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March 19, 2020

Rob Hiltbrand
R.R. Hiltbrand Engineers & Surveyors
575 North Main Street
Bristol, Connecticut 06010

Dear Mr. Hiltbrand,

I am writing to report the results of my recent survey of the Burlington Solar One Project Area on you property on Prospect Street in Burlington. I am a consulting field botanist with 30 years of experience conducting surveys for rare plants and plant communities in the Northeast, the bulk of that time working in Connecticut (see attached Curriculum Vitae).

The objectives of my survey were the following.

1) Detection of and mapping of the Critical Habitat listed in the letter dated Jan. 12, 2019, from the Connecticut Dept. of Energy and Environmental Protection - Natural Diversity Data Base (CTDEEP-NDDB) to Mr. Eric Davison:

   Medium Fen

2) An assessment of the potential of existing habitats at the site as habitat for the following State-listed plants listed in the same letter:

Table 1. State-listed plants for which survey is suggested by CTDEEP-NDDB in January 12, 2019 letter.		
Scientific Name	**Common Name**	**State-listing Status**
Carex limosa	Mud Sedge	Threatened
Eriophorum vaginatum var. *spissum*	Hare's tail	Threatened
Scheuchzeria palustris ssp. *americana*	Pod Grass	Endangered
Xyris montana	Northern Yellow-eyed Grass	Threatened

I conducted field survey of the site on February 23 and 24, and March 18, 2020. The routes of my surveys are shown in Attachment 1 to this letter. Conditions were ideal for winter botanical and community survey work, in that there was essentially no snow cover. All of these species are herbaceous, and not reliably detectable in the winter (except sometimes for *Carex limosa* and *Xyris montana*), and therefore my survey was not for the plants themselves but for potential habitat for them. I compiled a plant taxa list of those species I could identify in winter, and it is Attachment 4 to this report.

Results.

Medium Fen.

No Medium Fen habitat exists in or near the Project Area. The Project is in largest part upland forest, and in smaller parts, at the southwest corner open-canopy recently disturbed excavated areas which are currently sparsely vegetated (see Fig. 5). The only wet areas I observed in the Project Area were two shallow pools (see orange bull's eye on Attachment 2 map and Figs. 1 and 2 below). Outside of the Project Area, south of its southeast corner, I observed a area of recently disturbed, sloping, unvegetated, wet sand that was kept saturated on the dates of my field surveys by seepage from the base of a cut (see Fig. 3). None of these wet areas bear any resemblance, in appearance or in terms of vegetation present, to Medium fen habitat. There is a type of Medium Fen that can occur

on wet sand, but the wet sand at this site is so recently disturbed that there has been no opportunity for any vegetation to develop, and I observed no occurrences of fen vegetation anywhere nearby on the property outside of the Project Area.

Figure 1. Southern-most shallow pool in Project Area. Northern-most pool is within ~50 ft to the left.

Figure 2. Northern-most of 2 shallow pools in Project Area. Southern-most pool is within ~50 ft to the right.

Figure 3. Wet unvegetated sand kept saturated by seepage, south of southeast corner of Project Area.

Figure 5. Sparsely vegetated recently cleared and excavated area at the southwest corner of the Project Area.

Figure 4. Sand Barren habitat (outlined in red) at the border of forest and excavation south of southeast corner of the Project Area.

Figure 6. Western of 2 Sand Barrens in small openings in forest, connected by short trail to Sand Barren in Fig. 5. Northern limit of this Barren appears to be about 25 ft south of southern limit of Project Area.

Figure 7. Eastern of 2 Sand Barrens in small openings in forest. This one is on little knoll in small opening in forest. It appears to be about 30 ft south of southern limit of Project Area.

Assessment of Potential Habitat for State-listed Plants.

The 4 State-listed plants for which survey was recommended by CTDEEP-NDDB are all specialists that occur only in Poor and Medium Fens that occur on deep poorly decomposed organic deposits, or, in older, colloquial terminology, "peat bogs". Nothing resembling habitat for these species occurs within the Project Area, nor does it exist on the larger property east and southeast of the Project Area, where I also surveyed, and there appears not to be any such habitat west and southwest of the Project Area, based on my review of aerial photography of that area (I did not field survey that area).

Assessment of other potential State-listed plant habitat at the site.

During the course of this survey, I traversed the entire site and observed a Critical Habitat type called Sand Barren, which appears to be about 25-30 feet outside of, and to the south of, the Project Area. This is only an estimate, which is derived from 1) my plotting of the Sand Barren polygons, using GIS software, over 2016 and 2019 ortho-recitified aerial photographs, using a GPS data from the field and aerial photo interpretation, and 2) my

hand-digitizing, using GIS software[1], of the southern limits of grading and solar panels as shown on the sheet entitled "Grading Plan, Lot 33, Prospect Street, Burlington, Connecticut, October 31, 2019". Transfer of the southern Project Area boundary into my GIS coverage was done using reference points that appear on the "Grading Plan" that were also evident in aerial photos, and by comparing the topographic contour lines on the "Grading Plan" to 2016 Lidar elevation data available from the UCONN-CTDEEP CTECO web site.

In the field, I flagged the boundaries of the two Sand Barren areas using a combination of blue surveyor flagging tied to trees and shrubs and blue wire stake flags (the latter are placed along the southern border of the western area, where there is no woody vegetation). Flags around the western polygon are coded SB-1-1 through -32, and those around the eastern area are coded SB-2-01 through -10.

Sand Barren is potential habitat for several State-listed plants, including State-Special Concern *Crocanthemum propinquum* (Low Frostweed), State -Endangered *Piptatherum pungens* (Slender Mountain Rice-grass), and State-Special Concern (Historic) *Dichanthelium ovale* ssp. *pseudopubescens* (Stiff-leaved Rosette-panicgrass). The first two species are currently known in similar habitat within a few miles of this site, and last species I mention because I observed a dried last-year's remnant that resembles the State-listed plant but could not be identified with confidence in its winter state. If surveys to document presence or absence of these species are required, they should occur during the May 15 - July 15 period.

I observed no other Critical Habitat in the Project Area and no other habitat with a significant potential as a host for State-listed plants. The list of plant taxa that I observed on site is provided as Attachment 4.

