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Burrillville Interconnection Project

Burrillville, Rhode Island

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APPENDIX A

Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health: Rhode Island Transmission Line Projects – The Narragansett Electric Company d/b/a National Grid (March 9, 2015)

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Health Sciences Practice

Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health:

Rhode Island Transmission Projects – The Narragansett Electric Company d/b/a/ National Grid

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Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health:

Rhode Island Transmission Projects – The Narragansett Electric Company d/b/a National Grid

Prepared for:

Rhode Island
Energy Facility Siting Board
and
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Acronyms and Abbreviations

AC	Alternating current
ALL	Acute lymphoblastic leukemia
ALS	Amyotrophic lateral sclerosis
AMI	Acute myocardial infarction
CI	Confidence interval
DMBA	7,12-dimethylbenz[a]anthracene
ELF	Extremely low frequency
EMF	Electric and magnetic fields (or electromagnetic fields)
G	Gauss
HCN	Health Council of the Netherlands
Hz	Hertz
IARC	International Agency for Research on Cancer
ICES	International Commission on Electromagnetic Safety
ICNIRP	International Committee on Non-Ionizing Radiation Protection
JEM	Job exposure matrix
kV	Kilovolt
kV/m	Kilovolts per meter
mG	Milligauss
OR	Odds ratio
RR	Relative risk
SCENIHR	Scientific Committee on Emerging and Newly Identified Health Risks
TWA	Time weighted average
V/m	Volts per meter
WHO	World Health Organization

Limitations

At the request of Narragansett Electric Company d/b/a National Grid, Exponent prepared this summary report on the status of research related to extremely low-frequency electric- and magnetic-field exposure and health. The findings presented herein are made to a reasonable degree of scientific certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available, through any additional work, or review of additional work performed by others.

The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

1 Executive Summary

This report was prepared to address the topic of health and extremely low frequency (ELF) electric and magnetic fields (EMF) for the Rhode Island Energy Facility Siting Board at the request of The Narragansett Electric Company d/b/a National Grid as part of its Applications for the 2015 Rhode Island Transmission Projects.

ELF EMF are invisible fields surrounding all objects that generate, use, or transmit electricity. There are also natural sources of ELF EMF, including the electric fields associated with the normal functioning of our circulatory and nervous systems. People living in developed countries are constantly exposed to ELF EMF in their environments, since electricity is fundamental part of technologically-advanced societies. Sources of man-made ELF EMF include appliances, wiring, and motors, as well as distribution and transmission lines. Section 3 of this report provides information on the nature and sources of ELF EMF, as well as typical exposure levels.

Research on ELF EMF and health began with the goal of finding therapeutic application and understanding biological electricity, i.e., the role of electrical potentials across cell membranes and current flows between cells in our bodies. Over the past 35 years, researchers have examined whether ELF EMF from man-made sources can cause short- or long-term health effects in humans using a variety of study designs and techniques. Research on ELF EMF and long-term human health effects was prompted by an epidemiology study conducted in 1979 of children in Denver, Colorado, which studied the relationship of their cancers with the potential for ELF EMF exposure from nearby distribution and transmission lines. The results of that study prompted further research on childhood leukemia and other cancers. Childhood leukemia has remained the focus of EMF and health research, although many other diseases have been studied, including other cancers in children and adults, neurodegenerative diseases, reproductive effects, and cardiovascular disease, among others.

Guidance on the possible health risks of all types of exposures comes from health risk assessments, or systematic weight-of-evidence evaluations of the cumulative literature, on a particular topic conducted by expert panels organized by scientific organizations. The public and policy makers should look to the conclusions of these reviews, since the reviews are conducted using set scientific standards by scientists representing the various disciplines required to understand the topic at hand. In a health risk assessment of any exposure, it is essential to consider the type and strength of research studies available for evaluation. Human health studies vary in methodological rigor and, therefore, in their capacity to extrapolate findings to the population at large. Furthermore, relevant studies in three areas of research (epidemiologic, ***in vivo,*** and ***in vitro*** research) must be evaluated to understand possible health risks. Section 4 of this report provides a summary of the methods used to conduct a health risk assessment.

