ Old Tires
  - ☐ Tree Stumps
  - ☐ Cans/Bottles
  - ☐ Trash
  - ☐ Yard Waste
  - ☐ Demolition Debris
  - ☐ Abandoned Vehicles
  - ☐ Discarded Appliances
  - ☐ _____
- ☐ **Audiovisual Disturbance**

	Visible From Pool		Audible From Pool		
	Yes	No	Yes	No	N/A
Roads	☐	☐	☐	☐	☐
Trails	☐	☐	☐	☐	☐
Railroad	☐	☐	☐	☐	☐
Residence(s)	☐	☐	☐	☐	☐
Commercial or Industrial Feature	☐	☐	☐	☐	☐

☐ **NONE PRESENT** ☐ **Other** _____

Filling Out the Field Data Sheet (2022)

Site ID and **Date** on which the site visit occurred should be filled out on the top of both pages of the data sheet and any supplementary notes pages. Site ID will be provided in advance

⇨ If an unmapped feature is assessed use NEW_ASRI or NEW_BR as the Site ID.

The field data sheet is divided into six sections. Each section is marked either **REQUIRED** (sections 1 through 5) or **SUPPLEMENTARY** (section 6).

⇨ **REQUIRED** sections must be filled out completely.

⇨ **SUPPLEMENTARY** sections should be completed as time allows.

> **IMPORTANT**: Pay extra attention to the fields labeled **KEY ASSESSMENT DATA** (in shaded boxes). Feature status cannot be determined based on any individual field, and the **KEY ASSESSMENT DATA** fields must **ALL** be completed in order to determine whether the feature is a vernal pool.

Section 1: Location of Feature - REQUIRED

- The boxes labeled **Observers, Town, Contact Info** and **Landowner** can be filled out in advance of the arrival at the site. Leave the **Landowner** field blank if unknown.

> **Please make sure to fill out the contact information field so that we can contact you if we need clarification about data recorded.**

- **LOCATION OF FEATURE**: Record the **Latitude** and **Longitude** of the feature in decimal degrees. Ideally the GPS position will be recorded at the center of the feature, but this may not be practical in all circumstances.
  - ⇨ If the **GPS Point** was recorded **at the Center** of the feature, check **YES.**
  - ⇨ If the **GPS Point** was not recorded **at the Center** of the feature, check **NO**, and record the **Distance** and **Bearing** from the GPS point **to the Center** of the feature.
- **AQUATIC FEATURE PRESENT**: The purpose of this section is to confirm that there is a feature to be assessed and if not, to confirm the reason why the assessment was not completed.
  - ⇨ If upon arrival at the site, there is no feature to be assessed, (e.g. the surface has been paved over, a shadow was mistaken for a pool, etc), check **NO AQUATIC FEATURE PRESENT**. Indicate what kind of non-aquatic feature is present by checking **Undeveloped Feature, Developed Feature**, or **Other** (fill-in).

    STOP. There is no need to complete the remainder of the form.
  - ⇨ In most cases, there will be a feature to assess. Check **YES** to **AQUATIC FEATURE PRESENT** and continue to complete the entire form.

- **Weather Conditions**: Choose the box which best describes the current conditions at the time of the site visit. **NOTE: Assessments conducted in rain or snow conditions are discouraged, due to limited visibility of egg masses within the pool.**
  - ⇨ If known, fill in the box to indicate the number of **Days Since the Last Rain or Snow Event**. It is important to note if the site visit is immediately following a precipitation event. Note: This information can also be looked up and added after the field visit.

Section 2: Observed Biological Indicators- REQUIRED

> **KEY ASSESSMENT INFORMATION:** All four shaded boxes in this section (**Egg Masses Observed, Amphibians Observed, Tadpoles less than 2" long**, and **Fairy Shrimp**) MUST be checked **YES** or **NO**.

