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ENVIRONMENTAL REPORT -

TERRESTRIAL ECOLOGY

FOR A

PROPOSED 37.5MW BIOMASS FACILITY
(Facility Siting)

Prepared for:

PLAINFIELD RENEWABLE ENERGY, LLC

AUGUST 2006

Prepared by:

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ENVIRONMENTAL REPORT -
TERRESTRIAL ECOLOGY

FOR A

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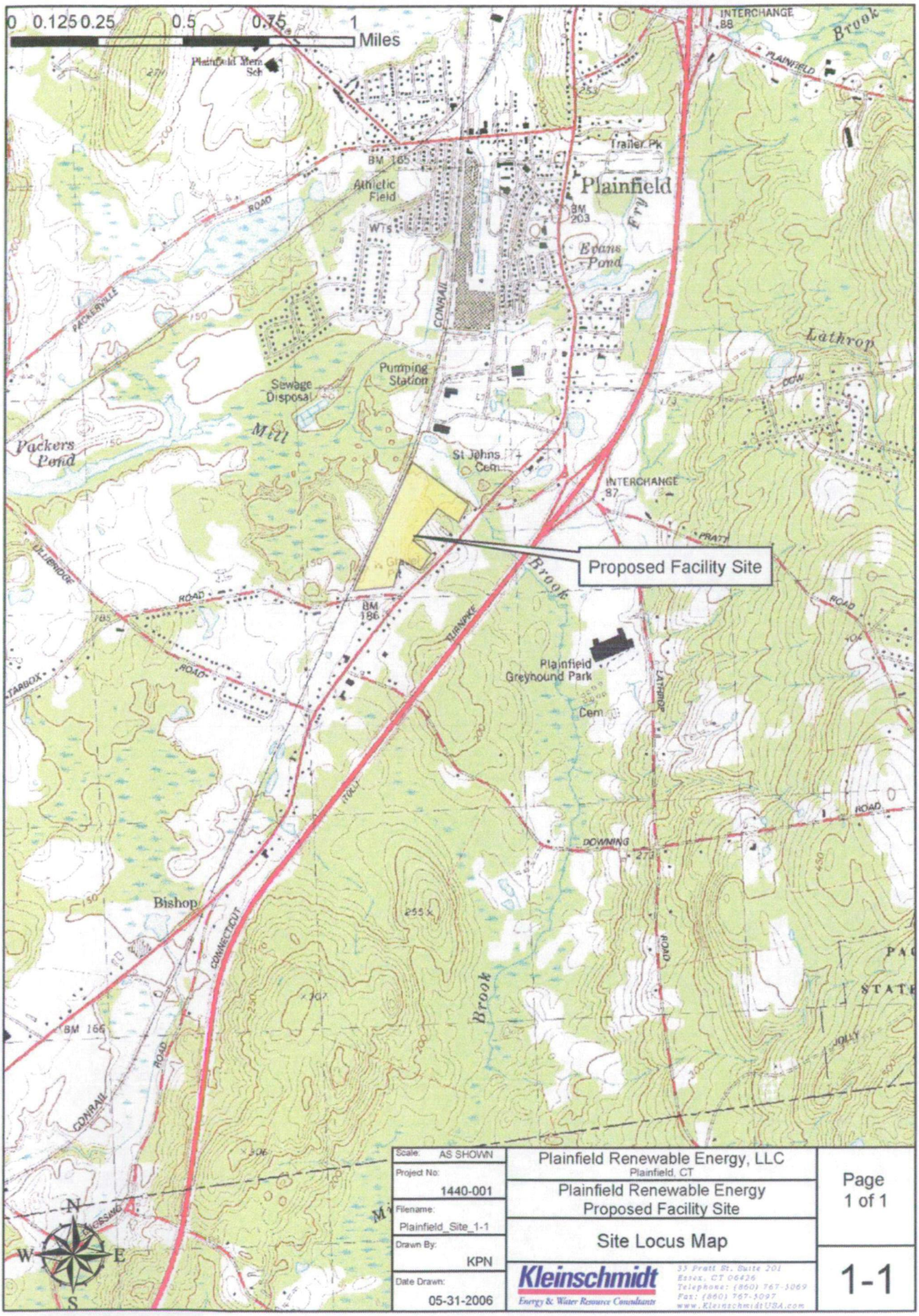
1.0 INTRODUCTION

This terrestrial ecology section is being submitted as part of the filing requirements associated with a Siting Council Petition application including Topic IV "*There is no Substantial Environmental Effect*". The objectives of the terrestrial ecology section are to (1) characterize the nature of plant communities and wildlife species present on the site (terrestrial ecology); and (2) describe the nature of the impacts to flora and fauna associated with the construction and operation of the new 37.5 megawatt (MW) Biomass facility.

1.1 General Overview

As proposed, Plainfield Renewable Energy, LLC proposes to construct a 37.5MW Biomass Facility with attendant structures on a 27–acre parcel of land located in Plainfield, Connecticut (site). The facility will be fueled solely by wood (biomass) and will utilize fluidized bed gasification technology.

The site is located one mile southwest of Plainfield Center and approximately 1,800 feet southeast of the Plainfield sewage treatment plant, which is situated at the confluence of Mill Brook and Frye Brook (Figure 1-1). Immediately to the north of the site, on the opposite side of Mill Brook, is an industrial park that includes the Intermark Fabric Corporation and the Safety Kleen Corporation. The site is bounded by a transmission line easement, Mill Brook, and associated floodplain wetlands to the north; single family residences and Route 12 to the east; an active Providence and Worcester railroad line and a severely degraded *Chamaecyparis thyoides* (Atlantic white cedar) swamp to the west; and single family residences to the south.



Scale: AS SHOWN	Plainfield Renewable Energy, LLC Plainfield, CT	Page 1 of 1
Project No: 1440-001	Plainfield Renewable Energy Proposed Facility Site	
Filename: Plainfield_Site_1-1	Site Locus Map	
Drawn By: KPN	Kleinschmidt Energy & Water Resource Consultants	1-1
Date Drawn: 05-31-2006	33 Pratt St., Suite 201 Essex, CT 06426 Telephone: (860) 767-3069 Fax: (860) 767-3097 www.KleinschmidtUSA.com	

Although presently vacant, the site was known as Gallup's Quarry during it's active period, and functioned as a sand and gravel operation that has long since been abandoned. In 1977, unlicensed waste disposal occurred at the site, and following a series of investigations was listed as a National Priority List (NPL) site in 1989 by the U.S. Environmental Protection Agency (USEPA). The compounds of concern include volatile organic compounds (VOCs), semi-volatile organic compounds (sVOCs), and three metals. Extensive contamination of the groundwater has occurred and the discharge of contaminated groundwater into Mill Brook was first observed during the spring and fall of 1978. Active remedial efforts including the removal of buried drums and contaminated soil occurred in 1977-1978 under the direction of the CTDEP. Presently, the remedial treatment of the compounds of concern at the Gallup's Quarry Superfund site is occurring via natural attenuation.

In the time that has elapsed since cessation of mining activities in the late 1970s (at which time the site was largely denuded), a wide range of early successional, disturbance – tolerant plant communities have established on the site that are characteristic of soil types that are acidic and possess low macronutrient levels. The following sections discuss the methodology used to characterize these habitat types and associated suites of wildlife. In addition, construction and operation related impacts to plant communities, wildlife (including rare, threatened, and endangered species), and mitigation options are also discussed.

2.0 METHODS

2.1 Vegetation

The assessment of on-site terrestrial ecology and impacts associated with construction and operation of the facility consists of the following components:

- A characterization of the species composition of each community based on reconnaissance surveys;
- A delineation of the vegetative communities or cover types present on the basis of field observations, including the identification and delineation of any unusual habitats or natural communities, such as vernal pools, which could support listed species or species of special concern;
- Documentation of the composition of these communities through the use of representative sample plots;
- A screening-level assessment of impacts to sensitive plants associated with air emissions in accordance with the thresholds established in the USEPA document "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (USEPA, 1980); and
- Identification and evaluation of reasonable mitigation measures regarding the vegetation impacts identified.

The formal boundary determination of on-site federal and state jurisdictional wetlands was previously conducted by others. As such, this section provides the following information regarding wetland plant communities:

- A description of the vegetative and hydrologic characteristics of all federal wetlands and state wetlands identified;
- A survey or coordinate map of the location of all federal wetland and state-regulated wetland boundaries identified above; and
- An identification and evaluation of reasonable mitigation measures to mitigate wetland impacts.

2.1.1 Plant Community Sampling

Plant communities encountered on the site were sampled within 29, randomly located 10 meter (m) radial plots on May 2, 2006. In sum, a total of 9,110.6 m^2 (2.25 acres) were sampled. Plots were situated within each plant community/cover type so as to be representative of general conditions. Within each plot, tree, shrub, herb, fern, lichen, and moss species present in the plot were identified to the level of species where possible. Each plant species encountered in the plot, in addition to non-vegetated cover, i.e. bare sand, standing water etc., were assigned an estimated percent cover. Raw data for all sample plots are presented within Appendix A and photographs of each community are presented in Appendix B.

In addition to this current survey, the U.S. Fish and Wildlife Service (USFWS) conducted an informal plant community survey in 1993. Where applicable, the results of the 1993 study have been included in this report.

2.1.2 Data Analysis

For each plant community sampled, the following four descriptive metrics are reported:

1. Species richness;

2. Relative Dominance(D_R); where $D_R = 100 * \frac{\left(\sum_{i=1}^{n} PC_{species}\right) / A_{TOTAL}}{\sum_{i=1}^{n} D_{species}}$; and

$PC_{species}$ = summed percent cover for species x in plots 1...n;

A_{total} = total area sampled

$D_{species}$ = summed dominance for species $1...n$

3. Relative Frequency (F_R); where $F_R = 100 * \frac{\left(\sum_{i=1}^{n} n_{species}\right) / N_{TOTAL}}{\sum_{i=1}^{n} F_{species}}$; and

$n_{species}$ = number of plots $1 \ldots n$ in which species x occurs;

N_{total} = total number of plots sampled;

$F_{species}$ = summed frequency for species $1 \ldots n$

4. An Importance Value (IV_{ave}) calculated as the arithmetic mean of D_R and F_R. This metric identifies those plant species that are essentially most important, i.e. most dominant and occur most frequently within the given community.

2.2 Wildlife

The site was surveyed for potentially suitable habitat for the three species by a Kleinschmidt Associates (Kleinschmidt) ecologist on May 2 and May 10, 2006. The field activities were geared towards characterizing habitat composition, identifying habitat types, and assessing their potential to support the three species, either directly or indirectly. The survey was conducted during two, 8-hour periods under cool and overcast conditions. Light rain was encountered during both survey periods.

In addition to this current survey, the U.S. Fish and Wildlife Service (USFWS) conducted an informal wildlife survey in 1993. This report incorporates the 1993 USFWS survey results along with the following site-specific information regarding wildlife and associated habitat as they occur upon the project site:

- A characterization of wildlife including mammals, birds, amphibians, and reptiles that occur on or within the vicinity of the project site based on spring reconnaissance surveys and supplemented by available data, including an identification and delineation of any unusual habitats or natural communities which could support listed species or species of special concern;

- A list of the species of mammals, birds, amphibians, and reptiles reasonably likely to occur on, or within the vicinity of the project site based on site observations and supplemented by publicly available sources;

- An analysis of the impact of operation on the wildlife (including listed rare species or species of special concern, that have been identified by resource agencies as potentially occurring on the site), wildlife habitats, and wildlife travel corridors; and

- An identification and evaluation of reasonable mitigation measures regarding wildlife impacts identified.

2.2.1 General Wildlife Survey

Wildlife observations were made concurrently with the characterization of habitat types over the course of a single day on May 2. It is worth noting that species not observed on the site but that may actually be present, may have been missed due to the timing of the survey.

Within each plant community sampled, wildlife habitat attributes were noted, e.g. snags, and observed wildlife species were identified to the level of species. As an added measure, published accounts of species occurrences by habitat type described in DeGraaf & Rudis (1986) were used to generate master taxa lists by habitat type. In addition to the direct observation of individual species, indirect evidence of wildlife presence, e.g. scat, tracks, vocalizations, burrows were also recorded.

2.2.2 Rare, Threatened, and Endangered Species

In response to the proposed activities on the site, the State of Connecticut Department of Environmental Protection (CTDEP) (Bureau of Natural Resources – Wildlife) was contacted regarding the presence of rare, threatened, and endangered species that could potentially be impacted. Based upon correspondence received from the CTDEP (Franklin Swamp Wildlife Management Area – Julie Victoria) on April 11, 2006 (Appendix C) it was

determined that the proposed activities could potentially impact three species, including the blue-spotted salamander (*Ambystoma laterale*) (Threatened); the eastern spadefoot toad (*Scaphiophus holbrooki*) (Endangered); and the savannah sparrow (*Passerculus sandwichensis*) (Special Concern). With respect to the presence/absence of rare, threatened, and endangered species on the project site, the USFWS conducted a survey of the 29–acre property in 1993. The results of their study indicated that no federally or state listed rare, threatened, or endangered species are present.

It is worth noting that two of the three species were observed within the vicinity of the proposed project. Specifically, at a nearby 200+ acre site on Tarbox Road (upon which the Lowe's distribution facility was constructed), two state-listed species of amphibians were observed including the Endangered spadefoot toad (*Scaphiopus holbrookii*) and the threatened pure diploid blue-spotted salamander (*Ambystoma laterale*). In addition, five state-listed avian species were observed, including the endangered vesper sparrow (*Pooecetes gramineus*); the grasshopper sparrow (*Ammodramus savannarum*); the threatened Cooper's hawk (*Accipiter cooperi*); and two species of special concern, the red shouldered hawk (*Buteo lineatus*); and Savannah sparrow (*Passerculus sandwichensis*). In addition to these species, the state-listed species of special concern, eastern ribbon snake (*Thamnophis sauritus*) was also observed.

The Natural Diversity electronic database was consulted and GIS data layers were downloaded from the CTDEP website in order to obtain Estimated Natural Diversity Database (NDDB) habitat polygons. Based upon the information provided by the NDDB layers (June, 2006), mapped estimated habitat does occur on the site (Appendix C). The following section summarizes the autecology of the three species, i.e. the relationship of the given organism with its environment.

Ambystoma laterale

Suitable habitat for the blue spotted salamander includes *Acer rubrum* (red

maple) swamps situated along stream borders, with approximately 90 – 100% canopy cover. It is worth noting that this species will also utilize other wetland types that are in close proximity. Mating takes place in early spring and individual egg masses may contain from 1-30 eggs that are scattered throughout the pool.

Scaphiophus holbrooki

Preferred habitats for the Eastern spadefoot toad include sandy or loose (friable) sandy soils found in farmlands, meadows, forests, and dunes and the breeding period for this species initiates in April or May during heavy precipitation events and continues until August (Tyning, 1990). A female will typically lay 1,000 to 2,500 eggs at a time in masses of 6 to 110 in irregular strings near or in vegetation within temporary pools (Tyning, 1990). Breeding pools can include "classic" vernal pools or more ephemeral pools formed in low-lying areas following heavy rain events.

This species is, however, rarely observed outside of the breeding period and is nocturnal. As such, the presence/absence of this species is typically documented in the field solely through evidence of breeding activity and vocalizations within suitable habitat (Tyning, 1990). With respect to the vocalization, it is characterized by an explosive grunt, is low-pitched, maintained for a short duration, and repeated at short intervals. Based upon tape-recorded vocalizations of the eastern spadefoot toad, the call is comprised of a series of guttural "*wahnk*" sounds.

The eastern spadefoot toad possesses an elongated, sickle-shaped "spade" on each hind foot, which is used for digging. Two poorly defined yellowish lines running down the back are usually present. When compared to the true toads (*Bufo*) spadefoots are soft bodied and have smoother skin. Perhaps the most distinctive feature however, is the presence of vertical pupils, whereas those of the true toads are horizontal. Furthermore, the eastern spadefoot toad lacks paratoid glands, which are typically present on the sides of the head in bufonid toads.