Sincerely,

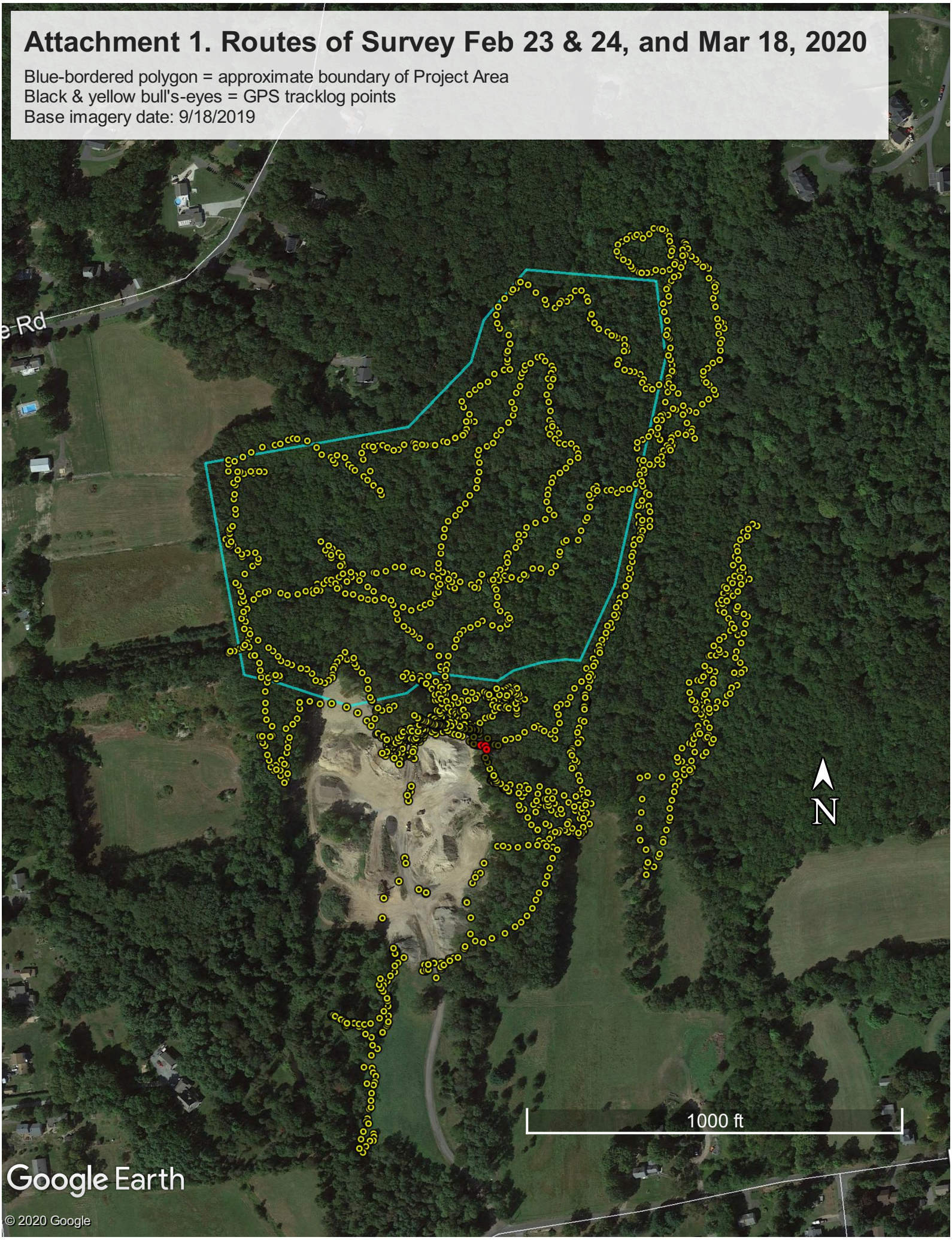
William H. Moorhead III, Consulting Field Botanist

Attachments:

Attachment 1. Routes of Survey Feb 23 & 24, and Mar 18, 2020
Attachment 2. Location of 2 shallow pools in Project Area
Attachment 3. Sand Barrens and Approx. Boundary of Project Area
Attachment 4. Vascular and non-vascular plants observed by Moorhead Feb. 23 & 24, and Mar. 18, 2020, at proposed Burlington Solar One site, in Project area and south and west of Project area.
Attachment 4. Moorhead Curriculum Vitae

Attachment 1. Routes of Survey Feb 23 & 24, and Mar 18, 2020

Blue-bordered polygon = approximate boundary of Project Area
Black & yellow bull's-eyes = GPS tracklog points
Base imagery date: 9/18/2019