- **EGG MASSES OBSERVED**: Thoroughly examine the entire feature for amphibian egg masses. Be sure to check in and around any potential attachment sites (dead branches lying in the pool). Make sure to carefully wade in as deep as possible to check for egg masses located away from the pool edge.
  - ⇨ If no egg masses are observed, check **NO** in the **Egg Masses Present** box and continue to the next section.
  - ⇨ **Egg Masses Present**: If any egg masses are present, check the box labeled **Yes** and indicate whether the egg masses observed are **Wood Frog** eggs, **Spotted Salamander** Eggs, or check **Other** and fill in the box to indicate another amphibian species.
  - ⇨ If the species cannot be identified, check **Other** and write "*Unknown*". Please include a picture if possible.
  - ⇨ Record the number of egg masses observed separately for each species in the box labeled **How Many?** Indicate if the number of egg masses recorded is **Estimated** or **Counted**.
- **AMPHIBIANS OBSERVED**: The presence of any adult or juvenile (including tadpoles or salamander larvae) should be recorded. Indicate if any amphibians were observed by checking **YES** or **NO** even if the species cannot be identified.
  - ⇨ If the species can be identified, check the box(es) labeled **Adult** or **Juvenile** next to the corresponding species.
  - ⇨ If uncertain or unable to identify the species, use the boxes for ***Unidentified Frog/Toad*** and ***Unidentified Salamander***.
  - ⇨ NOTE: Audible amphibian calls should be recorded as observations of adult amphibians.
  - ⇨ **Tadpoles less than 2" long**: If there are tadpoles present, note their size and indicate whether any are less than two inches long by checking **YES**. If none are smaller than two inches, check the box labeled **NO**.

- **FAIRY SHRIMP OBSERVED:** Use a dip net (if available) to look for fairy shrimp in the pool. Record the presence of any Fairy Shrimp by checking **YES** or **NO** in the Fairy Shrimp box.
- **OTHER VERNAL POOL SPECIES OBSERVED**: Check the appropriate box(es) for any other vernal pool species observed.
  - ⇨ The species listed are known to utilize vernal pools, however this list is not inclusive. If another species associated with vernal pools is observed, check the box marked **OTHER** and fill in the *Species Name*.
  - ⇨ If the species cannot be identified, check **Other** and write "*Unknown*". Please include a picture if possible.
  - ⇨ If no other species are observed, check the box labeled **None Observed**

Section 3: Feature Characteristics – Required

KEY ASSESSMENT INFORMATION: There are three key assessment fields in this section: **Pool Bottom**, **Canopy Cover** and **Inlet or Outlet Present.**

- **Feature Origin**: Record the origin of the feature being assessed. Most of the features being assessed will be naturally occuring, however some features may have been the result of human actions. Features that were originally the result of human activity may have become naturalized over time (development of hydrophytic vegetation.
  - ⇨ Any feature containing hydrophytic vegetation should be recorded as either **Natural** or **Human-Constructed Naturalized**.
  - ⇨ If the feature does not contain hydrophytic vegetation it should be recorded as **Natural** or **Human-Constructed NOT Naturalized**.
  - ⇨ If uncertain about the origin, check the box labeled **Natural**.
- **Feature Type:** Select the option which best describes the type of feature being assessed. Check one box only.
  - ⇨ Choices for features with a natural origin are: **Bog Pool, Marsh Pool. Forested Wetland Depression** and **Depression in Upland**.
  - ⇨ Choices for features with a human-constructed origin are: **Stormwater Ditch, Lined or Ornamental Pool, Commercial or Industrial Feature,** and **Quarry**.
  - ⇨ If the feature type is not listed, check **Other** and fill in *Feature Type Description*. Please include a picture if possible.
- **HYDROPERIOD INDICATORS:** Carefully read through the list of hydroperiod indicators and select **YES** or **NO** for each one.
  - ⇨ If none of the listed indicators apply, check the box for **None apply, likely seasonal**
- **Other Feature Characteristics**: Carefully read through the list of other feature characteristics and select YES or NO for each one.