Passerculus sandwichensis

The savannah sparrow is a grassland generalist and is typically found in a variety of grassland habitats, ranging from heathland to farmland. Unlike many grassland birds, savannah sparrows use fields of all ages. Although each pair has a territory size of one to two acres, they require relatively large areas of open space (20 to 40 acres in size) for breeding habitat.

Rare, Threatened, and Endangered Species Survey Methods

The site was surveyed for potentially suitable habitat for the three species by a Kleinschmidt Associates (Kleinschmidt) ecologist on May 2 and May 10, 2006. A resume for the surveyor is provided in Appendix D. It is worth noting that the May 10 vernal pool survey was conducted within the large isolated wetland within the southern portion of the site and appropriate sections of the large *Acer rubrum* swamp in an attempt to characterize the presence/absence of both *Ambystoma laterale* and *Scaphiophus h. holbrookii*, in addition to breeding activity.

The vernal pool survey consisted of sampling with an aquatic kick net and stirring up the substrate. Each sample was examined primarily for blue spotted salamander and eastern spadefoot toad larvae, but all aquatic invertebrates observed in the sample were identified. Those larvae and aquatic insects that were not readily identifiable in the field were examined under a light microscope. In addition to the identification of individuals, egg masses were searched for as evidence of breeding activity.

Meander surveys for the savannah sparrow were conducted in appropriate habitat on the site, where the potential for the occurrence was deemed low to moderate. In that this is another species that is rarely observed, the survey largely involved the identification of the savannah sparrow through vocalizations.

It is worth noting that species not observed on the site but that may actually be present, may have been missed due to the timing of the survey.

3.0 RESULTS

3.1 Plant Communities

The site supports a total of seven plant community cover types that are characteristic of disturbed, low nutrient soil conditions (Table 3-1; Figure 3-1). The seven plant communities observed include (1) an *Acer rubrum* (red maple) forested wetland; (2) a sand barren community; (3) an early successional hardwood stand; (4) a stand of *Pinus rigida* (pitch pine) (5) a forested *Quercus alba - Q. ilicifolia* (white oak-scrub oak) stand; (6) early successional shrub and herb communities; and (7) small and isolated scrub-shrub wetlands. Of the cover types, the early successional hardwood and the forested white oak-scrub oak stand types are co-dominant, and followed closely by the early successional grass/shrub community.

Table 3-1. Summary of plant communities observed on the site.

PLANT COMMUNITY	TOTAL AREA (Acres)	RELATIVE AREA (%)
1. *Acer rubrum* forested wetland	2.03	7.23
2. Sand Barren	3.12	11.11
3. Early Successional Hardwood Stand	6.75	24.04
4. *Pinus rigida* Stand	2.25	8.01
5. Forested *Quercus alba-Q. ilicifolia* stand	6.87	24.47
6. Early Successional grass/shrub	6.36	22.65
7. Isolated Wetlands	0.7	2.49
TOTAL	28.08	100

3.1.1 Plant Community 1 (red maple forested wetland)

Within the red maple forested wetland community *Symplocarpus foetidus* (skunk cabbage) is the most dominant species, which is followed closely by *Acer rubrum* (red maple) (Table 3-2). Other dominant species include *Vaccinium corymbosum* (highbush blueberry), *Carex stricta* (tussock sedge), and *Clethra alnifolia* (sweet pepperbush). Collectively, these species account for the top five most dominant species in this community type. Total observed species richness within the red maple swamp community is 29, which includes three tree species, nine shrub species, 13 herb species, and four species of moss.

PLANT COMMUNITY	NO. OF PLOTS	AREA - SQ. FT. /ACRES
ACER RUBRUM FORESTED WETLAND	6	88,416.6 SQ. FT. / 2.03 ACRES
SAND BARREN	2	135,930.9 SQ. FT. / 3.12 ACRES
EARLY SUCCESSIONAL HARDWOOD STAND	4	294,198.7 SQ. FT. / 6.75 ACRES
PRINUS RIGIDA STAND	3	98,176.2 SQ. FT. / 2.26 ACRES
FORESTED QUERCUS ALBA-Q ILICIFOLIA STAND	3	299,383.5 SQ. FT. / 6.87 ACRES
EARLY SUCCESSIONAL GRASS/SHRUB COMMUNITY	4	277,117.1 SQ. FT. / 6.36 ACRES
ISOLATED WETLANDS	6	30,869.7 SQ. FT. / 0.70 ACRES
TOTAL	29	1,223,890.7 S.F. / 28.1 ACRES

No.	Revision	Date

Scale: AS SHOWN
Project No: 1440-001
AutoCad Release: 2005
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Design By: JP
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Checked By: JP
Date Revised: 6-13-06

PLAINFIELD RENEWABLE ENERGY, LLC
LOCATION
PLAINFIELD FACILITY SITE PROJECT
PLANT COMMUNITY MAP

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Fig. 3.1

C:\Documents and Settings\Harold Fick\Desktop\1440-001\1440-001 Figure 3-1 Combined.dwg

Table 3-2. Ranked IV_{ave} values for the red maple forested wetland community.

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IV_{ave}
Symplocarpus foetidus	Skunk cabbage	23.32	9.86	16.59
Acer rubrum	Red maple	14.58	9.86	12.22
Vaccinium corymbosum	Highbush blueberry	9.04	8.45	8.74
Carex stricta	Tussock sedge	7.93	7.04	7.49
Clethra alnifolia	Sweet pepperbush	7.87	5.63	6.75
Osmunda cinnamomea	Cinnamon fern	7.58	5.63	6.61
Sphagnum magellanicum	Sphagnum moss	7.87	4.23	6.05
STANDING WATER	NA	8.75	2.82	5.78
Rhododendron viscosum	Swamp azalea	3.21	5.63	4.42
Amelanchier canadensis	serviceberry	2.04	4.23	3.13
Rubus hispidus	Swamp dewberry	0.64	4.23	2.43
Alnus rugosa	Speckled alder	0.87	2.82	1.85
Polytrichum commune	Polytrichum moss	0.87	2.82	1.85
Anemone quinquefolia	Wood anemone	0.58	2.82	1.70
Viola sp.	violet	0.35	2.82	1.58
Cephalanthus occidentalis	buttonbush	0.87	1.41	1.14
Ilex verticillata	winterberry	0.58	1.41	1.00
Lycopodium complanatum	Lycopodium moss	0.58	1.41	1.00
Quercus alba	White oak	0.58	1.41	1.00
Quercus bicolor	Swamp white oak	0.58	1.41	1.00
Impatiens capensis	Spotted touch me not	0.29	1.41	0.85
Maianthemum canadense	Canada mayflower	0.29	1.41	0.85
Spiraea tomentosa	steeplebush	0.29	1.41	0.85
Aster	Lance leaved aster	0.06	1.41	0.73
Galium palustre	Swamp bedstraw	0.06	1.41	0.73
Iris versicolor	Blue flag	0.06	1.41	0.73
Lycopodiella inundata	Bog clubmoss	0.06	1.41	0.73
Thalictrum thalicroides	Rue anemone	0.06	1.41	0.73
Veratrum viride	False hellebore	0.06	1.41	0.73
Viburnum recognitum	Northern arrowwood	0.06	1.41	0.73

The swamp itself is fairly large and those portions that occur on the property are predominantly forested with scrub-shrub inclusions, while those portions that occur in the transmission line easement are predominately scrub-shrub communities. To the north of the transmission line corridor, the plant community abruptly shifts to that of a forested wetland dominated by red maple. The forested wetland can be characterized as a floodplain forest associated with Mill Brook.

Standing water was present in offsite portions of the wetland to a depth of approximately 1.5 feet. Water lilies were present in these sections, which is

indicative of the permanence of the standing water. Soils in the swamp consist of a well decomposed (histic) peaty muck.

3.1.2 Plant Community 2 (Sand Barren)

The xeric sand barren community type occurs primarily within that portion of the site that is presently designated an Environmental Land Use Restriction Area (ELURA). In large part, this community is dominated by expanses of bare sand, with scattered plant species characteristic of low nutrient soil conditions and full light environments. ATV use is especially heavy in this community type and a series of deeply rutted trails lace throughout.

Although bare sand is the most important component of this community type, *Betula populifolia* (grey birch) is the most dominant plant species (Table 3-3). Other dominant species include the moss *Polytrichum commune*, (haircap moss) the warm-season grass *Schizachyrium scoparium* (little bluestem), the shrub species *Quercus ilicifolia* (scrub oak), and the upland sedge *Carex pennsylvanica* (Pennsylvania sedge). As observed in the field, these species occur in isolated patches that have developed in swales and undisturbed areas outside of the heaviest ATV traffic.

Table 3-3. Ranked IV_{ave} values for the sand barren community.

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IVave
BARE SAND	NA	36.92	15.38	26.15
Betula populifolia	Grey birch	16.92	15.38	16.15
Polytrichum commune	haircap moss	15.38	7.69	11.54
Schizachyrium scoparium	Little bluestem	7.69	15.38	11.54
Quercus ilicifolia	Scrub oak	9.23	7.69	8.46
Carex pennsylvanica	Pennsylvania sedge	4.62	7.69	6.15
Pinus rigida	Pitch pine	3.08	7.69	5.38
Populus tremuloides	Quaking aspen	3.08	7.69	5.38
Cladonia cristatella	British soldiers (lichen)	1.54	7.69	4.62
Usnea sp.	lichen	1.54	7.69	4.62

Total observed species richness is nine, which includes three tree species, two species of grass, a single shrub species, a single moss species, and two lichen species.

3.1.3 Plant Community 3 (Early Successional Hardwood Stand)

The early successional hardwood stand has developed upon those portions of the site that were previously disturbed during the sand and gravel operation. In general, the areas where this community type developed possesses a relatively more well – developed A horizon, with more organic matter than sand-dominated areas. Understory light levels are moderate, although there is significant lateral light penetration from adjacent cleared areas. Typically, this cover type is observed in the central portion of the site, although an isolated patch is observed in the northwestern corner.

The most dominant plant species in this community is *Maianthemum canadense* (Canada mayflower), which is followed by *Carex pennsylvanica* (Table 3-4). Other dominant species in this community type include *Solidago canadensis* (gray's goldenrod), *Prunus serotina* (black cherry), and *Acer rubrum.*

Table 3-4. Ranked IV_{ave} values for the early successional hardwood stand community.

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IV_{ave}
Maianthemum canadense	Canada mayflower	30.56	9.09	19.82
Carex pennsylvanica	Pennsylvania sedge	23.61	6.06	14.84
Solidago canadensis	Gray's goldenrod	8.47	6.06	7.27
Prunus serotina	Black cherry	1.39	12.12	6.76
Acer rubrum	Red maple	6.25	6.06	6.16
Carya ovata	Shagbark hickory	8.33	3.03	5.68
Populus tremuloides	Quaking aspen	4.17	6.06	5.11
Carex sp.	sedge	5.56	3.03	4.29
Lonicera tatarica	Tatarian honeysuckle	1.39	6.06	3.72
Potentilla simplex	cinquefoil	0.83	6.06	3.45
Quercus alba	White oak	0.69	6.06	3.38
Berberis thunbergii	Japanese berberry	2.08	3.03	2.56
Betula populifolia	Grey birch	1.39	3.03	2.21
Cornus stolonifera	Red osier dogwood	1.39	3.03	2.21
Quercus palustris	Pin oak	1.39	3.03	2.21
Juniperus virginiana	Eastern red cedar	0.69	3.03	1.86
Polytrichum commune	haircap moss	0.69	3.03	1.86
Rhus toxicodendron	Poison ivy	0.69	3.03	1.86
Cornus amomum	Silky dogwood	0.14	3.03	1.58
Galium asparine	bedstraw	0.14	3.03	1.58
Pinus strobus	White pine	0.14	3.03	1.58

Total species richness observed in this community type is 21, which includes nine tree species, five shrub species, six species of herb, and a single moss species.

3.1.4 Plant Community 4 (Pinus rigida stand)

The xeric *Pinus rigida* (pitch pine) stand has developed upon remnant tailings left over from the sand and gravel operation and is restricted to a small patch adjacent to the sand barren community. Light levels are very high within this cover type and the substrate alternately consists of either needle litter or bare sand with some gravel and cobbles. The most dominant plant species in this community includes *Pinus rigida*, which is followed by the moss *Polytricum commune*, the tree species *P. strobes* (white pine), in addition to the shrubs *Myrica pennsylvanica* (bayberry) and *Spiraea latifolia* (meadowsweet) (Table 3-5). Many of the species in this community, including the ericaeous shrubs, e.g. *Myrica*, are also characteristic of acidic, nutrient poor soils and high light levels.

Table 3-5. Ranked IV_{ave} values for the *Pinus rigida* stand community (n=3).

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IV_{ave}
Pinus rigida	Pitch pine	36.25	10.53	23.39
Polytrichum commune	haircap moss	13.75	15.79	14.77
Pinus strobus	White pine	17.50	5.26	11.38
Myrica pennsylvanica	bayberry	6.25	5.26	5.76
Spiraea latifolia	meadowsweet	6.25	5.26	5.76
Carex pennsylvanica	Pennsylvania sedge	5.00	5.26	5.13
Schizachyrium scoparium	Little bluestem	5.00	5.26	5.13
Vaccinium angustifolia	Lowbush blueberry	3.75	5.26	4.51
Betula populifolia	Grey birch	1.25	5.26	3.26
Eleagnus augustifolia	Russian olive	1.25	5.26	3.26
Juniperus virginiana	Eastern red cedar	1.25	5.26	3.26
Populus tremuloides	Quaking aspen	1.25	5.26	3.26
Quercus rubra	Northern red oak	1.25	5.26	3.26

Total species richness is 13, which includes six tree species, four shrub species, a single warm-season grass, a single sedge species, and one species of moss.

3.1.5 Plant Community 5 (forested *Quercus alba – Q. ilicifolia* stand)

Of the communities on the site, this is the least anthropogenically disturbed plant community type (although lightning damage was observed) and occurs at higher elevations present to the east of the site. The most dominant plant species in this community type include *Quercus* and *Q. alba*, which are considered co-dominants (Table 3-6). Other abundant species include the low stature ericaceous shrub species *Vaccinium angustifolia* (lowbush blueberry), the fern *Pteridium aquilinum* (bracken fern), and *Betula populifolia* (grey birch).

Within this xeric forest type, the growth of *Quercus ilicifolia* (scrub oak) was at times quite dense. In that the cover of this species increases dramatically following fire, and there was very little evidence of fire, apart from a standing dead *Pinus rigida* stem that had been struck by lightning, it appears that some localized clearing may have occurred. The cover of the shrub *Vaccinium angustifolia* is not continuous, which may be attributable to low levels of both downwelling and horizontal light. This is only noted because this species typically forms continuous mats within this forest type.

Table 3-6. Ranked IV_{ave} values for the forested *Quercus alba – Q. ilicifolia* stand community.

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IV_{ave}
Quercus ilicifolia	Scrub oak	10.76	20.00	15.38
Quercus alba	White oak	8.97	20.00	14.48
Vaccinium angustifolia	Lowbush blueberry	3.59	20.00	11.79
Carex pennsylvanica	Pennsylvania sedge	8.97	13.33	11.15
Pteridium aquilinum	Bracken fern	9.87	6.67	8.27
Betula populifolia	Grey birch	7.62	6.67	7.14
Prunus serotina	Black cherry	7.17	6.67	6.92
Pinus rigida	Pitch pine (SD)	1.35	6.67	4.01

Total species richness is eight, which includes four tree species, two shrub species, a single fern species, and a single sedge species. In contrast with other communities present on the site, the herbaceous layer is species poor, although characteristically so for this community type.

3.1.6 Plant Community 6 (Early successional shrubland)

This community type is fairly disturbed and appears to have developed upon deposited fill material that consists primarily of a smoothed sandy loam. The distribution of this community is restricted to the central portions of the site and extends in a southerly direction to the very edge of Tarbox Road.