The World Health Organization (WHO) published a health risk assessment of ELF EMF in 2007 that critically reviewed the cumulative epidemiologic and laboratory research to date, taking into account the strength and quality of the individual research studies. Section 5 provides a summary of the WHO's conclusions with regard to the major outcomes they evaluate. The WHO report provided the following overall conclusions:

> New human, animal, and in vitro studies published since the 2002 IARC Monograph, 2002 [***sic***] do not change the overall classification of ELF as a possible human carcinogen (WHO, 2007, p. 347).
>
> Acute biological effects [i.e., short-term, transient health effects such as a small shock] have been established for exposure to ELF electric and magnetic fields in the frequency range up to 100 kHz that may have adverse consequences on health. Therefore, exposure limits are needed. International guidelines exist that have addressed this issue. Compliance with these guidelines provides adequate protection. Consistent epidemiological evidence suggests that chronic low-intensity ELF magnetic field exposure is associated with an increased risk of childhood leukaemia. However, the evidence for a causal relationship is limited, therefore exposure limits based upon epidemiological evidence are not recommended, but some precautionary measures are warranted (WHO, 2007, p. 355).

This report provides a systematic literature review and a critical evaluation of relevant epidemiology and ***in vivo*** studies published from July 2013 to November 2014, and it updates the report submitted as part of the Application for the G-185S 115-kilovolt Transmission Line Project.[1] These recent studies did not provide sufficient evidence to alter the basic conclusion of the WHO: the research does not suggest that electric fields or magnetic fields are a cause of cancer or any other disease at the levels we encounter in our everyday environment.

There are no national recommendations, guidelines, or standards in the United States to regulate ELF EMF or to reduce public exposures, although the WHO recommends adherence to the International Commission on Non-Ionizing Radiation Protection's or the International Committee for Electromagnetic Safety's exposure limits for the prevention of acute health effects at high exposure levels and low-cost measures to minimize exposures. In light of the epidemiologic data on childhood leukemia, scientific organizations are still in agreement that only low-cost interventions to reduce ELF EMF exposure are appropriate. This approach is mirrored by the Rhode Island Energy Facility Siting Board that has approved transmission projects that have proposed effective no-cost and low-cost technologies to reduce magnetic-field exposure to the public. While the large body of existing research does not indicate any harm associated with ELF EMF, research on this topic will continue to reduce remaining uncertainty.

1 Exponent, Inc. ***Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health: G-185S 115-kV Transmission Line***. Prepared for the Rhode Island Energy Facility Siting Board. October 31, 2013.

Note that this Executive Summary provides only an outline of the material discussed in this report. Exponent's technical evaluations, analyses, conclusions, and recommendations are included in the main body of this report, which at all times the controlling document.

2 Introduction

Questions about electric and magnetic fields (EMF) and health are commonly raised during the permitting of transmission lines. Numerous national and international scientific and health agencies have reviewed the research and evaluated potential health risks of exposure to extremely low frequency (ELF) EMF. The most comprehensive of these reviews of ELF EMF research was published by the World Health Organization (WHO) in 2007. The WHO's Task Group critically reviewed the cumulative epidemiologic and laboratory research through 2005, taking into account the strength and quality of the individual research studies.

The Narragansett Electric Company d/b/a National Grid requested that Exponent provide an easily-referenced document that supplements a report previously prepared for the Rhode Island Energy Facility Siting Board to bring the WHO report's conclusions up to date.[2] The G-185S 115-kilovolt (kV) Transmission Line Project report systematically evaluated peer-reviewed research and reviews by scientific panels published up to July 2013. This current report systematically evaluates peer-reviewed research and reviews by scientific panels published between July 2013 and November 2014 and also describes if and how these recent results affect conclusions reached by the WHO in 2007.