Section 4: Pool Characteristics – REQUIRED

> **KEY ASSESSMENT INFORMATION:** There are three key assessment fields in this section: **Pool Bottom**, **Canopy Cover** and **Inlet or Outlet Present.**

- **POOL BOTTOM:** When wading into the pool, pay attention to the substrate beneath your feet. Record whether the bottom is **Firm** or **Mucky** (your feet sink in and movement is challenging).
  - ⇨ Indicate whether the **Dominant Pool Substrate** is **Peat, Mud, Sand, Gravel, Cobbles, Bedrock, Leaf Litter**, or **Other**.
- **Water Level**: Look for evidence of the maximum line of flooding (e.g. staining on tree trunks surrounding the pool) and indicate whether the current water level is **Full**, **More than 50%** full, **Less than 50%** full, or **Dry**.
- **Water Quality:** Check the box that best describes the color and clarity of any surface water in the pool (**Clear, Oily, Tea-Colored, Algae Green** or **Other**).
  - ⇨ If none of the descriptors listed are appropriate, check the box marked **Other** and fill in a description.
  - ⇨ If there is no surface water present, check **Other** and write in "*Dry Pool"*.
- **CANOPY COVER:** Use the cover classes to estimate the percent canopy cover over the pool. If spring leaf-out has not yet occurred, make an estimate based on live tree branches which over hang the pool. Cover classes available are: **None, 1 to 10%, 10 to 30%, 30 to 60%**, and **Greater than 60%**.
  - ⇨ If the canopy appears to cover approximate half the pool area check the **30-60%** box.
- **Vegetation in Pool**: Estimate percent cover of living **Tree Stems, Shrubs, Emergent** and **Floating Vegetation** rooted in the pool if possible according to the given cover classes.
  - ⇨ Shrub cover includes the entire shrub, not just the stem.
- **INLET OR OUTLET PRESENT.** Please indicate whether there is evidence of an **Inlet** to or an **Outlet** from the pool. Early spring is the wettest time of the year so any channel running to or from the pool is likely to have water in it at this time of year if ever. Please check whether either the inlet or outlet currently has **Water Flowing** in it, by checking the box marked yes or no.
- **Pool Dimensions.** If time allows, measurements may be taken for feature Depth, Width, Length and Perimeter. Please indicate whether dimensions entered are measured (such as by tape or pacing) or estimated. When measuring depth, be aware that pools may be very deep in early spring and care should be taken when wading into the pool.

Section 5: Landscape Characteristics – REQUIRED

- **Surrounding Habitat**: Indicate the habitat types surrounding the pool by checking all boxes which apply: Open Wetland, Forested Wetland, Forested Upland, Field/Grassland, Residential, Commercial, and/or Highway/Road. Within 300 feet.

  ⇨ If the type of forested wetland (deciduous, coniferous, or mixed), open wetland (emergent or scrub-shrub), or forested upland (deciduous, coniferous, or mixed) can be identified, please check the appropriate subcategory box(es).

- Distance to Nearest: Where appropriate, estimate or measure the distances to the nearest Road, Building or Mowed or Landscaped Feature. Do not approach any building or lawn for which you do not have access permission.

  ⇨ Complete the checkbox for **Road Type Nearby**: 4-Lane Paved; 2-Lane Paved; or Dirt.

Section 6: Human Activity and Stressors – Supplementary Information

> **IMPORTANT:** Section 6 is considered supplementary information and should be completed as time allows, but is not critical for confirmation of the feature's status.

- **Please check all stressor types and subtypes observed. Be sure to indicate whether the stressor was observed in OR near the pool where appropriate.**

Hydrologic Influences

- **Hydrologic Influences**: If any hydrologic influences or evidence of hydrologic influences in observed check the applicable box(es). Check the applicable boxes indicating the presence of any of the following hydrology influences: Storm Drainage Systems, Partial/Complete Drainage, Stream Channelization, Sedimentation, Filling, Impoundment, Excavation and/or Riprap. Where appropriate, check the descriptive subtypes and information about location of the stressor. If uncertain about subtypes, these boxes can be left blank.