The most dominant species in this community type is *Eleagnus augustifolia* (Russian olive), which forms dense thickets comprised of interlocking individuals along the main dirt access road leading into the site (Table 3-7). Other well represented species include the grasses *Dactylus glomerata* (orchard grass) and *Shizachyrium scoparium* (little bluestem, the tree *Juniperus virginiana* (eastern redcedar), and the shrub species *Myrica pennsylvanica* (bayberry).

Table 3-7. Ranked IV_{ave} values for the early successional shrubland community.

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IV_{ave}
Eleagnus augustifolia	Russian olive	34.86	20.00	27.43
Dactylus glomerata	Orchard grass	33.03	20.00	26.51
Schizachyrium scoparium	Little bluestem	15.60	15.00	15.30
Juniperus virginiana	Eastern red cedar	3.67	10.00	6.83
Myrica pennsylvanica	bayberry	3.67	10.00	6.83
Rhus typhina	Staghorn sumac	4.59	5.00	4.79
Achillea millefolium	yarrow	1.83	5.00	3.42
Pinus strobus	White pine	0.92	5.00	2.96
Prunus serotina	Black cherry	0.92	5.00	2.96
Verbascum thapsus	Common mullein	0.92	5.00	2.96

Total species richness is ten, which includes three tree species, three shrub species, and four herbs.

3.1.7 Plant Community 7 (isolated wetlands)

Isolated wetlands have been previously identified by others within five locations on the site. In large part, they have developed within shallow depressions formed during previous excavation activities within the gravel pit. Within several of the depressions, discarded tires and the occasional rusted 55 –

gallon drum were observed, and in general the communities were highly disturbed. The largest of the five isolated wetlands occurs adjacent to the Providence and Worcester railroad easement and contains standing water to a depth of 1.5 feet. Although water stained leaves are observed in the other three isolated wetlands, standing water is not present, which is indicative of fairly high infiltration rates.

The largest isolated wetland was most likely directly associated with a large and degraded *Chamaecyparis thyoides* (Atlantic white cedar) swamp to the west of the site prior to the construction of the railroad easement and other filling activites. It is worth noting that a single, 3 – 5 years old *Chamecyparis thyoides* seedling was observed in this wetland. A great deal of Fe (iron) flocculation was observed along the edges of the wetland and the water within the pool was the color of dark "iced-tea", which is the hallmark of leached tannins. Substrate types in this wetland include a thin veneer of organic material, including some periphyton, atop a mineral layer comprised of a fine sand and as such, is very firm.

The single most dominant plant species in the isolated wetland community is the shrub species *Vaccinium corymbosum* (Table 3-8). Other important species include *Salix bebbiana* (bebb willow), *Salix discolor* (pussy willow), *Dulichium arundinaceum* (three way sedge), and *Spiraea tomentosa* (steeplebush). Total species richness is 17, which includes three tree species, seven shrub species, five herbs, and two species of moss.

Table 3-8. Ranked IV_{ave} values for the early successional shrubland community.

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IV_{ave}
Vaccinium corymbosum	Highbush blueberry	13.19	8.33	10.76
STANDING WATER	NA	15.38	4.17	9.78
Salix bebbiana	Bebb willow	4.40	12.50	8.45
Salix discolor	Pussy willow	10.99	4.17	7.58
Dulichium arundinaceum	Three-way sedge	8.79	4.17	6.48
Spiraea tomentosa	steeplebush	7.69	4.17	5.93
Spiraea latifolia	meadowsweet	6.59	4.17	5.38
Populus deltoides	cottonwood	2.20	8.33	5.27

SCIENTIFIC NAME	COMMON NAME	D_R	F_R	IV_{ave}
Acer rubrum	Red maple	5.49	4.17	4.83
Polytrichum commune	haircap moss	5.49	4.17	4.83
Carex stricta	Tussock sedge	0.88	8.33	4.61
Alnus rugosa	Speckled alder	4.40	4.17	4.28
Cornus amomum	Silky dogwood	4.40	4.17	4.28
Onoclea sensibilis	Sensitive fern	3.30	4.17	3.73
Equisetum fluviatile	horsetail	2.20	4.17	3.18
Populus tremuloides	Quaking aspen	2.20	4.17	3.18
Osmunda cinnamomea	Cinnamon fern	1.10	4.17	2.63
Sphagnum spp.	Sphagnum moss	1.10	4.17	2.63
Chamaecyparis thyoides	Atlantic white cedar	0.22	4.17	2.19

The following section summarizes wildlife observed within each habitat, in addition to published accounts of species occurrence by habitat type (DeGraaf & Rudis, 1986). Rare, threatened, and endangered species are also discussed.

3.2 Wildlife

3.2.1 Habitat 1 (Acer rubrum forested wetland)

Within the *Acer rubrum* forested wetland community there is a great deal of structural diversity including forested stands, shrub dominated patches, and sections of standing water with emergent vegetation. As such, a correspondingly wide range of amphibians, reptiles, birds, and mammals could be expected to occur within this habitat type.

As it occurs within the boundaries of the site, the swamp is dominated by red maple with a fairly dense herbaceous layer characterized by a nearly continuous layer of *Symplocarpus foetidus*. The shrub layer is not as well developed, although *Clethra alnifolia*, *Vaccinium corymbosum*, and *Rhododendron viscosum* (swamp azalea) are present. Within sections of the utility right of way, scrub shrub communities dominate and species including highbush blueberry and swamp azalea become more prevalent.

In that there is considerable movement between adjacent patch types for species that are habitat generalists, it is presumed that those wildlife species that

utilize non-forested scrub shrub and emergent dominated patch types might also be encountered within the forested portions present on the site (Table 3-9). It is worth noting that many of these species were observed within similar habitat at a nearby site on Tarbox Road.

A high percentage of the species observed within this habitat type are fairly common and include amphibians such as *Gyrinophilus p. porphyriticus* (spring peeper), *Notophthalmus v. viridescens* (red spotted newt), and *Rana palustris* (pickerel frog). Avian species observed include *Agelaius phoeniceus* (red-winged blackbird) and a pair of *Anas platyrhynchos* (mallards). This pair was also observed within the largest isolated wetland at the southern end of the site. During the 1993 USFWS survey avian communities dominated by wood thrush were observed in the forested portions of this community, while species richness in the scrub-shrub portions was considerably higher. Specifically, species including common yellowthroat, song sparrow, American goldfinch, cedar waxwing, and chestnut-sided warbler were observed.

Table 3-9. Observed and expected wildlife species within the *Acer rubrum* swamp community.

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Amphibians and Reptiles			
Ambystoma maculatum	Spotted salamander		X
Gyrinophilus p. porphyriticus	Northern spring salamander		X
Desmognathus f. fuscus	Northern dusky salamander		X
Hyla c. crucifer	Northern spring peepers	X	
Notophthalmus v. viridescens	Red spotted newt	X	
Hyla versicolor	Gray treefrog		X
Rana calmitans melanota	Green frog		X
R. sylvatica	Wood frog		X
R. palustris	Pickerel frog	X	
Bufo fowleri	Fowlers toad		X
Bufo americanus	American toad		X
Thmnophis sirtalis sirtalis	Eastern garter snake		X
Nerodia sipedon sipedon	Northern water snake		X
Chelydra s. serpentina	Common snapping turtle		X

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Birds			
Podilymbus podiceps	Pied billed grebe		X
Nycticorax violaceus	Black crowned night-heron		X
Branta canadensis	Canada goose		X
Anas platyrhynchos	Mallard	X	
Rallus limicola	Virginia rail		X
Gallinago gallinago	Common snipe		X
Empidonax alnorum	Alder flycatcher		X
Vireo griseus	White-eyed vireo		X
Geothylpis trichas	Common yellowthroat	X[A]	X
Wilsonia citrina	Hooded warbler		X
Dendroica petechia	Yellow warbler	X[A]	X
Dendroica pennsylvanica	Chestnut-sided warbler	X[A]	X
Melospiza melodia	Song sparrow	X[A]	X
Melospiza lincolnii	Lincoln's sparrow		X
Melospiza georgiana	Swamp sparrow		X
Agelaius phoeniceus	Red-winged blackbird	X	
Euphagus carolinus	Rusty blackbird		X
Quiscalus quiscala	Common grackle		X
Scolopax minor	American woodcock		X
Carduelis tristis	American goldfinch	X[A]	X
Ceryle alcyon	Belted kingfisher		X
Hylocichla mustelina	Wood thrush	X[A]	X
Bombycilla cedrorum	Cedar waxwing	X[A]	X
Ardea herodias	Great blue heron		X
Mammals			
Didelphus virginiana	Virginia opossum		X
Odocoileus virginianus	White-tailed deer		X
Vulpes vulpes	Red Fox		X
Sorex cinereus	Masked shrew		X
Sciurus carolinensis	Gray squirrel		X
Mephitis mephitis	Striped skunk		X
Blarina brevicauda	Short-tailed shrew		X
Sorex cinereus	Masked shrew		X
Condylura cristata	Star-nosed mole		X
Myotis lucifugus	Little brown myotis		X

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Eptesticus fuscus	Big brown bat		X
Sylvilagus floridanus	Eastern cottontail		X
S. transitionalis	New England cottontail		X
Zapus hudsonius	Meadow jumping mouse		X
Peromyscus leucopus	White-footed mouse		X
Procyon lotor	Raccoon	X^A	X
Mustela vison	mink		X

X = observed/expected by KA; X^A = observed by USFWS 1993.

Amphibian species identified during the vernal pool survey included *Rana palustris* larvae, in addition to common aquatic insects including members of the *Dytiscidae* (predaceous diving beetle), *Gerridae* (water striders); and *Cladocerans* (daphnia). Other reptile and amphibian species that would be expected include the eastern garter snake, northern water snake, wood frog, and the gray treefrog.

3.2.2 Habitat 2 (Sand Barren)

The sand barren community is regularly disturbed by ATV traffic and as such, it is unlikely that even fossorial species, which are specifically adapted to burrowing in soils, would be able to utilize the substrate with the exception of adjacent, undisturbed patches. In addition, there is very little structure within this habitat type, which further limits the numbers of species that might be expected.

The few species that might occur within this community, at least along the edges of this community that support low stature shrub and warm season grasses include basking *Thamnophis s. sirtalis* (eastern garter snake), and *Coluber constrictor* (northern black racer). Other species that might be expected to pass along the edges of this community include *Odocoileus virginianus* (white-tailed deer) (tracks observed at the interface with the early successional hardwood stand). Ground nesting bird species that might be expected to utilize this habitat type include *Charadrius vociferous* (killdeer). The absence of killdeer within the sand barren areas and the unpaved pathways is most likely a consequence of the heavy ATV use in these areas.

3.2.3 Habitat 3 (Early successional hardwood stand)

This cover type only accounts for a small fraction of the total area on the site and is present as small, discrete patches. As such, large populations of wildlife are not expected to utilize this patch type (Table 3-10) and is most likely of low value for these species. However, in that many of the wildlife species observed on the site are generalists, there will most likely be a great deal of species that immigrate from adjacent patch types.

Some of the more common species observed in this patch type include *Caprimulgus vociferous* (whip-poor-will), prairie warblers and blue-winged warblers. Several small mammals including *Sylvilagus floridanus* (eastern cottontail) and *Tomias striatus* (eastern chipmunk) were also observed.

Table 3-10. Observed and expected wildlife species within the early successional hardwood stand community.

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Amphibians and Reptiles			
Plethodon cinereus	Redback salamander		X
Coluber c. constrictor	Northern black racer		X
Thamnophis s. sirtalis	Eastern garter snake		X
Birds			
Scolopax minor	American woodcock		X
Colinus virginianus	Northern bobwhite		X
Meleagris gallopavo	Wild turkey		X
Sphyrapicus varius	Yellow bellied sap sucker		X
Caprimulgus vociferus	Whip-poor-will	X	
Colaptes auratus	Northern flicker		X
Certhia americana	Brown creeper		X
Sturnus vulgaris	European starling		X
Vermivora ruficapilla	Nashville warbler		X
Dendroica discolor	Prairie warbler	X ,X[A]	
Vermivora pinus	Blue-winged warbler	X ,X[A]	
Dendroica petechia	Yellow warbler		X

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Passerina cyanea	Indigo bunting		X
Mammals			
Scolophus aquaticus	Eastern mole		X
Sylvilagus floridanus	Eastern cottontail	X	
S. transitionalis	New England cottontail		X
Tamias striatus	Eastern chipmunk	X	
Odocoileus virginianus	White-tailed deer		X

X = observed/expected by KA; X^A = observed by USFWS 1993.

3.2.4 Habitat 4 (*Pinus rigida* stand)

The *Pinus rigida* (pitch pine) stand is also an extremely small patch type and would be expected to support a proportionally low number of species (Table 3-11). In fact, many of the species listed in the table are presumed to be immigrants from adjacent patch types, e.g. sand barren, early successional shrubland, and *Quercus alba - Q. ilicifolia* forested stand.

Species observed in this stand type include *Pipilo erythrophthalmus* (rufous-sided towhee) and expected species include reptiles such as the *Thamnophis s. sirtalis* (eastern garter snake), bird species including *Parus atricapillus* (black capped chickadee) and *Bombycilla cedrorum* (cedar waxwing), and common mammals species such as the eastern cottontail and the eastern chipmunk.

Table 3-11. Observed and expected wildlife species within the *Pinus rigida* stand community.

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Amphibians and Reptiles			
Thamnophis s. sirtalis	Eastern garter snake		X
Birds			
Parus atricapillus	Black-capped chickadee		X
Regulus calendula	Ruby-crowned kinglet		X
Bobycilla cedrorum	Cedar waxwing		X

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Dumetella carolinensus	Grey catbird		X
Vermivora pinus	Blue-winged warbler		X
Dendroica coronata	Yellow-rumped warbler		X
D. discolor	Prairie warbler		X
Passerina cyanea	Indigo bunting		X
Spizella passerina	Chipping sparrow		X
Pipilo erythrophthalmus	Rufous-sided towhee	X	
Mammals			
Sylvilagus floridanus	Eastern cottontail		X
Tamias striatus	Eastern chipmunk		X

3.2.5 Habitat 5 (Forested *Quercus alba – Q. ilicifolia* stand)

Like many forests, this habitat type has pronounced structural diversity and would support a wide range of wildlife types (Table 3-12). It is worth noting that this stand is heavily fragmented and is restricted to a narrow strip that is bordered by light industry to the north and a cleared lot to the south. Some of the more common species identified in this stand include the rufous-sided towhee, and several small mammals including the eastern cottontail, short tailed shrew, meadow jumping mouse, eastern chipmunk, *Odocoileus virginianus* (white tailed deer), and *Sciurus carolinensis* (gray squirrel).

Table 3-12. Summary of observed and expected wildlife species within the forested *Quercus alba-Q.ilicifolia* stand community.

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Amphibians and Reptiles			
Plethodon cinereus	Redback salamander		X
Coluber c. constrictor	Northern black racer		X
Thamnophis s. sirtalis	Eastern garter snake		X
Birds			
Parus atricapillus	Black-capped chickadee		X
Meleagris gallopavo	Wild Turkey		X
Colinus virginianus	Northern bobwhite		X
Picoides pubescens	Downy woodpecker		X

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Pipilo erythrophthalmus	Rufous-sided towhee	X	
Parus bicolor	Tufted titmouse		X
Sitta carolinensis	White breasted nuthatch		X
Vireo philadelphicus	Philadelphia vireo		X
Mniotta varia	Black and White warbler		X
Mammals			
Cryptotis parva	Least shrew		X
Sylvilagus floridanus	Eastern cottontail	X	
Blarina brevicauda	Short-tailed shrew		X
Zapus hudsonius	Meadow jumping mouse		X
Sciurus carolinensis	Gray squirrel	X	
Tamias striatus	Eastern chipmunk	X	
Odocoileus virginianus	White-tailed deer	X	

3.2.6 Habitat 6 (Early successional shrubland)

Most of the site provides habitat for species that utilize early successional plant communities, which cover a significant proportion of the site. This shrub-dominated habitat would provide excellent cover for a range of bird species and a suite of small mammals (Table 3-13). Observed bird species included the American goldfinch, gray catbird, common yellowthroat, song sparrow, rufous-sided towhee, mockingbird, and field sparrows.