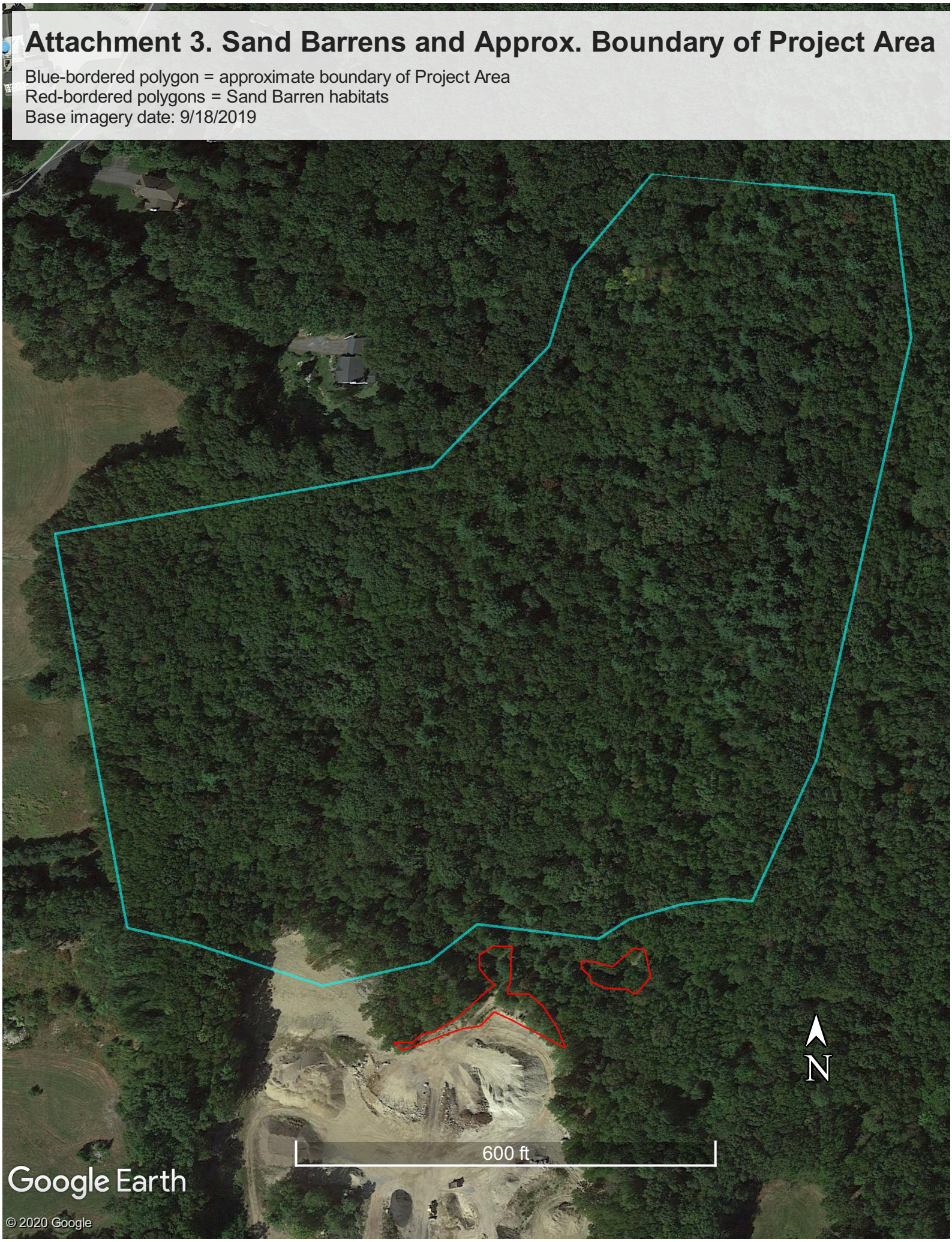


Attachment 2. Location of 2 shallow pools in Project Area

Blue-bordered polygon = approximate boundary of Project Area
Black & orange bull's-eye = location of 2 seasonally flooded pools observed on February site visits
Base imagery date: 9/18/2019

Attachment 3. Sand Barrens and Approx. Boundary of Project Area

Blue-bordered polygon = approximate boundary of Project Area
Red-bordered polygons = Sand Barren habitats
Base imagery date: 9/18/2019



LIFE FORM	Taxon	Common Name	ID confidence	Family	Native vs. non-native in CT[3]	CIPWG Invasive Status[5]	Project area	Project area	Project area	Outside Project area	Outside Project area	Outside Project area	Outside Project area	Outside Project area	Outside Project area	Outside Project area
							Project area upland forest	Sparsely vegetated excavated area that is not Sand Barren	Sand Barren-like recently excavated areas	Former Sand Barren with canopy recently closed	Sand Barren not recently excavated/ cleared	"RN" Wetland	Upland forest W of Project area	Little brook channel and bank W of Project area	Valley bottom wetland W of project area	Main brook channel and bank W of Project area
T	*Acer rubrum* L.	Red Maple		Sapindaceae	native		t					**t**			**t**	
T	*Acer saccharum* Marsh. var. *saccharum*	Sugar Maple		Sapindaceae	native								t			
H	*Anaphalis margaritacea* (L.) Benth. & Hook.f.	Pearly Everlasting		Asteraceae	native				h							
H	*Andropogon virginicus* L. var. *virginicus*	Broom-sedge		Poaceae	native						**h**					
H	*Artemisia vulgaris* L. var. *vulgaris*	Mugwort		Asteraceae	non-native	I			h							
S	*Berberis thunbergii* DC.	Japanese Barberry		Berberidaceae	non-native	I	s,h							s		s,h
T	*Betula alleghaniensis* Britt.	Yellow Birch		Betulaceae	native										t	
T	*Betula lenta* L.	Black Birch		Betulaceae	native								**t**			
T	*Betula papyrifera* Marsh.	Paper Birch			native		t									
T	*Betula populifolia* Marsh.	Gray Birch		Betulaceae	native		t				t					
	Bulbostylis capillaris (L.) Kunthe *ex* C.B. Clarke	a sedge		Cyperaceae	native				h		h					
H	*Cardamine pensylvanica* Muhl. ex Willd.	Pennsylvania Bitter-cress		Brassicaceae	native									h		
H	*Carex albicans* Willd. *ex* Spreng. var. *albicans*	a sedge	sp.?	Cyperaceae	native		h									
H	*Carex albicans* Willd. *ex* Spreng. var. *emmonsii* (Dewey ex Torr.) J. Rettig	a sedge	sp.?	Cyperaceae	native							h				
H	*Carex* L.	unidentified sedge spp.	sp.?	Cyperaceae	native		h					h				
H	*Carex laxiculmis* Schwein. var. *laxiculmis*	a sedge	sp.?	Cyperaceae	native											h
H	*Carex pensylvanica* Lam.	a sedge	sp.?	Cyperaceae	native		h									
H	*Carex tonsa* (Fern.) Bickn.	a sedge	sp.?	Cyperaceae	native						h					
T	*Carya glabra* (P. Mill.) Sweet	Pignut Hickory		Juglandaceae	native		t									
T	*Carya ovata* (P. Mill.) K. Koch	Shagbark Hickory		Juglandaceae	native		t					t				
SS,GV?	*Chimaphila maculata* (L.) Pursh	Spotted Wintergreen		Ericaceae	native		h									
H	*Crocanthemum canadense* (L.) Britt.	Canada Frostweed		Cistaceae	native						h					
H	*Crocanthemum* sp.	unidentified rock-rose		Cistaceae	native						h					
H	*Dendrolycopodium hickeyi* (W.H. Wagner, Beitel, & Moran) A. Haines	Hickey's Tree Clubmoss		Lycopodiaceae	native		**h**									
H	*Dennstaedtia punctilobula* (Michx.) T. Moore	Hay-scented Fern		Dennstaedtiaceae	native		h									
	Dichanthelium (Hitchc. & Chase) Gould	a panic grass	sp.?	Poaceae	native						h					
H	*Digitaria* Haller.	crabgrass		Poaceae	?				h							
H	*Diphasiastrum digitatum* (Dill. ex A. Braun) Holub	Southern Running-pine		Lycopodiaceae	native		h									
T	*Fraxinus americana* L.	White Ash		Oleaceae	native							t,s				
SS,GV	*Gaultheria procumbens* L.	Wintergreen		Ericaceae	native		h									
SS	*Gaylussacia baccata* (Wangenh.) K. Koch	Black Huckleberry		Ericaceae	native		h					h				
H	*Goodyera pubescens* (Willd.) R. Br. in Ait. & Ait. f.	Downy Rattlesnake-plantain		Orchidaceae	native		h									
S	*Hamamelis virginiana* L.	American Witch-hazel		Hamamelidaceae	native		s									
H	*Hypericum gentianoides* (L.) B.S.P.	Orange-grass		Hypericaceae	native				h							
S	*Ilex verticillata* (L.) Gray	Common Winterberry		Aquifoliaceae	native							s				
S	*Juniperus communis* L. var. *depressa* Pursh	Common Juniper		Cupressaceae	native		h				h					
T,S	*Juniperus virginiana* L. var. *virginiana*	Eastern Red Cedar		Cupressaceae	native		t					t				
S	*Kalmia angustifolia* L.	Sheep Laurel		Ericaceae	native		h (loc. dom.)									
S	*Kalmia latifolia* L.	Mountain Laurel		Ericaceae	native		**s,h**				h				**s,h**	**s,h**