[2] Exponent, Inc. ***Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health: G-185S 115-kV Transmission Line***. Prepared for the Rhode Island Energy Facility Siting Board. October 31, 2013.

3 Extremely Low Frequency Electric and Magnetic Fields: Nature, Sources, Exposure, and Known Effects

Nature of ELF EMF

Electricity is transmitted as current from generating sources to high-voltage transmission lines, substations, distribution lines, and then finally to our homes and workplaces for consumption. The vast majority of electricity in North America is transmitted as alternating current (AC), which changes direction 60 times per second (i.e., a frequency of 60 Hertz [Hz]).

Everything that is connected to our electrical system (i.e., power lines, wiring, appliances, and electronics) produces ELF EMF (Figure 1). Both electric fields and magnetic fields are properties of the space near these electrical sources. Forces are experienced by objects capable of interacting with these fields; electric charges are subject to a force in an electric field, and moving charges experience a force in a magnetic field.

- **Electric fields** are the result of voltages applied to electrical conductors and equipment. The electric field is expressed in measurement units of volts per meter (V/m) or kilovolts per meter (kV/m); one kV/m is equal to 1,000 V/m. Conducting objects including fences, buildings, and our own skin and muscle easily block electric fields. Therefore, certain appliances within homes and workplaces are the major source of electric fields indoors, while transmission and distribution lines are the major source of electric fields outdoors.

- **Magnetic fields** are produced by the flow of electric currents; however, unlike electric fields, most materials do not readily block magnetic fields. The strength of a magnetic field is expressed as magnetic flux density in units called gauss (G), or in milligauss (mG), where 1 G = 1,000 mG.[3] The strength of the magnetic field at any point depends on characteristics of the source; in the case of power lines, strength is dependent on the arrangement of conductors, the amount of current flow, and distance from the conductors.

[3] Scientists also refer to magnetic flux density at these levels in units of microtesla. Magnetic flux density in units of mG can be converted to microtesla by dividing by 10, i.e., 1 mG = 0.1 microtesla.

Figure 1. Numerous sources of ELF EMF in our homes (appliances, wiring, currents running on water pipes, and nearby distribution and transmission lines).

Sources and exposure

The intensity of both electric fields and magnetic fields diminishes with increasing distance from the source. Electric and magnetic fields from transmission lines generally decrease with distance from the conductors in proportion to the square of the distance, described as creating a bell-shaped curve of field strength around the lines.

Since electricity is such an integral part of our infrastructure (e.g., transportation systems, homes, and businesses), people living in modern communities literally are surrounded by these fields. Figure 2 describes typical EMF levels measured in residential and occupational environments, compared to levels measured on or at the edge of transmission-line rights-of-way. While EMF levels decrease with distance from the source, any home, school, or office tends to have a "background" EMF level as a result of the combined effect of the numerous EMF sources. In general, the background magnetic-field level in a house away from appliances is typically less than 20 mG, while levels can be hundreds of mG in close proximity to appliances. Background levels of electric fields range from 10-20 V/m, while appliances produce levels up to several tens of V/m (WHO, 2007).

Experiments have yet to show which aspect of ELF EMF exposure, if any, may be relevant to biological systems. The current standard of EMF exposure for health research is long-term, average personal exposure, which is the average of all exposures to the varied electrical sources encountered in the many places we live, work, eat, and shop. As expected, this exposure is difficult to approximate, and exposure assessment is a major source of uncertainty in studies of ELF EMF and health (WHO, 2007).