Mammals observed within this habitat type include eastern cottontail and the white-tailed deer (tracks and scat). Other mammals that is expected in this habitat type include woodchuck, Virginia opossum, eastern chipmunk, gray squirrel, and raccoon. In that herbaceous cover is low and that a sufficiently thick A-horizon with organic matter is present only in a few patches, the small mammal community is expected to be dominated by white footed mice and deer mice.

No reptiles were observed on the site either during this current survey or the 1993 USFWS survey. However, a number of snake species are expected to utilize this patch type, in addition to the mounds of soil and rocks scattered

throughout the site, and the railroad tracks themselves. With regard to amphibians, some of the more common species including the American toad and the redback salamander are expected.

Table 3-13. Observed and expected wildlife species within the early successional shrubland community.

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Amphibians and Reptiles			
Coluber c. constrictor	Northern black racer		X
Thamnophis s. sirtalis	Eastern garter snake		X
Bufo americanus	American toad		X
Plethodon cinereus	Redback salamander		X
Birds			
Colinus virginianus	Northern bobwhite		X
Scolopax minor	American woodcock		X
Zenaida macroura	Mourning dove	X	
Empidonax virescens	Acadian flycatcher		X
Tyrannus tyrannus	Eastern kingbird		X
Dumetella carolinensus	Gray catbird		X
Mimus polyglottos	Northern mockingbird	X,X[A]	X
Toxostoma rufum	Brown Thrasher		X
Bombycilla cedrorum	Cedar waxwing		X
Vireo griseus	White-eyed vireo		X
Vermivora pinus	Blue-winged warbler		X
V. peregrina	Tennessee warbler		X
Dendroica petechia	Yellow warbler		X
Geothlypis trichas	Common yellowthroat		X
Passerina cyanea	Indigo bunting		X
Carduelis tristis	American goldfinch	X	
Pipilo erythrophthalmus	Rufous-sided towhee	X	
Melospiza melodia	Song sparrow		X
Spizella pusilla	Field sparrow	X[A]	
M. lincolnii	Lincoln's sparrow		X
Zonotrichia albicollis	White-throated sparrow		X
Mammals			
Scolophus aquaticus	Eastern mole		X
Didelphus virginiana	Virginia opossum		X

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Sylvilagus floridanus	Eastern cottontail		X
S. transitionalis	New England cottontail		X
Sciurus carolinensis	Gray squirrel		
Marmota monax	woodchuck		X
Peromyscus luecopus	White footed mouse		X
Microtus pennsylvanicus	Meadow vole		X
Napaeozapus insignis	Woodland jumping mouse		X
Mephitis mephitis	Striped skunk		X
Odocoileus virginianus	White-tailed deer		X

3.2.7 Habitat 7 (Isolated wetlands)

As previously discussed, three isolated wetlands have developed within excavated basins in the former gravel pit. Given their extremely small size and disturbed nature it is unlikely that they would support large wildlife populations. However, there are a number of different types of amphibian and aquatic invertebrate species that would potentially utilize this habitat as breeding habitat and a few mammal and avian species that would use the dense shrub cover for shelter and those few berry-bearing shrubs as a food source (Table 3-14).

Common bird species observed within the isolated wetlands include red-winged blackbirds. Due to their small size, and the poorly developed plant communities in the smallest isolated wetlands, this habitat type is most likely of low value for this species. Small mammals would also be expected to use the isolated wetlands and include the short tailed shrew and the meadow jumping mouse.

Table 3-14. Observed and expected wildlife species within the isolated wetland community.

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Amphibians and Reptiles			
Hyla c. crucifer	Northern spring peepers		X
Bufo americanus	American toad		

GENUS AND SPECIES	COMMON NAME	OBSERVED	EXPECTED
Rana palustris	Pickerel frog	X	
Notophthalmus v. viridescens	Red spotted newt		X
Thamnophis s. sauritis	Eastern ribbon snake		X
Birds			
Anas platyrhynchos	Mallard	X	
Geothylpis trichas	Common yellowthroat		X
Agelaius phoeniceus	Red-winged blackbird	X	
Euphagus carolinus	Rusty blackbird		X
Quiscalus quiscala	Common grackle		X
Carduelis tristis	American goldfinch	X	
Mammals			
Didelphus virginiana	Virginia opossum		X
Sylvilagus floridanus	Eastern cottontail		X
S. transitionalis	New England cottontail		X
Zapus hudsonius	Meadow jumping mouse		X
Procyon lotor	Racoon		X

Although water-stained leaves are present within all of the isolated wetlands, indicating the presence of standing water, only the largest basin actually contained standing water. It is likely, given the absence of standing water in the smallest basins that the hydroperiod is far too short to support successful breeding activity by obligate vernal pool species, e.g. the mole salamanders. The USFWS observed that all three pools were dry during their 1993 survey, which was an unusually dry spring.

The vernal pool survey conducted within the largest pool on May 10 indicated the presence of an extremely rich assemblage of aquatic insects including members of the *Dytiscidae Rhantus* (predaceous diving beetle); *Gerridae* (water striders); *Cladocerans* (daphnia); and *Odonata* (dragonfly nymphs). In addition, a number of freshwater gastropods belonging to the *Lymnaeidae* were observed in the pool. Amphibian species identified include *Rana palustris* larvae, which were clustered in dense patches of the sedge species *Dulichium arundinaceum.*

Notwithstanding, the large isolated pool observed on the site is extremely productive and all efforts should be made to protect this resource both during and after construction.

3.3 Rare, Threatened, and Endangered Species

Although suitable habitat is present on the site for both the eastern spadefoot toad and the blue spotted salamander, evidence of breeding activity was not observed nor were individuals observed. Furthermore, habitat for the savannah sparrow is not present on the site.

3.3.1 Ambystoma laterale

Suitable habitat for the blue spotted salamander is present along the northern tip of the site, where a large *Acer rubrum* dominated swamp was observed during the May 2006 survey. It is worth noting that this species will also utilize other wetland types that are in close proximity, including onsite isolated wetlands.

The results of the vernal pool survey within the isolated wetlands indicated that evidence of blue-spotted salamander breeding activity is not present on this site, nor was there evidence of breeding behavior by any of the other mole salamanders, e.g. spotted salamander. However, pickerel frog larvae were abundant both in the large wetland and the onsite isolated wetlands.

It is worth noting that many of the vernal pool species observed in the largest isolated wetland are considered facultative species, which is most likely a consequence of the highly variable nature of the pool hydroperiod. By definition, facultative vernal pool species include those organisms that use both vernal pool and general wetland habitat. As such, their reproductive cycle is not so tightly linked to the vernal as it would be for obligate vernal pool species including wood frogs and spotted salamanders. For this reason alone, it is unlikely that obligate

vernal pool species that generally occur at low frequencies such as the blue spotted salamander would be observed within the isolated wetlands.

3.3.2 Scaphiophus holbrooki

Potential habitat for this species includes the largest isolated wetland on the site, in addition to the highly disturbed sand barren community. Although suitable habitat for the spadefoot toad is present on the site, neither individuals nor evidence of breeding activity were observed during the vernal pool survey.

Specifically, the vernal pool survey conducted within the largest pool on May 10 indicated the presence of an extremely rich assemblage of aquatic insects including members of the *Dytiscidae; Rhantus* (predaceous diving beetle); *Gerridae* (water striders); *Cladocerans* (daphnia); and *Odonata* (dragonfly nymphs). In addition, a number of freshwater gastropods belonging to the *Lymnaeidae* were observed in the pool. Amphibian species identified include *Rana palustris* larvae, which were clustered in dense patches of the sedge species *Dulichium arundinaceum.*

3.3.3 Passerculus sandwichensis

Surveys for the savannah sparrow were conducted in appropriate habitat on the site, where the potential for the occurrence was deemed low to moderate. In that this is another species that is rarely observed, the survey largely involved the identification of the savannah sparrow through vocalizations.

Given the small size of the site, and the lack of open area, suitable habitat for the savannah sparrow is not present. As such, this species was neither observed during the survey period, nor is it likely that that breeding populations of the savannah sparrow would be able to use this site.

4.0 IMPACTS

The project has been designed to minimize impacts to wildlife species and their associated habitat to the greatest extent possible. Specifically, the footprint associated with the facility and attendant structures has been configured to utilize previously disturbed habitats. In general, the more disturbed portions of the site are presently providing limited wildlife habitat. Notwithstanding, both permanent and temporary impacts to wildlife habitat will result from the construction of the facility. Potential impacts related to construction, operation and maintenance of the facility are discussed in the following sections.

4.1 Plant Communities

Impacts associated with the construction of the facility will result in the loss of approximately 16.2 acres of presently disturbed plant communities and dirt access roads. Wildlife species that utilize those types of habitat will also be impacted. The nature of impacts to plants and animals associated with the construction of the facility are discussed in the following sections.

4.1.1 Siting Impacts

Of the area affected by the site, a total of 14.1 acres of the plant communities observed on the site will be permanently impacted (Table 4-1). This total accounts for approximately half of the vegetated areas on the site. With respect to wetland plant communities, a small portion of the red maple swamp and a single disturbed isolated wetland will be impacted by the proposed access road, whereby 0.004 acres (191 square feet) and approximately 0.002 acres (87 square feet) will be filled respectively. In large part however, most impacts will be restricted to terrestrial communities including the *Pinus rigida* (pitch pine) stand, the early successional hardwood stand, and the early successional grass/shrub community.

Table 4-1. Summary of impacts by plant community type.

PLANT COMMUNITY	TOTAL AREA (Acres)	IMPACTED AREA (Acres)	RELATIVE IMPACT (%)
Acer rubrum forested wetland	2.0	0.0044	0.2
Sand Barren	3.1	0.9050	29.0
Early Successional Hardwood Stand	6.8	4.1390	61.3
Pinus rigida Stand	2.3	2.1060	93.6
Forested *Quercus alba-Q. ilicifolia* stand	6.9	2.5100	36.5
Early Successional grass/shrub	6.4	4.4690	70.3
Isolated Wetlands	0.7	0.002	0.3
TOTAL	28.1	14.1	50.3

Habitat related impacts associated with the clearing for construction laydown areas are anticipated to be temporary and cleared areas will be restored following construction.

4.1.2 Air Emission Impacts

The proposed project is situated within the Greater Connecticut one-hour O_3 (ozone) non-attainment area and as such, is subject to Section 176 of the Clean Air Act as amended "*Determining Conformity of General Federal Actions to State and Federal Implementation Plans*". Criteria pollutants analyzed as part of this permit application include particulate matter 10*u*m (PM_{10}); NO_2; SO_2; carbon monoxide (CO); volatile organic compounds (VOCs); carbon dioxide (CO_2); and lead (Pb).

Impacts to plants associated with certain of these criteria pollutants were assessed with the direct impact ambient screening concentrations provided in the USEPA document "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (USEPA, 1980). Specifically, impacts associates with NO_2, SO_2, CO, and Pb were assessed by comparing modeled results with the Air Quality Related Value (AQRV) screening concentrations presented in the guidance document (Table 4-2). Direct impact screening criteria have not been developed for either CO_2 or VOCs, and as such are not presented in the USEPA guidance document.

Plant species present on the site that are considered sensitive species include *Betula populifolia*, *Vaccinium angustifolium*, *Dactylis glomerata*, and *Pinus strobus*.

Screening modeling was performed with USEPA's SCREEN3 model (Screen View by Lakes Environmental Software) to evaluate air quality impacts of SO_2, NO_2, CO, and Pb. The modeling was performed using rural dispersion coefficients and the "full meteorology" option in SCREEN3, which includes the set of twenty worst-case meteorological conditions recommended for screening modeling in the CTDEP Ambient Impact Analysis Guideline. Since the present analysis was concerned with onsite impacts, receptors were placed along a single wind direction radial at 25-meter intervals out to 100 meters and 50-meter intervals out to 500 meters. All receptors were assumed to be in flat terrain, at the same terrain height as the stack base elevation. The screening impact analysis was performed using procedures outlined in the CTDEP's Stationary Source Stack Height Guidelines (SSSHG), Addendum to the Stationary Source Stack Height Guideline (ASSSHG) and alternate procedures accepted by CTDEP.

Table 4-2. Comparison of ambient screening criteria (ug/m^3), averaging time, and potential emissions.

Screening Criterion	**Averaging Time**	**AQRV Screening Concentration (ug/m^3)**	**Preliminary Modeled Emissions (ug/m^3)**
SO2	1 hr	917	17.6
	3 hr	786	15.8
	24 hr	--	7.0
	Annual	18	1.4
NO2	4 hr	3,760	33.9
	8 hr	3,760	26.3
	Monthly	564	15.1
	Annual	100	3.0
CO	1 hr	--	50.2
	8 hr	--	35.1
	Weekly	1,800,000	20.1
Pb	3 Month	1.5	0.3

Based upon this screening analysis, none of the modeled emissions of the criteria pollutants will adversely affect sensitive vegetation on the site. It is worth

noting however that preliminary data have been scaled up and that conservative assumptions have been made so that the screening modeling results are considered to be conservatively high.

4.2 Wetlands

As previously discussed, a small portion of a single isolated wetland adjacent to Mill Brook Road and the red maple swamp will be impacted by the proposed access road, whereby approximately 0.002 acres (87 square feet) and 0.004 acres (191 square feet) will be filled respectively.

The nature of the direct and indirect impacts to wetlands are discussed more fully in the following sections.

4.2.1 Direct Impacts

Isolated Wetlands

It is worth noting that the isolated wetland located by Mill Brook Road is extremely degraded and during the time of the field investigation tires, roadway runoff (sand), and other waste types were observed. Combined with the immediate proximity to Mill Brook Road, this degraded habitat is providing little to no wildlife habitat and this fact was confirmed during the field visit.

The present location of the proposed entrance roadway is such that impacts to the largest and most productive isolated wetland have been avoided. With respect to the productivity of the largest isolated wetland, the water within this pool was the deepest (and presumably the least variable) and as such the aquatic plant community was extremely well-developed. Specifically, a number of vernal pool species were observed, including a suite of amphibians and invertebrates and the plant community is especially diverse and supported a number of avian species.

As such, the impacts to the degraded isolated wetland, albeit minor, were unavoidable given the proximity of the isolated wetland habitat and the desire to eliminate impacts to this vernal pool habitat. It is likely however, that the wetland functions associated with the disturbed isolated wetland, e.g. flood storage, will be greatly improved with a combination of wetland restoration and the construction of the detention basin. Furthermore, it also seems plausible that wetland functions that are not currently present in this wetland, e.g. wildlife habitat will be enhanced somewhat. The proposed wetland compensation/restoration approach is discussed more fully in Section 5.0 Mitigation of Impacts.

Forested Wetland Impacts

The impacts to the palustrine forested wetland are also minor and will involve filling along the very edge of the wetland where a shrub and herb–dominated fringe is present. Specifically, the area of filling is immediately upgradient of vegetation sample plot 2, within which shrub species account for 30% cover, red maple accounts for 40% cover, and skunk cabbage accounts for 100% cover. As such, shrub and tree species are considered scattered and as observed in the field, their percent cover decreased markedly at the upland/wetland boundary where the filling will take place. Given the small area of the wetland impact, it is unlikely that wetland functions, e.g wildlife habitat, will be severely comprised.

Impacts to this wetland were also unavoidable, given the close proximity of the forested wetland to an existing property line and the need to construct an access road. Although only a very small portion of the wetland will be directly impacted by the construction of the facility, mitigation of the filled wetland is being proposed and is discussed further in Section 5.0.