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H	*Lechea maritima* Leggett ex B.S.P.	Beach Pinweed		Cistaceae	native				h							
T	*Liriodendron tulipifera* L.	Tuliptree		Magnoliaceae	native								**t**		**t**	
H	*Lycopodium clavatum* L.	Running Clubmoss		Lycopodiaceae	native		h									
SS,GV	*Mitchella repens* L.	Partridge-berry		Rubiaceae	native		h									
H	*Onoclea sensibilis* L.	Sensitive Fern		Onocleaceae	native			h				h				
H	*Osmundastrum cinnamomeum* (L.) C. Presl	Cinnamon Fern		Osmundaceae	native										**h**	h
T	*Picea* A. Dietr.	non-native spruce	sp.?	Pinaceae			t,s					s				
T	*Pinus resinosa* Ait.	Red Pine		Pinaceae	native					t						
T	*Pinus rigida* P. Mill.	Pitch Pine		Pinaceae		native					s					
T	*Pinus strobus* L.	Eastern White Pine		Pinaceae	native		**t**						**t**		s	
H	POACEAE	unidentified grasses		Poaceae	depends on sp. ID			h								
H	*Polystichum acrostichoides* (Michx.) Schott	Christmas Fern		Dryopteridaceae	native		h						h		h	h
T	*Populus grandidentata* Michx.	Bigtooth Aspen		Salicaceae	native		t									
H	*Pteridium aquilinum* (L.) Kuhn	Bracken Fern		Dennstaedtiaceae	native		h									
H	*Pyrola* L.	a shinleaf		Ericaceae	native								h			
T	*Quercus alba* L.	Eastern White Oak		Fabaceae	native		**t**				h	t,s	**t**			
T	*Quercus coccinea* Muenchh.	Scarlet Oak		Fabaceae	native		**t**									
T	*Quercus rubra* L.	Northern Red Oak		Fabaceae	native		**t**						**t**			
T	*Quercus velutina* Lam.	Black Oak		Fabaceae	native		**t**				h					
T,S	*Robinia pseudoacacia* L.	Black Locust		Fabaceae	non-native	I	t									
SS(?),GV	*Rubus hispidus* L.	Swamp Dewberry		Rosaceae	native							h				
H	*Schizachyrium scoparium* (Michx.) Nash var. *scoparium*	Little Bluestem		Poaceae	native					h	**h**					
L	*Smilax glauca* Walt.	Sawbrier		Smilacaceae	native		h									
L	*Smilax rotundifolia* L.	Comon Greenbrier		Smilacaceae	native							**s,h**				
H	*Solidago juncea* Ait.	Early Goldenrod		Asteraceae	native						h					
H	*Solidago rugosa* P. Mill.	Wrinkle-leaved Goldenrod		Asteraceae	native							h				
	Thelypteris palustris Schott var. *pubescens* (Lawson) Fern.	Marsh Fern		Thelypteridaceae	native										**h**	
	Trichostema dichotomum L.	Bastard Pennyroyal		Lamiaceae	native				h							
T	*Tsuga canadensis* (L.) Carr.	Eastern Hemlock		Pinaceae	native		t					t			t	
T	*Ulmus americana* L.	American Elm		Ulmaceae	native							t				
SS	*Vaccinium angustifolium* Ait.	Late Low Blueberry		Ericaceae	native		h(sp. ID?)				**h (sp. ID?)**	s				
S	*Vaccinium corymbosum* L.	Highbush Blueberry		Ericaceae	native		s					s				
SS	*Vaccinium pallidum* Ait.	Early Low Blueberry	sp.?	Ericaceae	native		h(sp. ID?)				**h (sp. ID?)**					
H	*Veronica officinalis* L.	Common Speedwell		Plantaginaceae	non-native								h			
	Non-vascular plants															
M/L	*Cladonia* sp[p].	a fruticose lichen			native					m						
M/L	unidentified lichen									**m**						m
M/L	unidentified non-sphagnous mosses											m		**m**		**m**
M/L	*Climacium*											m				
M/L	*Polytrichum* sp[p].	haircap moss			native					**m**						
M/L	*Thuidium*													**m**		
M/L	*Sphagnum* sp[p].	peat moss			native									m		m

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TABLE NOTES:

[3]"native" and "non-native" means native or non-native to Connecticut, according to Dreyer et al. 2013. Native and naturalized vascular plants of Connecticut checklist. Memoirs of the Connecticut Botanical Society No. 5. 232 pp.

[5](CIPWG = CT Invasive Plant Working Group) I = on current Inavisive Plant List as an Invasive; P = on current Invasive Plant List as "Potentially Invasive"; ED = on current Early Detection List; R = on current Research List

Abreviations:

dom. dominant
ID identification
loc. local or locally
p present in Project Area
p* present at site outside Project Area
sp. species, one
sp.? identification uncertain at species level
spp. species, more than one
sp[p]. species, one or possibly more species
ssp. subspecies
var. variety

Life form codes:
T tree (woody, not a vine, > 5m high at maturity)
S shrub (woody, non a vine, 1-5m high at maturity)
H herbaceous
L liana (high-climbing woody vine)
GV woody trailing vine
SS subshrub, max ht << 1 m, acc. to refs.
SS subshrub, max ht to 1 m, acc. to refs.
SS* subshrub, aerial parasite

Stratum codes (when code is **bold** plant is a dominant generally or dominant somewhere in habitat type; if code is not in bold, plant is present but not among dominants):
t tree layer (woody, > 5m high)
s shrub layer (woody, 1-5m high)
h herb layer (herbaceous any height; woody, < 1m)
m moss/liverwort/lichen

Curriculum Vitae

William H. Moorhead III

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Litchfield, Connecticut 06759
(860) 567-4920
whmoorhead@optonline.net

TECHNICAL EXPERTISE

- Inventory of Rare/Threatened/Endangered plants, natural communities, and Critical Habitats
- Mapping of vegetation, plant/natural communities using both traditional and modern tools and techniques (including various remote sensing coverages and GIS softwares)
- Identification and inventory of urban street trees
- Classification and mapping of vegetation, plant and natural communities, and Critical Habitats in the northeastern U.S.
- Various methods for sampling vegetation (e.g., relevé method) and plant populations, for purposes of description and monitoring over time
- Restoration, management, and monitoring of rare plant populations and plant/natural communities
- Interpretation and ground-truthing aerial photographic imagery and other remote sensing coverages
- Delineation of Tidal Wetlands in Connecticut
- Federal Jurisdictional ("Army Corps") Wetlands delineation
- Sampling, identification, and analysis of freshwater aquatic macro-invertebrate communities for water quality evaluation
- Lecturer and instructor in native and invasive plant identification, rare plant and plant/community inventory, ecology and management, and wetland delineation, at secondary school, college undergraduate, graduate school, and adult professional levels
- Wetland restoration and mitigation planning, implementation, and monitoring
- Review and technical critique of wetlands permit and other environmental applications
- Review of conservation & management plans, technical journal articles, books relating to rare plant conservation, identification and ecology
- Invasive plant control and eradication in rare plant/natural communities and Critical Habitats
- Sampling and an identification of stream macro-invertebrates for water quality assessments

PROFESSIONAL EXPERIENCE

Twenty-nine years conducting rare plant surveys (more than 900 new occurrences of State-listed rare plants documented, 31 State-Historic plants rediscovered, in CT, MA, NY, MD, and VA) and natural community inventories, vegetation sampling, analysis, and classification. Twenty years using ESRI and other GIS software and GPS equipment to map natural communities, vegetation, and rare plant occurrences. Four cumulative years conducting freshwater macro-invertebrate/water quality investigations. Two cumulative years experience conducting Federal Jurisdictional Wetlands delineation. Ca. 2.5 cumulative years experience in

delineation of State of Connecticut jurisdictional tidal wetlands and lands below high tide line, and general regulatory experience.