  ⇨ **Storm Drainage Systems, Partial/Complete Ditching, Filling, Sedimentation** and and/or **Rip-Rap**: Record whether the location of the activity by checking the box for **In Pool** and/or **Near Pool**.

  ⇨ **Sedimentation**: Indicate if **Siltation** and/or **Sand/Gravel** deposit are present.

  ⇨ **Impoundment**: Indicate whether there is a **Blocked/Restricted Culvert** and/or a dam (distinguish between a **Human-Constructed Dam** or a **Beaver-Constructed Dam**). present.

- If any other evidence of hydrologic manipulation is observed, check the box labeled **Other** and fill in a *description of the hydrologic influence* observed.

- If hydrologic influences or evidence of manipulation is observed check the box labeled **NONE PRESENT.**

Plant Community Stressors

- **Plant Community Stressors**: The most common plant community stressors are invasive species and removal of vegetation. If either of those are observed in the vicinity of the pool check the appropriate box. If unfamiliar with invasive plant species, do not fill out the section on Invasive species.
- **Invasives Present**: If any invasive plant species are observed, check the box.
  - ⇨ If the species present is **Phragmites** and/or **Purple Loosestrife**, check the corresponding box(es).
  - ⇨ If another species is present, check the third box and fill in the ***Species Name***. If uncertain of the species name, write in *"Unidentified."*
  - ⇨ NOTE: Please include a picture of any invasive species recorded that is not Phragmites or Purple Loosestrife.
- **Vegetation Removal**: If there is evidence that **Vegetation** Removal has occurred recently, check the box.
  - ⇨ Check all applicable additional boxes to record the method and location of the removal activity. While it is unusual for vegetation removal to be occuring within the feature itself, if observed check the box labeled **In Pool**. Otherwise check the box labeled **Near Pool** for the appropriate removal activity (**Cutting, Mowing, Burning, Grazing, Logging**, and/or **Stumping**).
- If any other evidence of hydrologic manipulation is observed, check the box labeled **Other** and fill in a *description of the hydrologic influence* observed.
- If hydrologic influences or evidence of manipulation is observed check the box labeled **NONE PRESENT.**

Habitat Stressors

- Dumping: Record any observations of dumping and check all appropriate boxes to describe the type found near the feature.
  - ⇨ Fill in the box for any other dumping observed and describe the type.
- Audiovisual Disturbances: Indicate if any of the listed developed features can be seen or heard from the pool. This is not a measure of proximity, but considers other variables such as vegetation density as a sound or visual barrier between the pool and the feature.
-
- Check the applicable boxes if other Audiovisual habitat stressors are nearby (**Roads**, **Trails**, **Railroads**, **Residences, and/or Commercial or Industrial Feature**). If these disturbances are close enough to be visible or audible from the pool feature, check the appropriate box.

List of Photos – Optional Information

- If you have taken any photos for documentation, a chronological list must be included.
    - For each photo, indicate the time, location if possible and subject matter. Be as specific/detailed as appropriate.
- Refer to the tip sheet for tips on photographing amphibians.
- Refer to the following information for DEM protocol for photography. Instructions on providing digital copies will be provided along with your site assignments.

Instructions for Photographs (DEM Standard Operating Procedure)

5.1. CAMERA AND FIELD NOTES

5.1.1. Verify that the date and time on the camera is accurate.

5.1.2. Activate the visible date and time option such that the recorded image will be imprinted with the date and time of the photo.

5.1.3. Select appropriate resolution quality. The higher the resolution the fewer the images that can be recorded for a given media.

5.1.4. Descriptive documentation should be recorded in sequentially numbered field notes immediately after the images are collected for specific photograph detail recall.