4.2.2 Indirect Impacts

Both during and following construction, indirect impacts to wetlands may occur, and primarily include sedimentation, which will be mitigated through best management practices (BMP's). For example, to minimize potential surface soil erosion and runoff into the wetland, areas disturbed following construction would be regraded to their original contours, seeded, and mulched upon completion of their use, which will serve to stabilize the soil.

The potential for indirect impacts on the wetland was considered by the applicant throughout the design of the access roadway, specification of buffer zones around wetlands, and construction methods. For example, wetlands were identified so that wetland fill, where unavoidable, would be located to minimize the impact and avoid the more sensitive portions of the wetland, e.g. those areas with mature *Acer rubrum* (red maple) stems and suitable vernal pool habitat.

Furthermore, much of the clearing and construction activities at the edge of the wetland would be conducted in winter when the ground surface is frozen and vegetation is dormant, thus minimizing the potential for disturbing soil and vegetation.

The wetland restoration/compensation approach and the different types of recommended BMP's are discussed more fully in Section 5.0 Mitigation.

4.3 Wildlife

Temporary displacement and avoidance of active construction areas would have a localized effect on wildlife present on the site by causing them to abandon feeding, breeding (where applicable), and resting activities. Small mammals, reptiles, and amphibians that utilize upland areas adjacent to wetland areas on the site will be displaced during construction activities. Furthermore, foraging and breeding opportunities for those wildlife species that utilized portions of the site that were cleared

during construction and allowed to re-vegetate would be disrupted until vegetation re-establishes.

Although these impacts may appear serious, it is important to note that the plant communities that are being disturbed on the site are early successional plant communities that have developed in response to severe disturbance. As such, they are not unique plant communities with a correspondingly unique suite of wildlife with acute habitat specificity. Rather, many of the observed wildlife species and those species expected to utilize this type of site are going to be habitat generalists and will make use of undisturbed habitat types remaining on the site and the large tracts of undeveloped land to the west of the site.

With respect to the structures being placed on the site, the cooling tower may pose impacts to avian species. As with other tall structures, cooling towers can cause mortality of migrating birds through collisions, particularly at night or during other periods of low visibility (e.g., fog, rain) or under conditions of low cloud cover. Although not as hazardous to birds as tall television broadcasting towers, power plant cooling towers have been found to cause bird mortalities. It seems unlikely however, given the low stature of the cooling tower (42.8 feet) that significant avian collisions will occur.

4.4 Rare, Threatened, and Endangered Species

As previously discussed, habitat for the savannah sparrow is not present on the site given the absence of large expanses of grassland habitat. As such, impacts to this species will not occur.

Given the disturbed nature of the habitat types it can be expected that the more commonly occurring amphibians will be habitat generalists without any acute habitat specificity, although potentially suitable habitat is present for the eastern spadefoot toad and the blue spotted salamander. Specifically, the large red maple swamp may provide excellent habitat for the blue spotted salamander and the combination of the sandy soils in the sand barren habitat and the large isolated wetland collectively provide suitable habitat for the eastern spadefoot toad.

With respect to the level of impact associated with the proposed activities, the work will be conducted within the more disturbed portions of the site, including the dirt access drives, and the early successional shrubland plant communities. As such, the sand barren area (which is presently under a Land Use Restriction), the large isolated wetland, and the red maple swamp will not be significantly impacted by the proposed project.

In conclusion, given the lack of significant impact of the proposed activities on the potentially suitable habitats for amphibians encountered on the site and the absence of observed individuals and breeding activity, it can be stated with some confidence that neither direct nor indirect impacts to eastern spadefoot toad and blue spotted salamander individuals, populations, and associated habitat will occur.

5.0 MITIGATION OF IMPACTS

The project has been designed to minimize impacts to wildlife species and their associated habitat. Specifically, the footprint associated with the facility and attendant structures has been configured to utilize previously disturbed habitats to the greatest extent possible. Unfortunately, the more significantly disturbed areas on the site fall within an Environmental Land Use Restriction Area (ELURA) and as such cannot be used. Potential impacts and mitigation measures related to construction, operation and maintenance of the facility are discussed in the following sections.

5.1 Upland Plant Communities

5.1.1 Siting Impacts and Mitigation

After construction begins, soil surface stabilization should be applied within 14 days to all disturbed areas that may not be at final grade but will remain undisturbed for periods longer than an additional 30 calendar days. In this regard, it is suggested that the "New England Roadside Matrix Upland Mix" be used to re-vegetate all upland areas with exposed loam. This seed mix is available from New England Wetland Plants in Amherst, Massachusetts and is particularly appropriate for roadsides, industrial sites, or cut and fill slopes and is unusual in that it blends native grasses, wildflowers and shrubs together in a native matrix seed mix.

Plant species contained in the mix include several grasses: creeping red fescue (*Festuca rubra*), switch grass (*Panicum virgatum*), little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), Virginia wild rye (*Elymus virginicus*); a number of wildflowers: partridge pea (*Chamaecrista fasciculata*), wild blue lupine (*Lupinus perennis*), showy tick trefoil (*Desmodium canadense*), New England aster (*Aster novae-angliae*), wild senna (*Cassia hebecarpa*), butterfly milkweed (*Asclepias tuberosa*), round-headed bush clover (*Lespedeza capitata*), white vervain

(*Verbena urticifolia*); in addition to several shrub species: gray dogwood (*Cornus racemosa*) and staghorn sumac (*Rhus typhina*).

In areas that may be frequently disturbed, the warm season grasses will dominate. In those areas that are not as frequently disturbed, the wildflower component will become dominant. Along cuts and side slopes that may never be mowed, the shrub component will add structural diversity and excellent wildlife habitat.

Additional upland plantings could be used to enhance upland habitat and vegetated buffers could be maintained along wetland areas. Planting within the upland area should consist only of native plantings and include tree species such as *Pinus rigida*, shrubs including *Myrica pennsylvanica* and *Rhus typhina* (staghorn sumac), and warm season grasses such as *Schizachyrium scoparium* and *Panicum virgatum* (switchgrass).

5.1.2 Air Emission Impacts

Based upon this screening analysis, none of the modeled emissions of the criteria pollutants will adversely affect sensitive vegetation on the site. Therefore mitigation is not being proposed.

5.2 Wetland Restoration

5.2.1 Proposed Isolated Wetland Restoration

As proposed, a detention basin will be constructed adjacent to the disturbed isolated wetland along Mill Brook Road. In order to enhance the functions of both the detention basin and the disturbed wetland, it is recommended that the basin be fully integrated with the existing wetland as a means of both compensation for filled areas and as restoration. Specifically, it is recommended that a palustrine emergent wetland be the target plant community

within the detention basin, with an admixture of scattered berry-bearing shrubs as a structural element for wildlife.

In order to develop the emergent wetland plant community, a wetland seed mix is available from New England Wetland Plants. The seed mix is comprised of a number of herbaceous species that would be fairly effective at out-competing invasive wetland plants, e.g. *Lythrum salicaria* (purple loosestrife). As indicated by the manufacturer, all species are best suited to moist disturbed ground as found in most wet meadows, scrub shrub, or forested wetland restoration areas. If planted during the fall months, the seed mix will germinate the following spring.

Based upon information provided by the manufacturer, the seed mix is comprised of the following species: fox sedge (*Carex vulpinoidea*), bearded sedge (*Carex comosa*), lurid sedge (*Carex lurida*), soft rush (*Juncus effusus*), grass-leaved goldenrod (*Euthamia graminifolia*), boneset (*Eupatorium perfoliatum*), hop sedge (*Carex lupulina*), blue vervain (*Verbena hastata*), nodding sedge (*Carex gynandra*), green bulrush (*Scirpus atrovirens*), sensitive fern (*Onoclea sensibilis*), blue flag iris (*Iris versicolor*), woolgrass (*Scirpus cyperinus*), spotted joe pye weed (*Eupatorium maculatum*), swamp milkweed (*Asclepias incarnata*), monkey flower (*Mimulus ringens*), soft-stem bulrush (*Shoenoplectus tabernaemontani*) (ex- *S. validus*), hardstem bulrush (*Schoenoplectus acutus*) (ex-*Scirpus acutus*), nodding bur marigold (*Bidens cernua*), and flat-top aster (*Aster umbellatus*).

Shrub species could be scattered along the margins of the wetland and include *Salix discolor* (silky dogwood).

5.2.2 Proposed Forested Wetland Restoration

Although only a very small area will be impacted by the proposed construction (0.004 acres/191 square feet), it is recommended that the impacted wetland be mitigated. Mitigation could simply consist of excavating a small area adjacent to the filled area and then planting with suitable wetland tree, shrub, and

herb species. Based upon the species composition observed in the field, it is recommended that the wetland restoration include a similar suite of species (Table 5-1). The plant species identified in the table are readily available from New England Wetland Plants located in Amherst, Massachusetts.

Table 5-1. Proposed wetland restoration species.

STRATUM	SCIENTIFIC NAME	COMMON NAME
	TREES	
TREE	*Acer rubrum*	Red maple
SHRUB	*Vaccinium corymbosum*	Highbush blueberry
	Rhododendron viscosum	Swamp azalea
	Clethra alnifolia	Sweet pepperbush
	Alnus rugosa	Speckled alder
HERB	*Symplocarpus foetidus*	Skunk cabbage
	Carex stricta	Tussock sedge
	Osmunda cinnamomea	Cinnamon fern
	Onoclea sensibilis	Sensitive fern
	Veratrum viride	False hellebore

In addition, it is proposed that the wetland seed mix used within the isolated wetland restoration be included in this wetland.

5.2.3 Buffer Zone Plantings

To the extent that it is possible, a vegetated buffer zone will be constructed around the wetlands on the site, which are the most susceptible to construction related impacts. It is recommended that the buffer zone consist of a mix of patch types that interdigitate with existing shrub, grass/herb habitats, and forested areas.

Enhancement wetland buffer zone plantings could include transitional wetland shrub species such as *Aronia melanocarpa* (black chokeberry), and *Amelanchier canadensis* (common serviceberry), while tree species could include a number of fast growing, early successional species such as grey birch, eastern red cedar, and quaking aspen along with white oak, which tolerates full sun to partial sun conditions, The buffer zone itself will occur in a strip designated for

planting, the width of which will be determined by onsite development. In addition to these species, it is proposed that a conservation seed mix be used that includes a range of wildflowers and grasses. Shrubs could be planted at 300 stems per acre and small trees (3' to 12' tall) relocated from upland disturbance areas on site.

5.2.4 Wetland Restoration Monitoring

The wetland restoration could be monitored the following growing season (or up to five growing seasons) to ensure that planted stock survived and also gauge the success of the restoration. Specifically, a fixed number of $1m^2$ plots could be established in the wetland to assess the percent cover of wetland species, or alternatively, the numbers of live woody species within the restoration could be tallied. A wetland monitoring report would then be prepared and submitted to the applicable regulatory agencies for their review.

5.2.5 Best Management Practices

To minimize the potential for erosion during construction, mitigation measures, including hay bales and silt fence, will be placed in appropriate locations on the site to both protect wetlands and to minimize the erosion of soil from stockpiles on the site. Prior to construction, erosion control devices would be placed between the work area and wetlands/receiving waters that are situated downgradient of construction activities.

6.0 LITERATURE CITED

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APPENDIX A

FLORISTIC INVENTORY

Table 1. Site-wide Floristic Inventory.

COMMUNITY TYPE	PLOT	SCIENTIFIC NAME	COMMON NAME	% COVER
Acer rubrum Swamp	1	*Acer rubrum*	Red maple	30
		Vaccinium corymbosum	Highbush blueberry	70
		Rhododendron viscosum	Swamp azalea	10
		Quercus alba	White oak	10
		Symplocarpus foetidus	Skunk cabbage	40
		Osmunda cinnamomea	Cinnamon fern	40
		Lycopodium complanatum	Lycopodium	10
		Carex stricta	Tussock sedge	20
		Sphagnum magellanicum	Sphagnum moss	5
	2	*Amelanchier canadensis*	serviceberry	15
		Vaccinium corymbosum	Highbush blueberry	15
		Symplocarpus foetidus	Skunk cabbage	100
		Polytrichum commune	Polytrichum moss	5
		Acer rubrum	Red maple	40
	3	*Amelanchier canadensis*	serviceberry	15
		Vaccinium corymbosum	Highbush blueberry	15
		Acer rubum	Red maple	70
		Symplocarpus foetidus	Skunk cabbage	100
		Veratrum viride	False hellebore	1
		Osmunda cinnamomea	Cinnamon fern	40
		Carex stricta	Tussock sedge	10
		Rubus hispidus	Swamp dewberry	5
		Viola sp.	violet	5
	4	*Anemone quinquefolia*	Wood anemone	5
		Symplocarpus foetidus	Skunk cabbage	100
		Osmunda cinnamomea	Cinnamon fern	40
		Carex stricta	Tussock sedge	5
		Impatiens capensis	Spotted touch me not	5
		Galium palustre	Swamp bedstraw	<1
		Aster	Lance leaved aster	<1
		Rubus hispidus	Swamp dewberry	<1
		Sphagnum magellanicum	Sphagnum moss	40
		Clethra alnifolia	Sweet pepperbush	10
		Rhododendron viscosum	Swamp azalea	15
		Amelanchier canadensis	serviceberry	5
	5	*Quercus bicolor*	Swamp white oak	10
		Acer rubrum	Red maple	70
		Clethra alnifolia	Sweet pepperbush	70
		Vaccinium corymbosum	Highbush blueberry	15
		Alnus rugosa	Speckled alder	5
		Viburnum recognitum	Northern arrowwood	<1
		Symplocarpus foetidus	Skunk cabbage	30
		Polytrichum commune	Polytrichum moss	10
		Carex stricta	Tussock sedge	<1
		Anemone quinquefolia	Wood anemone	5

COMMUNITY TYPE	PLOT	SCIENTIFIC NAME	COMMON NAME	% COVER
		Maianthemum canadense	Canada mayflower	5
		Sphagnum spp.	Sphagnum moss	5
		Rubus hispidus	Swamp dewberry	5
		Iris versicolor	Blue flag	1
		Thalictrum thalicroides	Rue anemone	<1
		Lycopodiella inundata	Bog clubmoss	<1
		Osmunda cinnamomea	Cinnamon fern	10
	6	*Rhododendron viscosum*	Swamp azalea	20
		Ilex verticillata	winterberry	10
		Clethra alnifolia	Sweet pepperbush	40
		Alnus rugosa	Speckled alder	10
		Spiraea tomentosa	steeplebush	5
		Acer rubrum	Red maple (sapling)	5
		Carex stricta	Tussock sedge	100
		Symplocarpus foetidus	Skunk cabbage	10
		Sphagnum magellanicum	Sphagnum moss	75
		Viola sp.	violet	<1
	7	*Rhododendron viscosum*	Swamp azalea	10
		Clethra alnifolia	Sweet pepperbush	15
		Vaccinium corymbosum	Highbush blueberry	15
		Acer rubrum	Red maple	20
		Symplocarpus foetidus	Skunk cabbage	20
		Sphagnum spp.	Sphagnum moss	10
		STANDING WATER	NA	70
	8	*Vaccinium corymbosum*	Highbush blueberry	25
		Cephalanthus occidentalis	buttonbush	15
		Acer rubrum	Red maple (sapling)	15
		STANDING WATER	NA	80
Sand Barrens	9	*Pinus rigida*	Pitch pine	10
		Betula populifolia	Grey birch	15
		Schizachyrium scoparium	Little bluestem	15
		Polytrichum commune	Polytrichum moss	50
		Cladonia cristatella	British soldiers	5
		Usnea sp.	lichen	5
		SAND	NA	50
Successional Hardwoods	10	*Acer rubrum*	Red maple	40
		Betula populifolia	Grey birch	10
		Populus tremuloides	Quaking aspen	10
		Prunus serotina	Black cherry	10
		Quercus palustris	Pin oak	10
		Quercus alba	White oak	5
		Lonicera tatarica	Tatarian honeysuckle	5
		Rhus toxicodendron	Poison ivy	5
		Cornus amomum	Silky dogwood	1
		Maianthemum canadense	Canada mayflower	80