Little research has been done to characterize the general public's exposure to magnetic fields, although some basic conclusions are available from the literature:

- ***Personal magnetic-field exposure:***
  - The vast majority of persons in the United States have a ***time-weighted average*** (TWA) exposure to magnetic fields less than 2 mG (Zaffanella and Kalton, 1998).[4]
  - In general, personal magnetic-field exposure is greatest at work and during travel (Zaffanella and Kalton, 1998).
- ***Residential magnetic-field exposure:***
  - The highest magnetic-field levels are typically found directly next to appliances (Zaffanella, 1993). For example, Gauger (1985) reported the maximum AC magnetic field at 3 centimeters from a sampling of appliances as 3,000 mG (can opener), 2,000 mG (hair dryer), 5 mG (oven), and 0.7 mG (refrigerator).
  - The following parameters affect the distribution of personal magnetic-field exposures at home: residence type, residence size, type of water line, and proximity to overhead power lines. Persons living in small homes, apartments, homes with metallic piping, and homes close to three-phase electric power distribution and transmission lines tended to have higher at-home magnetic-field levels (Zaffanella and Kalton, 1998).
  - Residential magnetic-field levels are caused by currents from nearby transmission and distribution systems, pipes or other conductive paths, and electrical appliances (Zaffanella, 1993).
- ***Workplace magnetic-field exposure***
  - Some occupations (e.g., electric utility workers, sewing machine operators, telecommunication workers) have higher exposures due to work near equipment with high magnetic-field levels.[5]

[4] TWA is the average exposure over a given specified time period (i.e., an 8-hour workday or a 24-hour day) of a person's exposure to a chemical or physical agent. The average is determined by sampling the exposure of interest throughout the time period.

[5] http://www.niehs.nih.gov/health/assets/docs_p_z/emf-02.pdf

- ***Power line magnetic-field exposure***

  - The magnetic-field levels associated with transmission and distribution lines vary substantially depending on their configuration, amount of current flow (load), and distance from conductors, among other parameters. At distances of approximately 300 feet from overhead transmission lines and during average electricity demand, the magnetic-field levels from many transmission lines are often similar to the background levels found in most homes (Figure 2).

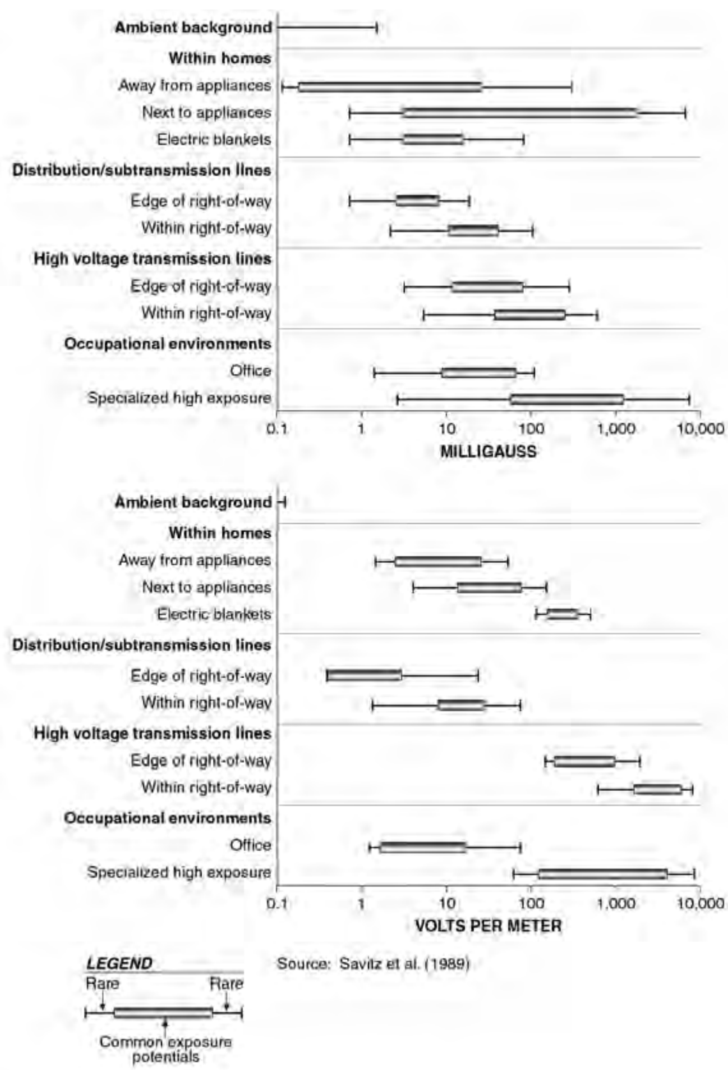


Figure 2. Electric- and magnetic-field strengths in the environment.