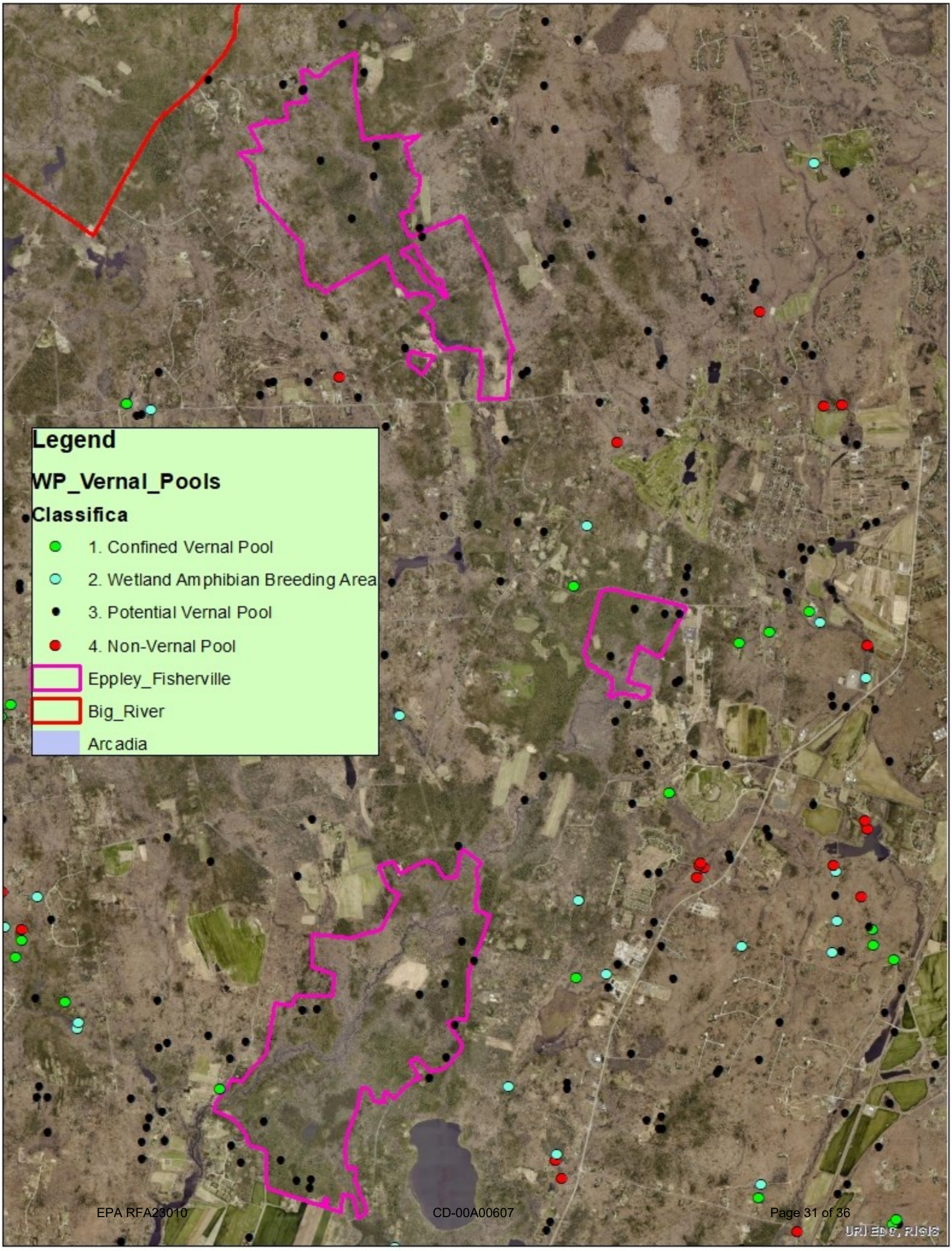
Appendix C. Study Areas 2022

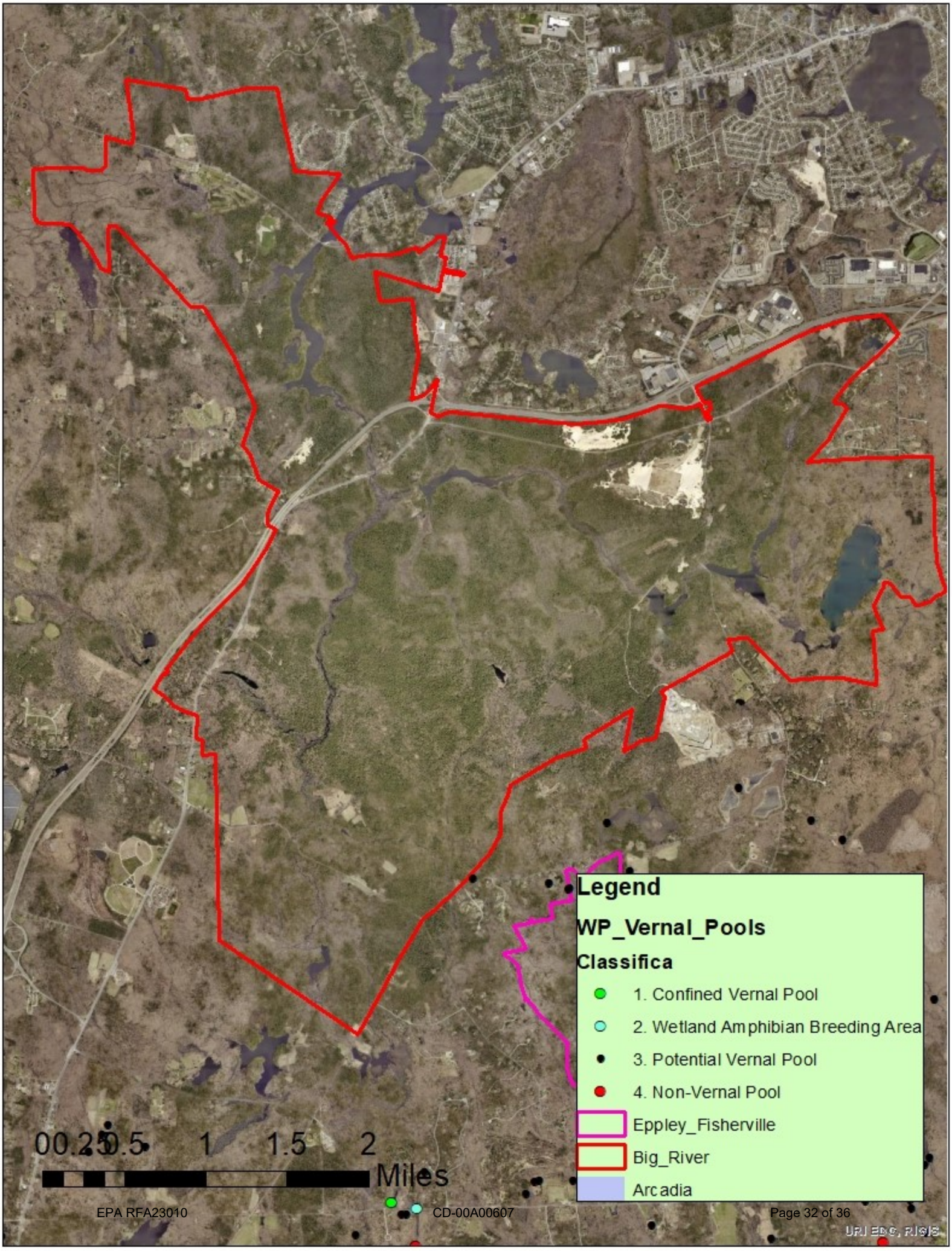
Audubon Society of Rhode Island:

Eppley Wildlife Refuge, Exeter, RI

Fisherville Brook Wildlife Refuge, Exeter, RI

Big River Management Area, Coventry, RI


Legend
WP_Vernal_Pools
Classifica
1. Confined Vernal Pool
2. Wetland Amphibian Breeding Area
3. Potential Vernal Pool
4. Non-Vernal Pool
Eppley_Fisherville
Big_River
Arcadia


Legend
WP_Vernal_Pools
Classifica
1. Confined Vernal Pool
2. Wetland Amphibian Breeding Area
3. Potential Vernal Pool
4. Non-Vernal Pool
Eppley_Fisherville
Big_River
Arcadia
0 0.25 0.5 1 1.5 2
Miles