COMMUNITY TYPE	PLOT	SCIENTIFIC NAME	COMMON NAME	% COVER
		Potentilla simplex	cinquefoil	5
		Polytrichum commune	Polytrichum moss	5
	11	*Quercus alba*	White oak	60
		Prunus serotina	Black cherry	15
		Cornus stolonifera	Red osier dogwood	10
		Potentilla simplex	cinquefoil	1
		Solidago canadensis	Gray's goldenrod	1
		Carex sp.	sedge	40
		Mainanthemum canadense	Canada mayflower	70
		Pinus strobus	White pine	1
		Galium asparine	bedstraw	1
	12	*Carya ovata*	Shagbark hickory	60
		Juniperus virginiana	Eastern red cedar	5
		Acer rubrum	Red maple	5
		Prunus serotina	Black cherry	10
		Berberis thunbergii	Japanese berberry	15
		Carex pennsylvanica	Pennsylvania sedge	90
		Mainanthemum canadense	Canada mayflower	70
Sand Barrens	13	*Betula populifolia*	Grey birch	40
		Populus tremuloides	Quaking aspen	10
		Quercus ilicifolia	Scrub oak	30
		Carex pennsylvanica	Pennsylvania sedge	15
		Schizachyrium scoparium	Little bluestem	10
		BARE SAND	NA	70
Pitch Pine Barrens	14	*Populus tremuloides*	Quaking aspen	5
		Pinus rigida	Pitch pine	70
		Eleagnus augustifolia	Russian olive	5
		Myrica pennsylvanica	bayberry	25
		Spiraea latifolia	meadowsweet	25
		Carex pennsylvanica	Pennsylvania sedge	20
		Polytrichum commune	Polytrichum moss	40
	15	*Pinus strobus*	White pine	70
		Quercus rubra	Northern red oak	5
		Vaccinium angustifolia	Lowbush blueberry	15
		Schizachyrium scoparium	Little bluestem	20
		Polytrichum commune	Polytrichum moss	10
	16	*Pinus rigida*	Pitch pine	75
		Betula populifolia	Grey birch	5
		Juniperus virginiana	Eastern red cedar	5
		Polytrichum commune	Polytrichum moss	5
Russian olive thicket	17	*Eleagnus augustifolia*	Russian olive	70
		Juniperus virginiana	Eastern red cedar	10
		Schizachyrium scoparium	Little bluestem	5

COMMUNITY TYPE	PLOT	SCIENTIFIC NAME	COMMON NAME	% COVER
		Prunus serotina	Black cherry	5
		Eleagnus augustifolia	Russian olive	10
		Myrica pennsylvanica	bayberry	5
		Schizachyrium scoparium	Little bluestem	70
		Dactylus glomerata	Orchard grass	20
	19	*Pinus strobus*	White pine	5
		Eleagnus augustifolia	Russian olive	90
			Common mullein	5
		Dactylus glomerata	Orchard grass	60
Successional Woodland	20	*Populus tremuloides*	Quaking aspen	20
		Prunus serotina	Black cherry	25
		Lonicera tatarica	Tatarian honeysuckle	5
		Solidago canadensis	Grays goldenrod	60
		Carex pennsylvanica	Pennsylvania sedge	80
Hilltop *Quercus alba*	21	*Quercus alba*	White oak	40
		Quercus ilicifolia	Scrub oak	60
		Betula populifolia	Grey birch	5
		Vaccinium angustifolia	Lowbush blueberry	30
		Carex pennsylvanica	Pennsylvania sedge	80
	22	*Quercus alba*	White oak	60
		Pinus rigida	Pitch pine (SD)	5
		Quercus ilicifolia	Scrub oak	60
		Vaccinium angustifolia	Lowbush blueberry	10
	23	*Quercus alba*	White oak	60
		Prunus serotina	Black cherry	10
		Quercus ilicifolia	Scrub oak	30
		Vaccinium angustifolia	Lowbush blueberry	20
		Carex pennsylvanica	Pennsylvania sedge	20
		Pteridium aquilinum	Bracken fern	70
Isolated Wetland 1	24	*Populus deltoides*	cottonwood	10
		Acer rubrum	Red maple	25
		Vaccinium corymbosum	Highbush blueberry	60
		Onoclea sensibilis	Sensitive fern	15
Isolated Wetland 2	25	*Populus tremuloides*	Quaking aspen	10
		Vaccinium corymbosum	Highbush blueberry	40
		Salix bebbiana	Bebb willow	20
		Spiraea tomentosa	steeplebush	35
		Carex stricta	Tussock sedge	4
		Polytrichum commune	Polytrichum moss	25
Old Field	26	*Juniperus virginiana*	Eastern red cedar	10
		Eleagnus augustifolia	Russian olive	20
		Rhus typhina	Staghorn sumac	25

COMMUNITY TYPE	PLOT	SCIENTIFIC NAME	COMMON NAME	% COVER
		Myrica pennsylvanica	bayberry	15
		Schizachyrium scoparium	Little bluestem	10
		Dactylus glomeratus	Orchard grass	100
		Achillea millefolium	yarrow	10
Isolated Wetland 3	27	*Salix discolor*	Pussy willow	50
		Salix bebbiana	Bebb willow	40
		Equisetum fluviatile	horsetail	10
		Osmunda cinnamomea	Cinnamon fern	5
		Carex stricta	Tussock sedge	15
	28	*Spiraea latifolia*	meadowsweet	30
		Alnus rugosa	Speckled alder	20
		Decodon verticillatus	Water willow	40
		Sphagnum spp.	Sphagnum moss	5
		STANDING WATER	NA	70
Isolated Wetland (Road)	29	*Populus deltoides*	cottonwood	20
		Salix bebbiana	Bebb willow	15
		Cornus amomum	Silky dogwood	20

APPENDIX B

PLANT COMMUNITY PHOTOS

Figure 1. Plant community 1 – *Acer rubrum* swamp.

Figure 2. Plant community 2 – sand barren. Note ATV tracks.

Figure 3. Plant community 3 – early successional hardwood stand.

Figure 4. Plant community 4 – *Pinus rigida* stand.

Figure 5. Plant community 5 – *Quercus alba* *Q. ilicifolia* stand.

Figure 6. Plant community 6 – early successional shrubland.

Figure 7. Plant community 7 – isolated wetland/vernal pool habitat.

Figure 8. Plant community 7 – degraded isolated wetland.

APPENDIX C

AGENCY CORRESPONDENCE

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bureau of Natural Resources
Division of Wildlife
79 Elm Street, 6th Floor
Hartford, CT 06106
Natural Diversity Data Base

RECEIVED APR 0 8 2006

April 5, 2006

Mr. D. Scott Atkin
Anchor Engineering Services, Inc.
75 Nutmeg Lane
Glastonbury, CT 06033

re: Brownfield Redevelopment of Superfund Site with a 30 Biomass Gasification Power Generation Facility (a.k.a. Gallup's Quarry Superfund Site) on Tarbox Road in Plainfield, Connecticut

Dear Mr. Atkin:

I have reviewed Natural Diversity Data Base maps and files regarding the area delineated on the map you provided for the proposed brownfield redevelopment of a superfund site with a 30 Biomass Gasification Power Generation Facility (a.k.a. Gallup's Quarry Superfund Site) on Tarbox Road in Plainfield, Connecticut. According to our information, there are known extant populations of State Endangered *Scaphiopus holbrookii* (eastern spadefoot), State Threatened *Ambystoma laterale* (blue-spotted salamander, diploid population) and State Special Concern *Passerculus sandwichensis* (savannah sparrow) that occur in the vicinity of this project site. I have sent your letter to Julie Victoria (DEP-Wildlife; 860-642-7239) for further review. She will write to you directly with her comments.

Natural Diversity Data Base information includes all information regarding critical biological resources available to us at the time of the request. This information is a compilation of data collected over the years by the Natural Resources Center's Geological and Natural History Survey and cooperating units of DEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the Data Base should not be substitutes for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available.

Please contact me if you have further questions at 424-3592. Thank you for consulting the Natural Diversity Data Base. Also be advised that this is a preliminary review and not a final determination. A more detailed review may be conducted as part of any subsequent environmental permit applications submitted to DEP for the proposed site.

Sincerely,

Dawn M. McKay
Biologist/Environmental Analyst

Cc: Julie Victoria, NDDB # 14470

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

April 11, 2006

Mr. D. Scott Atkin
Anchor Engineering Services, Inc.
75 Nutmeg Lane
Glastonbury, CT 06033

re: Brownfield Redevelopment Superfund Site, Tarbox Road, Plainfield

Dear Mr. Atkin:

Your request was forwarded to me on 4/11/06 from Dawn McKay of the Department of Environmental Protection (DEP) Natural Diversity Data Base. Their records indicate that a state endangered species, Eastern Spadefoot Toad (*Scaphiopus holbrookii*), a state threatened species, Blue-spotted salamander (*Ambystoma laterale*) and a state species of special concern, Savannah sparrow (*Passerculus sandwichensis*) occurs in the vicinity of this property.

Blue-spotted salamanders are associated with riparian red maple swamps. They also occur in disjunct vernal wetlands near red maple swamps. They breed in March and April and may be found on the surface on wet rainy nights. They favor grassy or wooded, flood plain wetlands for breeding. If the favored habitats occur on this property and are going to be impacted than the blue-spotted salamander may be affected.

Limited information is known about Eastern Spadefoot Toad. They are very secretive and have irregular breeding periods. They are most active from June through August. They are expert burrowers going as deep as 2 meters in sandy well-drained soil. They are very rarely observed outside of the breeding period. Their habitat is described as arid to semi-arid areas, such as fields, farmland, dunes and woodlands with sandy or loose soils. And they breed in temporary bodies of water, flooded fields and forested wetlands. I've enclosed a fact sheet with life history information.

The Savannah Sparrow is a bird that nests in open, grassy areas. Its breeding season is approximately from May through August and it is during this period that the species is most susceptible to disturbances in its habitat. Minimizing impact to open fields, meadows, marshes, and other grassy areas during this time period will likewise minimize impact to this species. For further information on this species contact Jenny Dickson at the DEP Wildlife Sessions Woods office, 860-675-8130

The Wildlife Division has not been provided with details or a timetable of the work to be done. If this work will be conducted in these species' habitat, the Wildlife Division recommends that an ornithologist and herpetologist familiar with the habitat requirements of these species conduct surveys. A report summarizing the results of such surveys should include habitat descriptions, avian and herptile species list and a statement/resume giving the ornithologist' and herpetologist' qualifications. The DEP doesn't maintain a list of qualified surveyors. A DEP Wildlife Division permit may be required by the surveyors to conduct survey work, you should ask if your surveyor has one. The results of this investigation can be forwarded to the Wildlife Division and, after evaluation, recommendations for additional surveys, if any, will be made.

Consultation with the Wildlife Division should not be substituted for site-specific surveys that may be required for environmental assessments. Please be advised that should state permits be required or should state involvement occur in some other fashion, specific restrictions or conditions relating to the species discussed above may apply. In this situation, additional evaluation of the proposal by the DEP Wildlife Division should be requested. If you have any additional questions, please feel free to contact me at 860-642-7239. Thank you for the opportunity to comment.

Sincerely,

Julie Victoria, Wildlife Biologist
Franklin Swamp Wildlife Management Area
391 Route 32
N. Franklin, CT 06254

cc: D. McKay – (123047) 14465

FILE
952-01

Connecticut Natural Diversity Data Base Review Request Form

Please complete this form *only* if you have conducted a review which determined that your activity is located in an area of concern.

Name: **Anchor Engineering Services, Inc.**

Affiliation: **Consultant**

Mailing Address: **75 Nutmeg Lane**

City/Town: **Glastonbury** State: **CT** Zip Code: **06033**

Business Phone: **860-633-8770** ext. Fax: **860-633-5971**

Contact Person: **D. Scott Atkin** Title: **Vice President**

Project or Site Name: **Tarbox Road, LLC (aka Gallup's Quarry Superfund Site)**

Project Location

Town: **Plainfield** USGS Quad: **Plainfield**

Brief Description of Proposed Activities:

Proposed brownfield redevelopment of Superfund Site with a 30MW Biomass Gasification Power Generation Facility.

Have you conducted a "State and Federal Listed Species and Natural Communities Map" review?

☒ Yes ☐ No Date of Map: **Dec. 2005**

Has a field survey been previously conducted to determine the presence of any endangered, threatened or special concern species? ☐ Yes ☒ No

If yes, provide the following information and submit a copy of the field survey with this form.

Biologists Name:

Address:

If the project will require a permit, list type of permit, agency and date or proposed date of application:

see attached statement

MAR 22 2006

(See reverse side - you must sign the certification on the reverse side of this form)

The Connecticut Natural Diversity Data Base (CT NDDB) information will be used for:

☒ permit application

☒ environmental assessment (give reasons for assessment):

EPA requirement

☐ other (specify):

"I certify that the information supplied on this form is complete and accurate, and that any material supplied by the CT NDDB will not be published without prior permission."

Signature

March 22, 2006
Date

All requests must include a USGS topographic map with the project boundary clearly delineated.

Return completed form to:

WILDLIFE DIVISION
BUREAU OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 ELM ST, 6TH FLOOR
HARTFORD, CT 06106-5127

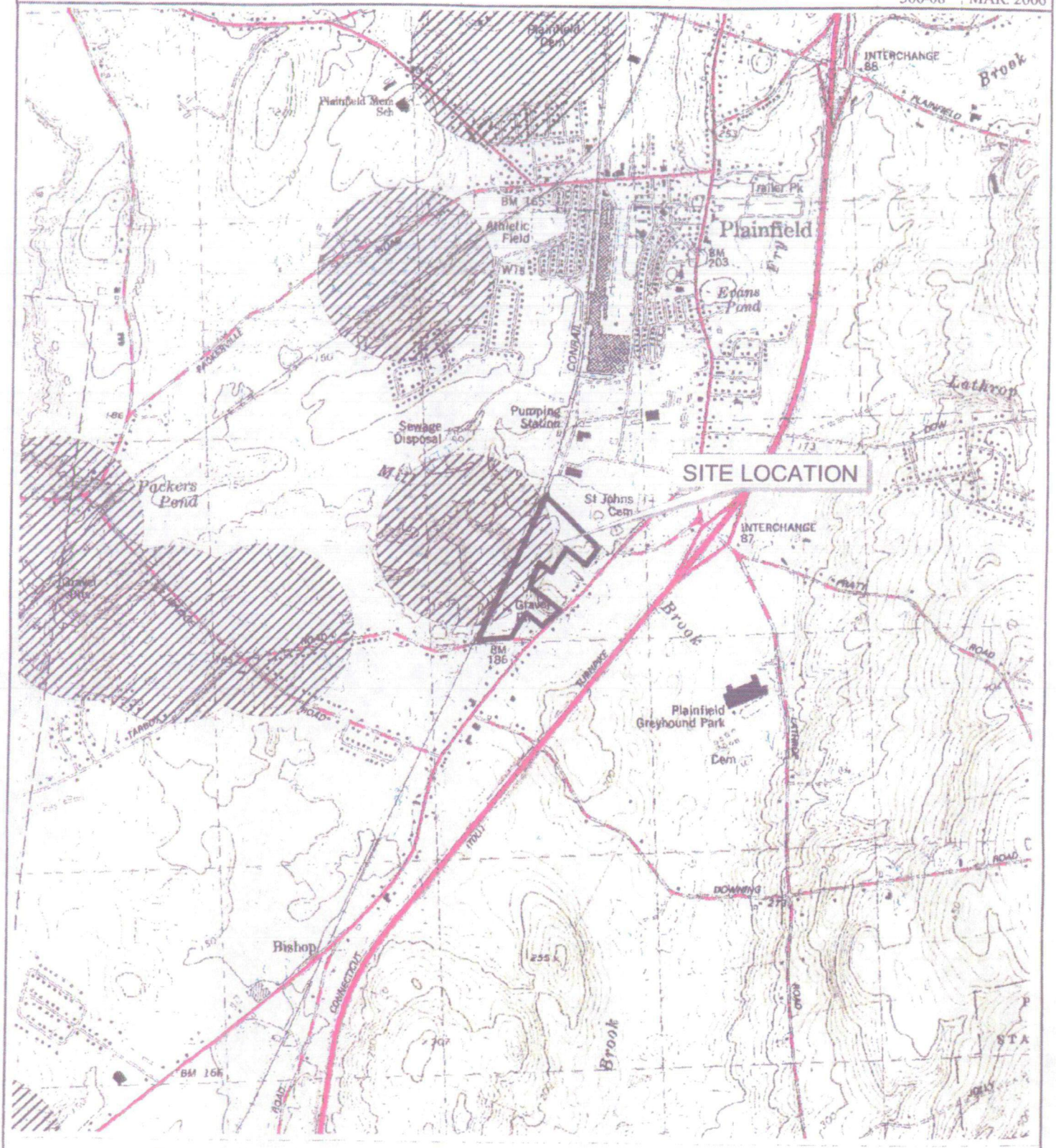
* You must submit a copy of this completed form with your registration or permit application.