Known effects

Similar to virtually any exposure, adverse effects can be expected from exposure to very high levels of ELF EMF. If the current density or electric field induced by an extremely strong magnetic field exceeds a certain threshold, excitation of muscles and nerves is possible. Also, strong electric fields can induce charges on the surface of the body that can lead to small shocks, i.e., micro shocks. These are acute and shock-like effects that cause no long-term damage or health consequences. Limits for the general public and workplace have been set to prevent these effects, but real-life situations where these levels would be exceeded are rare. Standards and guidelines are discussed in more detail in Section 8.

4 Methods for Evaluating Scientific Research

Science is more than a collection of facts. It is a method of obtaining information and of reasoning to ensure that the information and conclusions are accurate and correctly describe physical and biological phenomena. Many misconceptions in human reasoning occur when people casually interpret their observations and experience. Therefore, scientists use systematic methods to conduct and evaluate scientific research and assess the potential impact of a specific agent on human health. This process is designed to ensure that more weight is given to those studies of better quality and studies with a given result are not selected out from all of the studies available to advocate or suppress a preconceived idea of an adverse effect. Scientists and scientific agencies and organizations use these standard methods to draw conclusions about the many exposures in our environment.

Weight-of-evidence reviews

The scientific process entails looking at ***all*** the evidence on a particular issue in a systematic and thorough manner to evaluate if the overall data presents a logically coherent and consistent picture. This is often referred to as a weight-of-evidence review, in which all studies are considered together, giving more weight to studies of higher quality and using an established analytic framework to arrive at a conclusion about a possible causal relationship. Weight-of-evidence reviews are typically conducted within the larger framework of health risk assessments or evaluations of particular exposures or exposure circumstances that qualitatively and quantitatively define health risks. Weight-of-evidence and health risk assessment methods have been described by several agencies, including the International Agency for Research on Cancer (IARC), which routinely evaluates substances such as drugs, chemicals, and physical agents for their ability to cause cancer; the WHO International Programme for Chemical Safety; and the US Environmental Protection Agency, which set guidance for public exposures (WHO, 1994; USEPA, 1993; USEPA, 1996). Two steps precede a weight-of-evidence evaluation: a systematic review to identify the relevant literature and an evaluation of each relevant study to determine its strengths and weaknesses.

The following sections discuss important considerations in the evaluation of human health studies of EMF in a weight-of-evidence review, including exposure considerations, study design, methods for estimating risk, bias, and the process of causal inference. The purpose of discussing these considerations here is to provide context for the later weight-of-evidence evaluations.

Exposure considerations

Exposure methods range widely in studies of ELF EMF, including: the classification of residences based on the relative capacity of nearby power lines to produce magnetic fields (i.e., wire code categories); occupational titles; calculated magnetic-field levels based on job histories (i.e., a job-exposure matrix [JEM]); residential distance from nearby power lines; spot measurements of magnetic-field levels inside or outside residences; 24-hour and 48-hour measurements of magnetic fields in a particular location in the house (e.g., a child's bedroom); calculated magnetic-field levels based on the characteristics of nearby power installations; and, finally, personal 24-hour and 48-hour magnetic-field measurements.

Each of these methods has strengths and limitations (Kheifets and Oksuzyan, 2008). Since magnetic-field exposures are ubiquitous and vary over a lifetime as the places we frequent and the sources of ELF EMF in those places change, making valid estimates of personal magnetic-field exposure challenging. Furthermore, without a biological basis to define a relevant exposure metric (average exposure or peak exposure) and a defined critical period for exposure (e.g., ***in utero***, shortly before diagnosis), relevant and valid assessments of exposure are problematic. Exposure misclassification is one of the most significant concerns in studies of ELF EMF.