EMPLOYMENT

1996-present **Self-employed Consulting Field Botanist/Plant Community Ecologist:** rare plant and natural community, Critical Habitat survey and inventory; classification and mapping of ecological communities and Critical Habitats; Federal and State tidal wetland delineation; technical support of environmental permit applications; technical support of oppositions to environmental permit applications.

MAJOR PROJECTS:

- From 1996-2005, contract inventory botanist/ecologist for the Connecticut Natural Diversity Data Base, Connecticut Department of Environmental Protection. Scope of work included:
  - Survey for and documentation of State-listed vascular plants. Highlights of this work: rediscovery of 19 State-Historic taxa; ~390 new populations and unmapped historic sites discovered/rediscovered; first state records for 2 native species; and first state records for several non-native species.
  - Vegetation reconnaissance and collection of relevé data from plant communities of special conservation significance; data used in development of state and national vegetation classifications.
  - Rare plant inventory, classification and digital (GIS) mapping of the vegetation of four CT Natural Area Preserves (NAP), totaling 3,476 acres cumulatively: Canaan Mountain NAP, Kitchel NAP, Pachaug Great Meadows and Mount Misery NAPs, and Matianuck NAP.
  - Assistance with environmental review, periodic reevaluation of state ranks and legal status of species in state, training of interns, coordination with The Nature Conservancy and other NGOs.
- From 2004 to present, instructor of 1- and 2-day workshops on identification of more challenging plant groups, including genus *Carex*, cool- and warm-season grasses, grass-like plants, and willows. Also have regularly taught workshops in distinguishing invasive plants from native look-a-likes in winter and summer.
- From 2017 to present, conducting a total floristic inventory and inventory and mapping of Critical Habitats and rare plants of The Preserve, a 1000-acre natural area in Old Saybrook, CT.
- From 2012 through 2015, conducted an inventory and mapping of Critical Habitats and rare plants of the 41 in-fee parcels (2500± ac, cumulatively) of the Steep Rock Association preserve system, in Washington, CT.
- In 2012 and 2013, as subcontractor to Fitzgerald Halliday, Inc., conducted inventory of rare plants and critical habitats at the 680-ac Sikorsky Memorial Airport in Stratford, CT. Occurrences of 4 State-listed plants documented, 3 of these previously unknown at the airport. Also delineated state Tidal Wetlands in a portion of the study area.
- Contract botanical survey for MA NHESP in June, 2010, to relocate/update status of not-recently-observed State-listed plant populations in Berkshire County, in support of BIOMAPS 2 critical habitat mapping project. Twenty-seven State-listed plant occurrences documented.
- Contract botanical survey for MA NHESP in 2009, for globally rare sedge *Eleocharis diandra*, along Connecticut River in MA. Eight *Eleocharis diandra* occurrences documented and *Eleocharis ovata* documented for the first time (3 occurrences) on the CT River. Twenty-one populations of other State-listed plants documented. New occurrences of State-listed plants totaling ~2 1.

- Contract botanical survey for MA NHESP, 2008-2009, surveying for State-listed plants within 500-m-radius of Housatonic River from Pittsfield to Sheffield, MA. Approx. 138 new State-listed plant populations documented, including rediscovery of 1 State-Historic species and 1 Berkshire County-Historic species, 19 previously known populations relocated & updated.
- Principal Investigator in 2006-2009 research project, funded by the Long Island Sound License Plate Fund, describing and mapping the complex mosaic of plant communities in a 330-acre brackish tidal wetland system on the lower Connecticut River, involving collection and analysis of 950 stratified random floristic plots.
- From 2004 to 2006, research and preparation of the Eightmile River Watershed Biodiversity Report, commissioned by the National Park Service and the Eightmile River Wild & Scenic Study Committee, summarizing existing information on plant, animal, and natural community diversity in the watershed.
- Co-investigator in 2005-2007 rare plant and natural community survey for private landowner of 600+ ac in Alford and West Stockbridge, MA; 5 new State-listed and 3 Watch-list species documented.
- In 2005, as subcontractor to The Maguire Group (consultant to CONN-DOT), classified and described vegetation and natural communities, and performed avian point counts along 15 avian survey transects (14 cumulative miles) in the proposed Rte. 11 corridor in Salem, East Lyme, Montville, and Waterford, CT; ancillary to main tasks, new occurrences of 1 Federally-Threatened and 4 State-listed plants were documented.
- Co-investigator in 2004 survey to rediscover a State-historic plant in Greenfield, Massachusetts, funded by a Massachusetts Natural Heritage and Endangered Species Program's Small Research Grant; occurrences of 5 State-listed and 4 Watch-list species documented.
- In 2003 and 2004, botanical consultant to Northwest Conservation District and King's Mark Environmental Review Team, in review of large proposed golf course-subdivision project in Norfolk, CT; 5 new State-rare species occurrences documented.
- Survey, 2003-2006, of the 62-mi^2 Eightmile River watershed in Middlesex and New London Counties, CT, for rare plants and significant natural communities, commissioned by the National Park Service and the Eightmile River Wild & Scenic Study Committee; 35 new rare species occurrences (more than doubling number of know extant occurrences) and 101 priority natural community occurrences were documented; results delivered as digital GIS product.
- Farmington River Watershed Association's 2002 Farmington River Biodiversity Project: 7-month inventory of rare plants and priority natural communities in 7-town (214 mi^2) study area in the lower Farmington River watershed; approx. 100 new rare species populations documented, tripling number of known extant occurrences, and 160 priority natural community occurrences documented.
- Inventory, 2000-2007, of nine parcels in western Connecticut ranging from 60 to 400 acres, in technical support of applications for State Open Space Acquisition Grants by local and national land preservation groups, including Trust For Public Land, Roxbury Land Trust, Sharon Land Trust, Cornwall Land Trust, and Southbury Land Trust. Eighteen new occurrences of State-listed plants documented.