ANCHOR ENGINEERING SERVICES, INC.
75 NUTMEG LANE
GLASTONBURY, CONNECTCIUT 06033
860-633-8770 FAX 860-633-5971

ESA PHASE I
TARBOX ROAD, LLC
MILL BROOK ROAD
PLAINFIELD, CONNECTICUT

FIGURE 1

PROJECT	DATE
300-08	MAR. 2006



USGS TOPO QUAD #58
PLAINFIELD, CT

APPENDIX D

SURVEYOR RESUME

Kleinschmidt
Energy & Water Resource Consultants

PROFESSIONAL RESUME

Jeffrey J. Park

Ecologist

Jeffrey J. Park is an Ecologist with Kleinschmidt Associates. He received an M.A. in Biology from Harvard University (1998) (*Thesis*: *The Effects of Gap-Phase Heterogeneity on Stand Dynamics within a Chamaecyparis thyoides Forest*) and a B.A. in Anthropology from the University of Maine (Orono) (1993). Mr. Park has 8 years of experience.

Mr. Park joined Kleinschmidt Associates in early 2006. Prior to joining Kleinschmidt, Mr. Park was an Ecologist/Biostatistician for TRC Environmental Corporation, where he worked for seven years. During that seven-year period, Mr. Park designed and conducted numerous aquatic and terrestrial ecological studies within the northeast and Mid-Atlantic States. Studies quantitatively assessed spatial and temporal patterns in abundance, distribution, and species composition within plant, fish, amphibian, benthic macroinvertebrate, phytoplankton/zooplankton, and macroalgal communities. Biota were evaluated with respect to biotic properties, e.g., competitive interactions, and abiotic properties, e.g., soil/water physico-chemical attributes, substrate types, and light intensity. Aquatic resource analyses have also included quantifying CWIS entrainment/impingement (E/I) impacts, providing an analysis of thermal plume impacts, assessing population, community, and ecosystem-level effects associated with heated cooling water discharges and E/I, and discussing species-specific biology. This work was conducted in association with Hydro re-licensing projects, National Pollutant Discharge Elimination System (NPDES) permits, and State Pollutant Discharge Elimination System (SPDES) permits, e.g., the Bowline Facility (Hudson River). Impact analyses have also included the identification of sensitive aquatic resources and critical aquatic habitats.

In addition to applying fundamental ecological principles, Mr. Park has extensive experience with various univariate/multivariate biostatistical analyses, experimental design, and hypothesis testing. Standard quantitative ecological analyses have included, amongst others, rarefaction analysis, similarity/dissimilarity indices, diversity indices, and spatial pattern/coefficients of dispersion. With respect to statistical analyses, Mr. Park has used data transformations and a suite of goodness-of-fit tests, along with quantile:quantile plots, frequency distribution histograms, and basic descriptive statistics. Nonparametric and parametric univariate statistics have included the Mann-Whitney *U*-test, two-sample Kolmogorov-Smirnov *D*-test, simple linear regression, Mann-Kendall test for trend, and one-way ANOVA. Multivariate methods have included Detrended Correspondence Analysis (DCA), Two-way Indicator Species Analysis (TWINSPAN), Principle Factors Analysis (PFA), and agglomerative/hierarchical Cluster Analysis. Mr. Park has also modeled fish (closed systems) and benthic macroinvertebrate populations. Quantitative analyses have included simple linear regression, one way ANOVA, equivalent adult loss calculations, and manipulating Conditional Entrainment Mortality Rate (CEMR) based modeling results. Population size estimates have utilized maximum weighted likelihood estimates, mark/recapture studies, and software programs including MARK/CAPTURE.

The following summaries present a sampling of the experience types that Mr. Park has generated over the past seven years. Experience types discussed include ecological studies; ecological risk assessment; aquatic resource analyses; biostatistics; ACOE wetland functions & values assessments; wetland design and construction; and rare, threatened, and endangered species/habitat assessments.

PROJECT/CLIENT	DATE	RESPONSIBILITY
Plainfield Renewable Energy, LLC New Cooling Water Intake Aquatic Ecology Assessment Canterbury, CT	ongoing	Project Manager for a study that characterized fish communities within the Quinebaug River. Mr. Park collected the fish data through a combination of electrofishing and hoopnet sampling, conducted all data analyses, and wrote the environmental impact assessment. The impact assessment discussed impacts to larval and adult fishes with respect to suspended solids, waste stream physico-chemical properties, entrainment, and impingement. Mr. Park also assessed baseline fish health by assessing the effects of parasites on juvenile redbreast sunfish, calculating a fish condition factor, and constructing linear length:weight regression plots for juvenile fishes
Niantic River Restoration Plan Niantic River Ecology Niantic, CT	ongoing	Using data sets collected by the University of Connecticut and the Millstone Environmental Laboratory, Mr. Park developed an aquatic ecology assessment for the Niantic River estuary that quantitatively assessed the effects of nutrient loading, light attenuation K_d, and chlorophyll *a* densities on macroalgal and eelgrass biomass, in addition to macroalgal community composition. Mr. Park also examined the effects of changes in eelgrass biomass on benthic macroinvertebrates, and fishes. Data analyses included a non-parametric Mann-Kendall test for trend, a *t*-test for independent samples, and the Shannon-Weiner Diversity Index (including evenness).
Long-term Forested Wetland Vegetation Monitoring FAA Atlantic City, NJ	ongoing	Lead ecologist presently conducting a long-term study designed to monitor and assess the effects of changes in groundwater elevation on the vertical distribution of forested wetland seedlings. The target species included in the analysis will include *Chamaecyparis thyoides* (Atlantic white cedar), *Acer rubrum* (red maple), and *Clethra alnifolia* (sweet pepperbush). By establishing baseline conditions, drawdown effects will be distinguished from natural variation using statistically based analyses.
Benthic Macroinvertebrate Population Modeling and Measures of Effect Study FAA Atlantic City, NJ	2006	Aquatic macroinvertebrates were collected in contaminated and uncontaminated portions of the mercury-impacted South branch of Absecon Creek. Population estimates were calculated using a maximum weighted likelihood (MLE) estimate developed by Carle and Strub (1978), which is a multiple pass depletion method. Statistical analyses included Cluster Analysis and a Kruskal-Wallis ANOVA. Mr. Park conducted the data analysis for one of the co-authors of the MLE Method (Dr. Frank Carle of Rutgers University).

Stream Bioassessment using Benthic Macroinvertebrates FAA Atlantic City, NJ	2006	Assessed the Index of Biotic Integrity (IBI) within a stream community using benthic macroinvertebrates collected from riffle and pool habitats. Variables examined included % Ephemeroptera, % Plecoptera, % Trichoptera, % Dicronota, % Trichoptera, in addition to functional feeding group, the Coastal Plain Macroinvertebrate Index (CPMI), species richness (R), Shannon-Weiner diversity (H), evenness (J), and a MLE generated population size. Abiotic properties examined included total/filtered surface water Hg, DO, temperature, total dissolved solids, conductivity, pH, and flow volume/velocity/depth. Cluster Analysis was used to segregate sites on the basis of H, J, R, and the MLE estimate. A Spearman Rank Order correlation analysis was used to associate community metrics with abiotic properties.
Avian Foraging/Avian Migrant Study Kibby Windpower Project ME	2006	Using existing avian community data, Mr. Park calculated a Morisita coefficient of similarity, the Shannon-Weiner diversity coefficient (H), and an index of community equitability (J). Statistically significant differences in the *H* index for species were assessed with a Mann-Whitney U-test. Variability in avian data was linked with temperature. Using existing avian community data, Mr. Park calculated a species-specific coefficient of estimated turbine exposure, and conducted a statistical evaluation of avian flight vectors. Mr. Park also provided critical review of an avian radar study conducted by Woodlot Alternatives, Inc.
Geostatistical Modeling of Hg Distribution in Reservoir Sediments FAA Atlantic City, NJ	2005	Mr. Park provided statistical support for an analysis of the spatial distribution of Hg contaminated sediments present in the FAA wetland/open water complex. The complex was partitioned into hydraulic units including the South and North Branches of Absecon Creek, in addition to the Upper and Lower reservoirs. The analysis included the assessment of the distribution of the data, in addition to modeling of Hg distribution using an empirical semivariogram and kriging. The effort resulted in surface maps identifying Hg concentration contours by hydraulic unit which facilitated a calculation of the total estimated volume of Hg in the FAA wetlands/reservoirs.
Breeding Anuran Measures of Effect Study FAA Atlantic City, NJ	2005	Mr. Park was responsible for designing and writing the results up for a study that examined the effects of Hg contamination and habitat parameters on breeding anuran populations. Habitat properties were sampled within a total of 14 breeding sites and included: conductivity, dissolved oxygen, pH, oxidation/reduction potential, total dissolved solids, total suspended solids, temperature, conductivity; aluminum (Al), total mercury (Hg), understory light intensity, and estimated percent cover of substrate types. Principal Factor Analysis (PFA) was used to reduce the large set of habitat variables to a smaller set of underlying variables, which would account for the common variance in the total data set. Habitat variables, auditory call scores, and breeding anuran numbers were associated with PFA axis scores with a Spearman Rank correlation coefficient. The results of the study indicate that light levels, water temperature, and pH are more proximate to the distribution of anurans than surface water Hg concentrations.

Peatland Restoration Lockheed-Martin/Former GE Site North Reading, MA	2005	Mr. Park was responsible for designing a shrub-dominated bog restoration of a metals-contaminated portion of a wetland that was dominated by the invasives *Phragmites australis* and *Lythrum salicaria.* Once the invasives were removed, and the contaminated soils excavated, Mr. Park specified the wetland soil type, plant species list, and designed the wetland restoration hummock-hollow micro-topography. Mr. Park was responsible for quantitative post-construction monitoring, data analysis, and reporting.
Fish Population Measures of Effect Study FAA Atlantic City, NJ	2005	Mr. Park helped design and execute a fish mark/recapture study that utilized line sampling and hoop nets. All fishes caught were tagged (dorsally), identified to species, weighed, and measured (TL mm). Mr. Park was also responsible for using simple linear regression of log transformed length-weight data in order to identify possible Hg related effects on growth. In addition, Mr. Park calculated fish condition factors. Differences in fish growth between the contaminated and reference sites were assessed with a Kolmogorov- Smirnov D-test. Population estimates were conducted with the software program MARK/RECAPTURE. Mr. Park was responsible for summarizing all results in a technical report that was included in the Supplemental Ecological Risk Assessment.
Dendrochemical Dating Study FAA Atlantic City, NJ	2005	Mr. Park developed and conducted a study designed to identify the timing of the deposition of elemental Hg (mercury) within the forested wetlands associated with the South Branch of the Absecon Creek (SBAC). Specifically, Mr. Park used increment cores extracted from *Chamaecyparis thyoides* (Atlantic white cedar), and Hg concentrations contained within five-year increments to determine the date of Hg deposition. A Mann-Kendall test was used to examine trends with time, while box plots and a Mann-Whitney U- test was used to assess spatial trends. This investigation was used as an ancillary study to sediment dating analyses conducted by Rensellaer Polytechnic Institute (RPI) with critical review being provided by the Massachusetts Institute of Technology (MIT). All analyses of Hg in wood tissue followed USEPA approved protocols and were conducted by a USEPA approved laboratory. The results of the dendrochemical study closely matched the results of the sediment dating study and effectively pinpointed a timeframe for the initial input of Hg into the SBAC forested wetlands.
Tree Swallow Measures of Effect Study FAA Atlantic City, NJ	2005	Mr. Park was responsible for conducting all data analysis on tree swallow nestling growth and egg tissue Hg concentrations. Data analysis included generating predicted nestling weights, comparing median nestling weights with a Mann-Whitney U-test, and assessing the effects of hatch date, location, and egg tissue Hg levels with Principal Factors Analysis (PFA). Mr. Park was responsible for all data analysis and summarized the findings in a brief technical report that was included in the Supplemental Ecological Risk Assessment.

Saxifraga pennsylvanica survey Proposed Subdivision Kennebunkport, ME	2005	Mr. Park's responsibilities included the design and execution of a field survey for the state listed (threatened) swamp saxifrage (*Saxifraga pennsylvanica*). Sampling included establishing randomly placed 5 meter radial plots; identifying all plant species within the plots; estimating percent canopy cover and measuring understory light levels. All data were presented in a technical memorandum. Mr. Park presented the plant survey results at a public hearing before the Kennebunkport Planning Board and discussed impacts to the swamp saxifrage, which was identified on the site.
Terrestrial Ecology Analysis North Bellport Energy Facility EA Long Island, NY	2005	Mr. Park was responsible for the characterization of natural resources on a 90-acre parcel in Long Island, NY. Natural resource characterization included a quantitative study of terrestrial forest communities, identification of forest successional trends, a wildlife survey, and a rare species survey (tiger salamander). An impact assessment was also conducted. Mr. Park summarized the findings in the Terrestrial Ecology section of an EA under New York State's SEQRA process.
Reservoir Plankton Mercury Study FAA Atlantic City, NJ	2005	In order to more accurately identify mercury transfer with the aquatic food web present in the Atlantic City Reservoirs (Upper and Lower), plankton were collected with a tow-net for quantitative analysis and analyzed for both mercury and methylmercury. Mr. Park developed the quantitative approach used to compare impacted plankton populations with non-impacted populations. Preliminary data analyses included correlation, and a test for the mean.
MCP Stage I Ecological Risk Characterization Brownfield Site Gardner, MA	2005	Mr. Park conducted a Stage I Ecological Risk Characterization (ERC) in accordance Massachusetts Contingency Plan (MCP) rules and regulations at a Brownfields site located in Gardner, Massachusetts. Mr. Park characterized all habitat types, identified ecological receptors, and identified complete exposure pathways with existing soil and sediment PAH data. The results of the Stage I ERC indicated that PAH concentrations were elevated throughout the brook located on the site, in addition to associated tributaries. A "Local Conditions" argument was used to suggest that the association between site contamination and brook contamination was confounded by outside sources of PAHs. It was concluded that a Stage II ERC was not warranted and that the removal of the brook sediments would do little to remedy the PAH problem, given that PAH input may be ongoing.
Wetland Restoration Woodbury Development Associates, Woodbury, NY	2001-2005	Mr. Park was responsible for the oversight of a 4.7-acre wetland restoration, post-construction monitoring, and reporting to the ACOE District Engineer. Data analysis reflected an interaction between TRC and the ACOE District Office. The agreed upon analysis included absolute and relative dominance, absolute and relative frequency, and finally absolute and relative percent cover. Assessment of tree survival was assessed in the field. Mr. Park conducted all analyses and submitted the final monitoring report in 2005.