Appendix D

Dry-Phase Vernal Pool Survey Field Data Sheet

Pilot Project 2022

Dry-phase Vernal Pool Survey Pilot

Investigator_____ Site ID_____ Date_____

Arrival time_____ Departure time_____

1. Location

Latitude (*DD*):	Town:
Longitude (*DD*):	Landowner:

2. Potential vernal pool (PVP) source. Indicate photo-interpreted, mapped, or found in the field.

□ Photo-interpreted Imagery source and date:	Observation date:
□ Mapped Feature Mapping date: Map type: □ Lidar □ Photo-interpretation □ Other:	□ Found in Field Date:

3. Indicators of potential vernal pool presence. Check all observed. *Also DEM hydrologic indicators

- □ Distinct depression (open basin)
- □ Surface water present*
- □ Drainage features*
- □ Grayed or dark leaf litter*
- □ Saturated soils within 12" of surface*
- □ Cracked mud
- □ Changes in soil character*
- □ Water marks on trees, shrubs, rocks*
- □ Draped algae or moss on logs or branches
- □ Drift or wrack lines of waterborne materials*
- □ Sparse or lacking vegetation
- □ Sphagnum moss*
- □ Wetland plants
- □ Buttressed trees*
- □ Woody vegetation on raised hummocks*
- □ Fingernail clams (*Pisidiiae*)
- □ Caddisfly cases (*Trichoptera*)
- □ Amphibious snails (*Basommatophora*)

4. Water conditions and prior rainfall, as of today. If present, indicate surface-water dimensions in *feet*

- □ Dry
- □ Saturated
- □ Surface water present: L_____ W_____ D_____

Flowing inlet……□ Yes □ No
Flowing outlet…….□ Yes □ No

Days since rain_____ Rainfall amount in prior week, check one: □ < .25 *in* □ .25 to 1.0 *in* □ > 1.0 *in*

5. Animal vernal pool indicators. Use a dip net, baited minnow pot (flooded PVPs, all species), or evening eye-shine surveys (Class 1 hydroperiod PVPs only, eastern spadefoot toad)* to document any vernal pool animals observed using the pool or the contiguous 100' jurisdictional area. *Refer to supporting guidance for methods.

Defined indicator species	Life stage or species	Number	Method used*
□ Wood frog	□ Adult □ Metamorph	*n* =	
□ Spotted Salamander	□ Adult □ Metamorph	*n* =	
□ Marbled Salamander	□ Adult □ Metamorph	*n* =	
□ Fairy Shrimp		*n* =	

Other species of interest			
□ Eastern Spadefoot	□ Adult □ Metamorph	*n* =	
□ Fish	Species	*n* =	
□ Other	Species	*n* =	

□ *No vernal-pool fauna detected*

6. Open Basin Depth (OBD). Use a surveyor's level and rod to calculate OBD to the nearest 0.01 *feet*. Use the average height of 4 to 6 edge features (*Acer rubrum* tree stems, outlet bottom etc.) and the greatest basin-depth measurement. *If OBD is not ≥0.98 feet, assess wetland hydrology using the Draft Rapid Wetland Hydrology Worksheet (App. 1).

Edge Height (*ft*)		Deepest Point (*ft*)
1.	4.	1.
2.	5.	2.
3.	6.	3.

Greatest Measured Depth	
Average Edge Height	–
Open Basin Depth (OBD)	=
Is OBD ≥ 0.98 feet?	□ Yes □ No*

7. Plant indicators of hydrology (Mitchell 2005). Check all below plants identified in the lowest 10-foot-diameter zone of the PVP (or lowest or 5-foot-wide vegetated band). Average the indicator-plant coefficients (*IPC*) associated with each plant. *Additionally recommended by Mitchell (2005). **If average *IPC* is not ≥ 1.5, check for wetland hydrology using the Draft Rapid Wetland Hydrology Worksheet (App. 1).