5/2011-2012 **Botanical Data Specialist: employed full-time by New England Wildflower Society (NEWFS), Framingham, MA.** Researched and assembled plant character data for input into the data base that

supports the random access plant identification key at NEWFS' "Go Botany" web site. Also conducted quality control of data entered by other less experienced data specialists.

2008-2009 **GIS Mapper of "Critical Habitats": part-time employee of University of Connecticut Dept. of Ecology & Evolutionary Biology**, I created a digital GIS coverage of several types of "Critical Habitats", which are natural communities identified in Metzler & Wagner's 1998 document "Thirteen of Connecticut's Most Imperiled Ecosystems". I used a synthesis of interpretation of remote sensing imagery, Connecticut Natural Diversity Data Base data, and data from past and current field surveys of my own and others. I was responsible for creating or editing more than 2000 Critical Habitat polygons and populating associated attribute data base, which are now part of the "Critical Habitats" GIS coverage available at the CTDEEP and CT ECO websites.

2005-present **Botanist: Casual employee of Parsons Transportation Group.** Types of work have included survey for and documentation of rare plants, classification and mapping of natural communities, vegetation component of Federal Jurisdictional Wetland delineation, and sampling of vegetation monitoring plots in mitigation wetlands, inventories of urban street trees. Geographic areas in which I have worked: CT, MA, MD, NYC boroughs, and VA. Major projects:

- In 2015, member of teams delineating Federal Jurisdictional Wetlands delineations along route of proposed AMTRAK high-speed rail service between Richmond and Washington, DC. My responsibilities included vegetation sampling, assessment of habitat potential for Federally-listed plants, rare plant documentation, and stream habitat quality assessments.
- In 2015, conducted inventory of 1,100± street trees in a 50-square-block area of Long Island City (a part of Queens), NY. I was responsible for identifying, measuring, mapping, and assessing the condition of each tree (also conducted similar but smaller scale street tree inventories in Brooklyn, Queens, and The Bronx in 2012 and 2013).
- In 2010 and 2011, in Maryland, part of team delineating Federal Jurisdictional Wetlands along existing AMTRAK rail line between BWI Airport and downtown Baltimore. Also assisted Straughan Environmental staff in conducting survey for and documentation of rare plants.
- From 2010 to 2014, collected yearly total floristic data from vegetation monitoring plots in three CT DOT mitigation wetlands in Bristol and Wilton, CT.
- In 2007, conducted survey in Richmondtown, Staten Island, NY, for State-listed rare E/T/SC plants and rare/uncommon natural communities, in support of NY-DOT roadway improvement project.
- In 2006, conducted an inventory of State-listed endangered plants and significant natural communities, and classified and mapped vegetation of 500-ac Groton-New London Airport; 9 new State-listed species documented on property (follow-up re-survey and monitoring of mitigation conducted in 2013 and 2014).

1994-1996 **Ecologist: Virginia's Natural Heritage Program (VA Department of Conservation and Recreation, Division of Natural Heritage)**:
Key responsibilities:

- Together with the Division's other two ecologists, development of vegetation classifications of study areas in Virginia's mountain provinces and in the southeastern coastal plain, via the collection and analysis of relevé data using the Braun-Blanquet tabular comparison approach. Project leader responsibility for:
  - an intensive vegetation survey of a 9,900-ac study area in the George Washington National Forest in the Ridge and Valley Province. Tasks included collection and analysis of 50+

relevés, classification and mapping of the vegetation at the Land Type Phase level, and production of accompanying report for U.S.D.A. Forest Service contract
    - Nature Conservancy contract calling for collection/assemblage of relevés from Virginia's pitch pine-scrub oak woodland and related vegetation. Tasks included collection of new relevés, a Braun-Blanquet analysis and classification of these and existing relevés, and production of a report.
- Analysis of relevé data and other community data to advance Virginia state vegetation classification.
- Inventory for and collection of relevés and other documentation from Virginia's globally rare, state-rare, and exemplary natural communities, both in fulfillment of contracts with the Jefferson National Forest, Dept. of Defense, and NASA, and *de novo* inventory.
- Technical assistance, including advice and collection of relevé data, to natural area preserve stewardship section in development of resource management plans
- Technical assistance, including project review, to the environmental review section.

6-12/1993 **Independent Consulting Field Ecologist, doing business as Western Highlands Consulting, Woodbury, Connecticut.**
Key Projects:

- Contract work for CT-DEP-Natural Diversity Data Base: performing field surveys to locate and characterize occurrences of RTE plant species; collecting relevé data from Atlantic White Cedar swamp and calcareous fens for use in development of state and national vegetation classifications
- Sampling and identification of stream macro-invertebrates, using RBP III and other protocols, as subcontractor to several environmental consulting firms.
- Survey, characterization, and mapping of vegetation and habitats for several clients in support of land use permit applications, *e.g.* wetlands permit applications, Superfund clean-up plans.

1/1991-6/1993 **Environmental Analyst (Biological): Office of Long Island Sound Programs (OLISP), Connecticut Department of Environmental Protection.**
Key responsibilities:

- Investigation of violations of State Tidal Wetlands Act and Structures, Dredging, and Fill Statutes, using botanical/ecological expertise and aerial photo interpretive skills to determine jurisdictional boundaries, identify violations, determine degree of environmental harm and make recommendations to the Commissioner for appropriate site remediation requirements
- Negotiation of consent orders with violators of Tidal Wetlands and Structures & Dredging Acts
- Provided testimony at enforcement hearings and trials
- Documentation of State-listed species occurrences
- Technical assistance within my areas of expertise to OLISP Permitting and Coastal Programs sub-offices, other DEP bureaus and State agencies, municipalities, and private entities
- Coordination of the Long Island Sound Clean Water Account Research Fund
- Review and evaluation of site remediation and restoration plans
- Review and processing of applications for Structures & Dredging and Tidal Wetlands permits.