Screening Level Ecological Risk Assessment (SLERA) GE Silicones Facility-Hazardous Waste Incinerators Waterford, NY	2004	Mr. Park was responsible for identifying ecological receptors and characterizing the ecological setting. All work was conducted in accordance with Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA, August 1999). Mr. Park also provided guidance to the lead risk assessor with respect to assessment endpoints and ingestion rates. Ingestion rate data were obtained from the Wildlife Exposure Factors Handbook (USEPA, 1993).
Wetland Restoration KC Realty Trust Siting Plan Newburyport, MA	2000-2004	Designed a 2.6-acre wetland restoration at a previously filled site. The design included preparing a plan that specified excavation depths, volume of material to be removed, a planting plan, and a post-construction monitoring protocol. Data analyses included simple percent cover and an examination of species richness with time. The restoration plan was submitted to the MA DEP Northeast regional office and the Newburyport Conservation Commission. Both agencies approved the plan. Mr. Park submitted the Final Monitoring Report to the ACOE in 2004 and received a certificate of compliance from the Newburyport Conservation Commission.
Benthic Macroinvertebrate Community Characterization Idaho Power Company Snake River Facility Hydro Re-licensing Project Idaho	2003	Mr. Park conducted an analysis of benthic invertebrate data collected over a seven-year period within the Snake River. Data analyses included rarefaction curves, Shannon-Weiner diversity indices (H), Sorenson's index of similarity (C_N), Renkonen Similarity index, and a Hilsenhoff biotic index. Statistical analyses included Multivariate hierarchical and agglomerative Cluster Analysis; non-parametric Kruskal-Wallis ANOVA; a two sample Kolmogorov-Smirnov D-test; and using 95% confidence intervals around the actual mean to determine a required sample size to characterize under-sampled portions of the river. Mr. Park was responsible for interpreting results and presenting the discussion in reports that were incorporated into the overall report for each year.
Statistical Analysis of Toxicity Data FAA Atlantic City, NJ	2003	Mr. Park collected toxicity data and statistically assessed significant differences in mean toxicity values with a one-way Analysis of Variance (ANOVA). The raw toxicity data used in the ANOVA included the eight laboratory runs of (1) *Hyallela azteca* survival fraction; (2) *Hyallela azteca* length; (3) *Hyallela azteca* weight; and (4) *Chironomus tentans* survival fraction. Prior to the ANOVA analysis, all raw survival fraction data were subjected to a Shapiro-Wilk *W*-test for normality. Following the *W*-test, all non-normally distributed survival fraction data were arcsine ((square root (x)) transformed to achieve normality. Following the ANOVA analysis, a *post-hoc* pairwise comparison of site means was conducted with a Tukey HSD (honestly significantly different) test, which is based upon the studentized range distribution. Mr. Park also conducted an analysis of Rapid Bioassessment Protocol (RBP) data using a Pearson product-moment correlation coefficient with corresponding 0.05α probability levels.

Statistical Analysis of RBP Data Ecological Risk Assessment, BNSF Site	2003	Mr. Park was responsible for conducting a non-parametric correlation analysis of RBP scores, benthic invertebrate community indices, and various surface water and sediment chemical properties. All data were first subjected to a Shapiro-Wilk *W*-test for normality. The non-normally distributed data were then analyzed with a Spearman Rank Order correlation coefficient matrix. Mr. Park summarized all findings in a technical report that was incorporated into the Risk Assessment.
Assessment of Benthic Macroinvertebrate Assemblages Ecological Risk Assessment Montello Site	2003	The non-parametric Wilcoxon Matched Pairs test was used to explore the possibility of significant differences in benthic macroinvertebrate community metrics between Rapid Bioassessment Protocol (RBP) Site Pairs. A necessary additional step in the analysis of the benthic community was to investigate exactly how species composition changed between sites. This was achieved with the use of the Morisita Index of Similarity (MS_{ij}). Mr. Park summarized all findings in a technical report that was incorporated into the Risk Assessment.
Carex bullata Survey Islander East Proposed Gas Pipeline Long Island, NY	2003	In response to NYSDEC concerns over impacts to four plant species within a proposed gas pipeline right-of-way (ROW), Mr. Park developed and executed a quantitative rare plant survey. The sample methodology employed was submitted to the NYSDEC before any work was conducted. During the course of the survey, a small population of the state-listed plant *Carex bullata* (button sedge) was identified. The plant population was identified, a quantitative assessment of population e.g. densities was conducted, and the plant population was surveyed. All findings were presented in a report that was submitted to the NYSDEC.
Disturbance-mediated Forested Wetland Dynamics FAA Atlantic City, NJ	2003	Mr. Park designed and conducted a study as part of the FAA Ecological Risk Assessment eco-values studies that identified differences in contaminated versus uncontaminated stand composition and structure, *Acer rubrum* (red maple) and *Chamaecyparis thyoides* (Atlantic white cedar) growth rates, and understory species richness. The study also characterized the effects of allogenic processes including hurricanes, the channelization of the SBAC, and mechanical timber removal on vegetation dynamics. The study employed historic aerial photographs (1932-1974), age-structure analysis, tree-ring chronologies, stand structure analysis, understory photosynthetic photon flux density (PPFD) intensity, and understory vegetation characterization. Data analyses included Kolmogorov-Smirnov test; Kruskal-Wallis ANOVA; Principal Factors Analysis; G-test for spatial pattern, Coefficient of Dispersion, and the Fisher Exact Probability test.

Pilot Mitigation Program: Shrubland Restoration FAA Atlantic City, NJ	2003	Mr. Park designed and conducted a shrubland study that recorded data on dominant herbs, tree and shrub seedlings, depth of the A/A_p horizon and underlying strata, and A-layer physical and chemical properties. In addition, soil data were collected at the bases of *Andropogon scoparius*, *Lyonia mariana*, and *Baptisia tinctorum*. These plants have been documented to be important to the life cycles of various endangered moth and butterfly species. The baseline study will assess what factors comprise the driving mechanisms behind the reference butterfly plant community and the individual plant species. The results of the baseline study will be used to generate a barren area restoration plan, the construction of which will be overseen by Mr. Park. Mr. Park is presently writing the report and will also be responsible for post-construction monitoring and reporting. Data analyses included 95% confidence intervals, Kolmogorov-Smirnov one sample *D*-test and the Mann-Whitney *U*-test.
Terrestrial Ecology Indian Point Peaking Facility Article X Buchanan, NY	2002	Mr. Park was responsible for the characterization of natural resources on a 102-acre parcel in Buchanan, NY. Natural resource characterization included a quantitative study of terrestrial forest communities, a delineation of wetlands, and a wildlife assessment. An impact assessment was also conducted. Mr. Park summarized the findings in the Terrestrial Ecology section in accordance with Article X of the New York State Public Service Law.
Islander East Proposed Gas Pipeline Helianthum propinquum and Floerkea prosepinacoides Surveys Various Sites, CT.	2002	The Connecticut Department of Environmental Protection (CTDEP) identified four areas intersected by the proposed pipeline alignment potentially containing seven rare plant species. It was determined that three of the four areas would not be affected by the proposed project and that of the seven plant species both *Helianthum propinquum* (frostweed) (endangered) and *Floerkea prosepinacoides* (false mermaid-weed) (endangered) exhibited the potential to occur in the pipeline ROW. All upland and wetland habitats were initially screened with a meander survey. Walk-through survey methods involved two paired individuals walking in a zig-zag fashion so as to cover the entire extent of the right-of-way, while simultaneously noting immediately adjacent habitat. The survey indicated that while a rich floral assemblage occurred in the ROW, the two plant species of interest did not. The CTDEP concurred with the findings of the survey.
Forest Mitigation Bank Study FAA Atlantic City, NJ	2002	Mr. Park designed and conducted a forest attributes study that recorded data on dominant herbs, tree and shrub seedlings and substrate cover type present within each of the forest mitigation areas. In addition, the number and species composition of basal sprouts, discrete saplings, and mature shrubs were also assessed. The objectives of the study were to extrapolate from evidence gleaned from germinated and recruited woody tree species, shrubs, and herbaceous species and predict future forested stand composition. Based upon the data collected in the field, management strategies, i.e. selective thinning, will be identified that would accelerate desirable vectors and that will optimize forested habitat for the ovenbird, hairy woodpecker, and the scarlet tanager. Mr. Park was responsible for all data analysis and writing the Methods, Results, and portions of the Discussion sections of the report.

Review of Statistical Analysis of Groundwater Data Laurel Park Landfill Naugatuck, CT	2002	Mr. Park critically reviewed a statistical analysis of groundwater data conducted by others relative to the assessment of cap effectiveness under EPA jurisdiction. Upon the completion of the review Mr. Park identified several problems with the analysis, offered up suggested analyses and conducted an independent assessment of the data. Specifically a linear regression analysis, parametric prediction interval analysis, and a non-parametric tolerance interval analysis were conducted. Additional analyses included a Kolmogorov-Smirnov D-test. All analyses and interpretations of data were presented in a report that was appended to the overall 5-year Multi-Site Review report.
Review of Statistical Analysis of Groundwater Data Beacon Heights Landfill Beacon Falls, CT	2002	Mr. Park critically reviewed a statistical analysis of groundwater data conducted by others relative to the assessment of cap effectiveness under EPA jurisdiction. Upon the completion of the review Mr. Park identified several problems with the analysis, offered up suggested analyses and conducted an independent assessment of the data using CHEMSTAT. Specifically a linear regression analysis, parametric prediction interval analysis, and a non-parametric tolerance interval analysis were conducted. Additional analyses included a Mann-Whitney U-test. All analyses and interpretations of data were presented in a report that was appended to the overall 5-year Multi-Site Review report.
Wetland Functions/Values Assessment and Designed Wetland Development CRRA Wallingford, CT	2001	Mr. Park conducted a Wetland Functions and Values Assessment of onsite wetlands present upon a contaminated 45-acre property adjacent to the Wallingford Landfill for the Connecticut Resources Recovery Authority (CRRA). The functional assessment was conducted in accordance with the ACOE Highway Methodology and utilized surface water and shallow groundwater data to assess the degree to which onsite wetlands processed the landfill leachate plume. Mr. Park wrote the Wetland Functions and Values Assessment Report, which summarized all data, impacts, and compensation. Mr. Park designed a conceptual wetland mitigation plan that provided for the processing of a landfill leachate plume.
Aquatic Resources Calpine Energy Proposed Power Plant Lawrence, OH	2001	Mr. Park was responsible for summarizing water quality, electro-fishing, and Hester-Dendy invertebrate sampling results within the Greenup Pool portion of the Ohio River. Quantitative analyses included correlation, Shannon-Weiner diversity index (H), and an equitability index (J).
Wetland Functional Assessment Millenium Industrial Park Middletown, CT.	2001	Mr. Park conducted a survey of wetland plant communities on an 80-acre parcel situated in central Connecticut. In addition to identifying major plant communities, Mr. Park conducted a wetland Functions and Values Assessment in accordance with the ACOE Highway Methodology. Mr. Park wrote the Wetland Functions and Values Assessment Report, which summarized all data, impacts, and compensation.
Aquatic Resources Calpine Energy Lawrence Energy Center Lawrence, OH	2001	Mr. Park was responsible for summarizing water quality, electro-fishing, and Hester-Dendy invertebrate sampling results within the Greenup Pool portion of the Ohio River. Quantitative analyses included correlation, Shannon-Weiner diversity index (H), and an equitability index (J). Mr. Park also compiled CORMIX input parameters.

Confidential Pipeline Client, *Betula nigra* and *Gentiana crinata* surveys, Various sites, NH.	2000	The New Hampshire Natural Heritage Bureau identified several areas intersected by the proposed pipeline alignment potentially containing state listed threatened plant species. Mr. Park conducted quantitative surveys for both *Betula nigra* (river birch) and *Gentiana crinata* (fringed gentian) within the areas of interest. Mr. Park located both species and quantitatively sampled percent cover, in addition to numbers of associated plant species. The population of each plant species was flagged off and subsequently surveyed prior to pipeline construction.
Article X Aquatic Resources Impact Assessment New York Power Authority 500 MW Charles Poletti Power Project Long Island City, NY	2000	Mr. Park wrote the Aquatic Resources section of an Article X application that discussed fish biology/life history, entrainment impacts and impingement impacts. Mr. Park also identified all historical studies conducted within the vicinity of the facility. Mr. Park conducted an assessment of diel trends in entrainment with a one-way ANOVA. In addition, general patterns in both entrainment and impingement were discussed.

Article X Aquatic Resources Impact Assessment Mirant Energy Proposed 750 MW Bowline Unit 3 Haverstraw, NY	1999-2000	Mr. Park wrote the Aquatic Resources section of an Article X application that discussed fish biology/life history, entrainment impacts, impingement impacts, and thermal plume impacts. Data analysis included simple linear regression to obtain predicted Bowline Unit 3 100% CMR (Conditional Mortality Rate) values from CEMR model generated CMR values; flow-weighting CMR values through ontogenetic progression (eggs, YSL, PYSL, JUV), and developing a total length (TL) adjustment factor for each fish to reflect the percentage of a given lifestage susceptible to entrainment with the use of a Johnson wedge-wire screen, i.e. <15mm TL. In this manner, conditional entrainment mortality rates were developed for the seven fishes of concern. In addition to the manipulation of CMR values, a thermal assessment analysis and an Equivalent Adult Loss calculation were also conducted. This power plant was successfully permitted.
Article X Terrestrial Resources Impact Assessment Mirant Energy Proposed 750 MW Bowline Unit 3 Haverstraw, NY	1999-2000	Mr. Park was responsible for the characterization of natural resources on the Bowline parcel in Haverstraw, NY. Natural resource characterization included a quantitative study of terrestrial plant communities, wetlands, and a wildlife characterization, including an impact assessment. Mr. Park summarized the findings in the Terrestrial Ecology section of a permit application submitted under New York State's Article X process.
EFH Impact Assessment Mirant Energy Proposed 750 MW Bowline Unit 3 Haverstraw, NY	1999-2000	Mr. Park developed an Essential Fish Habitat (EFH) Impact Assessment report that discussed EFH fish biology/life history, entrainment impacts, impingement impacts, Equivalent adult losses, thermal plume impacts, and included an assessment of Best Technology Available (BTA).
Helonias bullata Survey AES Red Oaks Power Plant Facility Sayreville, NJ	1999	Mr. Park's responsibilities included designing and executing a field survey for the federally listed (threatened) swamp pink (*Helonias bullata*) with data analysis. Sampling included establishing non-randomized 10 meter radial plots along linear transects; identifying all plant species within the plots; constructing species-area curves to ensure adequate sampling; characterizing wetland sub-communities with Sorenson's index of similarity (C_N); and presenting an analysis of the field data in a technical report. The final report was submitted to the U.S. Fish and Wildlife Service who agreed with the conclusion that the swamp pink was not present on the AES site.
Muddy River Restoration Project Boston Parks & Recreation Dept. Boston, MA	1998	Mr. Park conducted a feasibility study associated with the proposed restoration of the Muddy River. The study results were presented in an Environmental Notification Form (ENF), which was presented to MEPA. The study included a characterization of wetland and aquatic resources in addition to a dredging feasibility assessment, including dredged material volumes, and dredged material treatment.
Aquatic Macrophyte Study Franklin Park Ponds and Lakes Study Grant Boston Parks & Recreation Dept. Boston, MA	1998	Mr. Park developed and conducted a study that assessed the effects of nutrient loading and sediment thickness on the distribution of aquatic macrophytes. Sampling was conducted along linear transects within 1m x 1m PVC quadrat. Data collection included identifying all macrophytes, estimating % cover, measuring water depths, taking secchi disk readings, and collecting sediment samples. Sediment samples were measured for TKN, total N and total P, ammonium, and phosphates.