In general, long-term personal measurements are the metrics selected by epidemiologists. Other methods are generally weaker because they may not be strong predictors of long-term exposure and do not take into account all magnetic-field sources. ELF EMF can be estimated indirectly by assigning an estimated amount of exposure to an individual based on calculations considering nearby power installations or a person's job title. For instance, a relative estimate of exposure could be assigned to all machine operators based on historical information on the magnitude of the magnetic field produced by the machine. Indirect measurements are not as accurate as direct measurements because they do not contain information specific to that person or the exposure situation. In the example of machine operators, the indirect measurement may not account for how much time any one individual spends working at that machine or any potential variability in magnetic fields produced by the machines over time. In addition, such occupational measurements do not take into account the worker's residential magnetic-field exposures.

While JEMs are an advancement over earlier methods, they still have some important limitations, as highlighted in a review by Kheifets et al. (2009) summarizing an expert panel's findings.[6] A person's occupation provides some relative indication of the overall magnitude of their occupational magnetic-field exposure, but it does not take into account the possible variation in exposure due to different job tasks within occupational titles, the frequency and intensity of contact to relevant exposure sources, or variation by calendar time. This was highlighted by a recent study of 48-hour magnetic-field measurements of 543 workers in Italy in a variety of occupational settings, including: ceramics, mechanical engineering, textiles, graphics, retail, food, wood, and biomedical industries (Gobba et al., 2011). In this study, there was significant variation in measured TWA magnetic-field levels for workers in many of the International Standard Classification of Occupations' job categories, which the authors attributed to variations within these task-defined categories in some of the industries.

Types of health research studies

Research studies can be broadly classified into two groups: 1) epidemiologic observations of people and 2) experimental studies on animals, humans, cells, and tissues conducted in laboratory settings. Epidemiology studies investigate how disease is distributed in populations

[6] Kheifets et al. (2009) reports on the conclusions of an independent panel organized by the Energy Networks Association in the United Kingdom in 2006 to review the current status of the science on occupational EMF exposure and identify the highest priority research needs.

and what factors influence or determine this disease distribution (Gordis, 2000). Epidemiology studies attempt to identify potential causes for human disease while observing people as they go about their normal, daily lives. Such studies are designed to quantify and evaluate the associations between disease and reported exposures to environmental factors.

The most common types of epidemiology studies in the ELF EMF literature are case-control and cohort studies. In case-control studies, people with and without the disease of interest are identified and the exposures of interest are evaluated. Often, people are interviewed or their personal records (e.g., medical records or employment records) are reviewed in order to establish the exposure history for each individual. The exposure histories are then compared between the diseased and non-diseased populations to determine whether any statistically significant differences in exposure histories exist. In cohort studies, on the other hand, individuals within a defined cohort of people (e.g., all persons working at a utility company) are classified as exposed or non-exposed and followed over time for the incidence of disease. Researchers then compare disease incidence in the exposed and non-exposed groups.

Experimental studies are designed to test specific hypotheses under controlled conditions and are vital to assessing cause-and-effect relationships. An example of a human experimental study relevant to this area of research would be studies that measure the impact of magnetic-field exposure on acute biological responses in humans, such as hormone levels. These studies are conducted in laboratories under controlled conditions. ***In vivo*** and ***in vitro*** experimental studies are also conducted under controlled conditions in laboratories. ***In vivo*** studies expose laboratory animals to very high levels of a chemical or physical agent to determine whether exposed animals develop cancer or other effects at higher rates than unexposed animals, while attempting to control other factors that could possibly affect disease rates (e.g., diet, genetics). ***In vitro*** studies of isolated cells and tissues are important because they can help scientists understand biological mechanisms as they relate to the same exposure in intact humans and animals. In the case of ***in vitro*** studies, the responses of cells and tissues outside the body may not reflect the response of those same cells if maintained in a living system, so their relevance cannot be assumed. Therefore, it is both necessary and desirable that agents that could present a potential health threat be explored by both epidemiology and experimental studies.