1983-1990 **Consulting Field Biologist/Ecologist, Stereo-photogrammetrist, and Seller of Maps, doing business as Western Highlands Consulting, Woodbury, Connecticut.** Field biology/ecology component less than ½ time until about 12/87, full-time thereafter. Representative projects. It was in this period

that I received from Dr. Karl Tolonen most of my initial training in field botany and ecology, and stream bio-monitoring techniques. Key projects and experience:

- Survey and mapping of occurrences of RTE plant species and critical habitats in and near the proposed right-of-way for the Iroquois Gas Transmission System Ltd. 24" natural gas pipeline: surveyed the entire CT portion and part of the NY portion, a total of approximately 700 acres and 55 linear miles. Also provided botanical support for the delineation of Federal Jurisdictional Wetlands. 3/90-6/91.
- Sampling, identification, and analysis of freshwater aquatic macro-invertebrate communities, using RBP III and other protocols, as subcontractor to The Ecological Consulting Services (EcoS, Dr. Karl Tolonen, principal).
- Performed multi-season bird and wildlife inventories, vegetation inventories and habitat/plant community maps, water quality assessments of streams, ponds, and lakes, delineation of Federal Jurisdictional Wetlands, delineation of watercourses, and site design evaluations, working as subcontractor to EcoS on a number of residential and commercial development projects seeking permits in Colchester, Fairfield, Marlborough, Glastonbury, Westport, West Hartford, East Lyme, Stamford, Cromwell, and Rocky Hill, Connecticut. 9/85-3/90.
- Produced an evaluation of construction-related sedimentation impacts and a wetland restoration plan for a 5-acre inland wetland on the site of the Mall at Buckland Hills, Manchester, CT, 8/89-8/90. Client: Fuss & O'Neill, Inc., Manchester, CT.
- Performed a biological/ecological inventory of a large seasonal pond, provided site design recommendations, and testified before the Glastonbury Conservation Commission on behalf of The Balf Co., Newington, CT, in support of their application for a town mining/excavation permit, 4/89-2/90. Client: Fuss & O'Neill, Inc.
- Planning and installation of a number of interpretive nature trails on Girl Scouts of America properties, 4/84-5/90.
- Provided technical support to a citizen's group opposing a proposed 19-lot subdivision in Brooklyn, CT, in the form of application review and testimony before the local zoning commission on biological issues, 11/89.

1984-1986 **Lab & Field Technician: Internship with CT Dept. of Environmental Protection (CTDEP), Water Compliance Unit.** I conducted a variety of data collection and data processing tasks in support of CTDEP's monitoring of physical, chemical, and biotic water quality parameters of streams and lakes in the state. Working under the supervision of and with training by former CTDEP chief macro-invertebrate taxonomist Guy Hoffman, I identified stream macro-invertebrate Surber samples. I entered and ran computer analyses on macro-invertebrate sample data. Collected stream and lake water samples for chemical and physical analyses, and measured chemical and physical parameters in the field with various types of equipment. Performed multiple data collection and analysis tasks during 24-hour stream modelling dye studies. Collected and prepared for chemical analysis fish and shellfish.

SPECIAL PROJECTS

Partner in research funded in part by The Nature Conservancy into changes in vegetation due to beaver activity at Beckley Bog, Norfolk, CT, 5/87-7/90.

From 2005 to present, in cooperation with Farmington river Watershed Association and the Town of Avon, CT, principal investigator and technical advisor in longitudinal experiment in non-chemical control of Japanese

Barberry (*Berberis thunbergii*), using volunteer labor, and restoration of native understory vegetation in a high floodplain forest ecosystem at Fisher Meadows Recreation Area, Avon, CT.

From 1993 to present, volunteer collection of seeds from rare plant populations for testing and banking by the New England Wildflower Society's conservation program.

From 2000 to 2017, participant in 9 Bioblitzes in Connecticut, Rhode Island, and Massachusetts as member of botanical inventory teams.

EDUCATION

1986 **B.S. Chemistry with concentration in Biology**, Charter Oak College, based on course work completed at Middlesex Community College, University of Connecticut, and Central Connecticut State University.

1983 **A.S. Environmental Science**, Middlesex Community College.

***Post-graduate course work*:**

2018 **Soil Fertility –** 3 credits, graduate level, UMASS CPE program. Instructor: Dr. Allen Barker.

2017 **Hydric Soils and Advanced Hydric Soils** – 2 credits, graduate level, UMASS CPE program. Instructor: Mickey Spokas.

2017 **Soil Microbiology** – 3 credits, graduate level, UMASS CPE program. Instructor: Dr. Stephen Simkins.

2016 **Soil Morphology and Mapping** – 3 credits, graduate level, UMASS CPE program. Instructor: Peter c. Fletcher.

2005 ***Isoetes* Identification –** 1.5-day identification and ecology workshop, Delta Institute of Natural History, Bowdoin, ME. Instructor: Carl Lewis.

2005 ***Dryopteris* and its Hybrids** – 1.5-day identification workshop, Delta Institute of Natural History, Bowdoin, ME. Instructor: James D. Montgomery.

2002 **Dragonflies and Damselflies of Southern New England** – 1-day workshop, Center for Conservation & Biodiversity, University of Connecticut. Instructors: Dave Wagner, Mike Thomas.

1996 ***Carex* section Ovales Identification Workshop** – 2-day identification and ecology workshop, University of Connecticut and Connecticut Museum of Natural History. Instructor: Dr. Anton Reznicek.

1996 ***Sphagnum* Identification Workshop** – 2-day identification and ecology workshop, University of Connecticut and Connecticut Museum of Natural History. Instructor: Dr. Anton Damman.

1995 **Prescribed Burn Crew Training Workshop** – 2 day workshop, certificate, Virginia Dept. of Conservation and Recreation, Division of Natural Heritage.

1993 **Field Methods in Ecology** (EEB 452) - graduate level, 2 credits, University of Connecticut. Instructor: Dr. Anton Damman.

1993 **Soils** (PLSC 250) - undergraduate level, 3 credits, University of Connecticut. Instructor: Harvey Luce.

1992 **Sedge Identification and Ecology** – 1-week identification and ecology workshop, certificate, Eagle Hill Wildlife Research Station, Steuben, ME. Instructor: Dr. Anton Reznicek.

1991 **Wetland Evaluation Technique (W.E.T. III)** – 32-hour training seminar, certificate, National Highway Institute, Federal Highway Administration.

1989 **Delineation of Federal Jurisdictional Wetlands** – 5-day training seminar, certificate, The National Wetland Science Training Cooperative.

1987 **Geomorphology** - graduate level, 3 credits, University of New Haven.

MAJOR PRESENTATIONS

2017 **"A Longitudinal Experiment in Volunteer-Powered Restoration of a *Berberis thunbergii*-Infested Floodplain Forest"** – An updated 20-minute illustrated talk presented at the Long Island Invasive Species Management Area's June 2017 Invasive Species Conference, Brentwood, NY.

2016 **"A Longitudinal Experiment in Volunteer-Powered Restoration of a *Berberis thunbergii*-Infested Floodplain Forest"** – A 20-minute illustrated talk presented at the CT Invasive Plant Working Group's Oct 2016 Invasive Plant Symposion, Storrs, CT.

1995 **"Old Growth Forests of Peters Mountain, Alleghany County, Virginia."** A 20-minute illustrated talk presented at the 73rd Annual Meeting of the Virginia Academy of Science, May 23-26, 1995, VA Military Institute, Lexington, VA.

REPRESENTATIVE TECHNICAL REPORTS

Moorhead, W.H. III. 2017. A Survey of Rare and Uncommon Plants Occurring on Steep Rock Association In-fee Preserves, with an Updated Inventory of Critical Habitats and other Significant Communities. Prepared for the Steep Rock Association, Washington, CT; 57 pp. plus appendices, including digital GIS products.