Is there a ≥ 5-*ft*-radius band of vegetation within the PVP basin? □ Yes □ No (skip this section)

	Scientific name	Common name	*IPC*
□	*Athyrium filix-femina*	Lady fern	1
□	*Carex stricta*	Tussock sedge	1
□	*Glyceria acutiflora*	Mannagrass	1
□	*Impatiens capensis*	Jewelweed	1
□	*Juncus effusus*	Soft rush	1
□	*Lycopodium obscurum**	Princess pine	1
□	*Lycopus virginicus*	Water-horehound	1
□	*Osmunda cinnamomea*	Cinnamon fern	1
□	*Spiraea tomentosa**	Hardhack	1
□	*Symplocarpus foetidus*	Skunk cabbage	1
□	*Thelypteris palustris*	Marsh fern	1
□	*Viola lanceolata**	Strap-leaved violet	1
□	*Viola primulifolia**	Primrose-leaved violet	1
□	*Carex bullata*	Button sedge	2
□	*Carex lasiocarpa*	Hairy-fruited sedge	2
□	*Dulichium arundinaceum*	Three-way sedge	2
□	*Eleocharis acicularis**	Least spike rush	2
□	*Galium tinctorium*	Three-lobed bedstraw	2
□	*Glyceria obtusa*	Coastal mannagrass	2
□	*Hypericum boreale*	Marsh St. John's wort	2
□	*Iris versicolor*	Northern blue flag	2
□	*Juncus canadensis*	Marsh rush	2
□	*Lysimachia terrestris*	Swamp candle	2

	Scientific name	Common name	*IPC*
□	*Onoclea sensibilis*	Sensitive fern	2
□	*Osmunda regalis*	Royal fern	2
□	*Proserpinaca palustris*	Common mermaid weed	2
□	*Puccinellia pallida*	Pale mannagrass	2
□	*Rhexia virginica**	Meadow beauty	2
□	*Sagittaria latifolia*	Common arrowhead	2
□	*Scirpus cyperinus*	Woolgrass	2
□	*Sparganium americanum*	Common bur-reed	2
□	*Sphagnum* spp.	Sphagnum moss	2
□	*Spiraea alba**	Meadowsweet	2
□	*Triadenum virginicum*	Northern St. John's wort	2
□	*Typha latifolia*	Broad-leaved cattail	2
□	*Vaccinium macrocarpon**	Big Cranberry	2
□	*Woodwardia virginica**	Virginia chain-fern	2
□	*Carex oligosperma**	Few-seeded hop sedge	3
□	*Decodon verticillatus*	Swamp loosestrife	3
□	*Eleocharis palustris*	Marsh spike rush	3
□	*Glyceria canadensis*	Rattlesnake mannagrass	3
□	*Glyceria septentrionalis*	Eastern mannagrass	3
□	*Nymphaea odorata*	White water lily	3
□	*Utricularia* spp.	Bladderwort	3
□	*Nuphar variegata*	Yellow water lily	4

Average *IPC*:	Is average *IPC* ≥ 1.5? □ Yes □ No**

Notes_____

_____

Appendix 1: Draft Rapid Wetland Hydrology Worksheet

For use at depressions with Category 1 hydroperiod classification. Conduct this survey in the deepest zone of the PVP.

Investigator_____ Site ID_____ Date_____

Location_____ Owner_____ Start time_____ End Time_____

Vegetation: List the three dominant species in each vegetative strata along with their NWPL (USACE) status:

Tree	Indicator Status	Herbs	Indicator Status

Saplings/Shrubs	Indicator Status	Woody Vines	Indicator Status

Soil: SCS Soil Survey Mapping Unit: _____

On Hydric Soils List? ☐ YES ☐ NO

Soil Profile:

Horizon	Depth	Matrix Color	Mottling Description	Depth to Saturation	Depth to Free Water

Other hydrologic indicators (e.g. water marks, drainage patterns, root rhizospheres, etc.; see § 3.21.1 (D) of the Rules):

_____

_____

Landscape position: _____

Altered/atypical situation? (describe): _____

_____

Comments: _____

_____