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Moorhead, W.H. III. 2015. An Inventory of Critical Habitats, Other Significant Natural Communities and Vegetation Types in Steep Rock Association In-Fee Preserves. Prepared for the Steep Rock Association, Washington, CT; 59 pp. plus appendices, including digital GIS products.

Moorhead, W.H. III. 2010. A Survey for Rare Plants at Aton Forest: Results of Moorhead Field Surveys 2005-2010. 31 pp. plus appendices, including digital GIS products.

Moorhead, W.H. III, C. Chadwick, S. Prisloe, J. Barrett, and N.E. Barrett. 2009. The Vegetation Mosaic of Ragged Rock Creek Tidal Marsh, Connecticut River, Old Saybrook, Connecticut. A final report to Department of Environmental Protection, State of Connecticut. A Long Island Sound License Plate Research Fund project. 39 pp. plus appendices, including digital GIS products.

Moorhead, W.H. III. 2006. Eightmile River Watershed Biodiversity Report. Prepared for the Eightmile River Wild and Scenic Study Committee. 138 pp. plus digital GIS product.

Moorhead, W.H. III. 2005. Pachaug Great Meadow Natural Area Preserve and Mount Misery Brook – Rhododendron Sanctuary Natural Area Preserve, Voluntown, New London County, Connecticut: A Survey of Rare Vascular Plant Species and Provisional Classification and Mapping of Vegetation and Natural Communities. 69 pp. plus appendices, including digital GIS products.

Moorhead, W.H. III. 2004. Final Summary Report of Eightmile River Watershed Rare Plant and Community Survey, 19 Jun – 27 Oct 2003. 19 pp. plus appendices, including digital GIS products.

Moorhead, W.H. III. 2004. Matianuck Sand Dunes Natural Area Preserve, Windsor, Hartford County, Connecticut: Provisional Classification and Mapping of Vegetation and Natural Communities. 23 pp. plus appendices, including digital GIS products.

Moorhead, W.H. III. 2003. Farmington River Watershed Association 2002 Biodiversity Project. Rare Plant and Natural Community Inventory. Summary Report. 22 pp. plus

Moorhead, W.H. III. 2001. Kitchel Natural Area Preserve, Litchfield County, Connecticut. A survey of rare vascular plant species and significant natural communities and provisional classification and mapping of vegetation and natural communities. 69 pp. plus appendices.

Moorhead, W.H. III. 2000. Canaan Mountain Natural Area Preserve, Litchfield County, Connecticut: a survey of rare vascular plant species and significant natural communities, and provisional mapping of vegetation and natural communities. Unpublished report submitted to the Connecticut Natural Diversity Data Base, Connecticut Dept. of Environmental Protection. 128 pp. plus appendices.

Fleming, G.P. and W.H. Moorhead III. 1998. Comparative wetlands ecology study of the Great Dismal Swamp, Northwest River, and North Landing River in Virginia. Natural Heritage Tech. Rep. 98-9, VA Dept. of Conservation and Recreation, Div. of Natural Heritage, Richmond. Unpublished report submitted to the U.S. EPA.
181 pp. plus appendices

Fleming, G.P. and W.H. Moorhead III. 2000. Plant communities and ecological land units of the Peters Mountain area, James River Ranger District, George Washington and Jefferson National Forests, Virginia. Natural Heritage Tech. Rep. 00-07, VA Dept. of VA Dept. of Conservation and Recreation, Div. of Natural Heritage, Richmond. Unpublished report submitted to the USDA Forest Service. 195 pp. plus appendices

Fleming, G.P. and W.H. Moorhead III. 1996. Ecological land units of the Laurel Fork area, Highland County, Virginia. Natural Heritage Tech. Rep. 96-08, VA Dept. of VA Dept. of Conservation and Recreation, Div. of Natural Heritage, Richmond. Unpublished report submitted to the USDA Forest Service. 114 pp. plus appendices

Belden, A. Jr. and W.H. Moorhead III. 1996. A Natural Heritage Inventory of the Clinch Ranger District III, George Washington and Jefferson National Forests, Virginia. Natural Heritage Tech. Rep. 96-10, VA Dept. of VA Dept. of Conservation and Recreation, Div. of Natural Heritage, Richmond. Unpublished report submitted to the USDA Forest Service. 106 pp. plus appendix.

Ludwig, J.C., W.H. Moorhead, and A. Belden. 1995. A Natural Heritage Inventory of the Clinch Ranger District II, George Washington and Jefferson National Forests. Natural Heritage Tech. Report 95-3. Virginia Dept. of Conservation and Recreation, Division of Natural Heritage. Unpuplished report submitted to the USDA Forest Service. 66 pp. plus appendices.

Hobson, C.S., D.J. Stevenson, and W.H. Moorhead. 1995. A Natural Heritage Inventory of the Polecat Creek Watershed, Caroline County, Virginia and Preliminary Results of a Mark-Recapture Study of *Elliptio complanata*. Natural Heritage Tech. Report 95-12. Virginia Dept. of Conservation and Recreation, Division of Natural Heritage. Unpuplished report submitted to the Chesapeake Bay Local Assistance Department. 60 pp. plus appendices.

REFEREED PUBLICATIONS

Moorhead W.H. III, B.A. Connolly, C.R. Mangels, and N.E. Barrett. 2017. Big Leaf Magnolia: A New Addition to the Flora of New England. Rhodora: Vol. 119, No. 980, pp. 349-354.

Moorhead, W. H. III and E. J. Farnsworth. 2004. *Floerkea proserpinacoides* Willd. (False mermaid-weed) Conservation and Research Plan for New England. New England Wild Flower Society, Framingham, Massachusetts, USA. 76 pp.

Van Alstine, N.E., W.H. Moorhead III, Allen Belden, Jr., T.J. Rawinski, and J.C. Ludwig. 1996. Recently discovered populations of small whorled pogonia (*Isotria medeoloides*) in Virginia. Banisteria 7:3-10.

AFFILIATIONS

CTDEEP Endangered Species Advisory Committee for Plants, 2017 – present (committee member)
New England Plant Conservation Program (NEPCoP), CT Task Force, 1996 – present (member)
Flora Novae Angliae Advisory Committee, 2005 – 2011(committee member)
Flora Conservanda Update Committee, 2008 – 2012(committee member)
New England Botanical Club, 1999 – present (member).
Connecticut Botanical Society, 1990 – present (member)
North American Benthological Society, 1989 – 1993 (member).
Connecticut Invasive Plant Working Group, 2015 – present (steering committee member)
Early Detection and Distribution Mapping System (EDDMapS), 2017 – present (Lead verifier of invasive plant reports in CT)
Connecticut Association of Wetland Scientists (CAWS), 2015-present (associate member)

References and samples of previous work furnished upon request