Both of these approaches—epidemiology and experimental laboratory studies—have been used to evaluate whether exposure to ELF EMF has any adverse effects on human health. Epidemiology studies are valuable because they are conducted in human populations, but they are limited by their non-experimental design and typical retrospective nature. In epidemiology studies of magnetic fields, for example, researchers cannot control the amount of individual exposure, how exposure occurs over time, the contribution of different field sources, or individual behaviors other than exposure that may affect disease risk, such as diet. In valid risk assessments of ELF EMF, epidemiology studies are considered alongside experimental studies of laboratory animals, while studies of isolated tissues and cells are generally considered supplementary.

Estimating risk

Epidemiologists measure the statistical association between exposures and disease in order to estimate risk. This brief summary of risk is included to provide a foundation for understanding and interpreting statistical associations in epidemiology studies as risk estimates.

Two common types of risk estimates are absolute risk and relative risk (RR). Absolute risk, also known as incidence, is the amount of new disease that occurs in a given period of time. For example, the absolute risk of invasive childhood cancer in children ages 0 to 19 years for 2004 was 14.8 per 100,000 children (Reis et al., 2007). RRs are calculated to evaluate whether a particular exposure or inherent quality (e.g., EMF, diet, genetics, race) is associated with a disease outcome. This is calculated by looking at the absolute risk in one group relative to a comparison group. For example, white children in the 0 to 19 year age range had an estimated absolute risk of childhood cancer of 15.4 per 100,000 in 2004, and African American children had an estimated absolute risk of 13.3 per 100,000 in the same year. By dividing the absolute risk of white children by the absolute risk of African American children, we obtain a RR of 1.16. This RR estimate can be interpreted to mean that white children have a risk of childhood cancer that is 16% greater than the risk of African American children. Additional statistical analysis is needed to evaluate whether this association is statistically significant, as defined in the following sub-section.

It is important to understand that risk is estimated differently in cohort and case-control studies because of the way the studies are designed. Traditional cohort studies provide a direct estimate of RR, while case-control studies only provide indirect estimates of RR, called odds ratios (OR). For this reason, among others, cohort studies usually provide more reliable estimates of the risk associated with a particular exposure. Case-control studies are more common than cohort studies, however, because they are less costly and more time efficient.

Thus, the association between a particular disease and exposure is measured quantitatively in an epidemiology study as either the RR (cohort studies) or OR (case-control studies) estimate. The general interpretation of a risk estimate equal to 1.0 is that the exposure is not associated with an increased incidence of the disease. If the risk estimate is greater than 1.0, the inference is that the exposure is associated with an increased incidence of the disease. On the other hand, if the risk estimate is less than 1.0, the inference is that the exposure is associated with a reduced incidence of the disease. The magnitude of the risk estimate is often referred to as its strength (i.e., strong vs. weak). Stronger associations are given more weight because they are less susceptible to the effects of bias.

Statistical significance

Statistical significance testing provides an idea of whether or not a statistical association is a chance occurrence or whether the association is likely to be observed upon repeated testing. The terms “statistically significant” or “statistically significant association” are used in epidemiology studies to describe the tendency of the level of exposure and the occurrence of disease to be linked, with chance as an unlikely explanation. Statistically significant associations, however, are not necessarily an indication of cause-and-effect, because the interpretation of statistically significant associations depends on many other factors associated with the design and conduct of the study, including how the data were collected and the number of study participants.

Confidence intervals (CI) reported along with RR and OR values, indicate a range of values for an estimate of effect that has a specified probability (e.g., 95%) that the sample of data examined includes the "true" estimate of effect; CIs evaluate statistical significance, but do not address the role of bias, as described further below. A 95% CI indicates that, if the study were conducted a very large number of times, 95% of the measured estimates would be within the upper and lower confidence limits based on sampling of a normal statistical distribution.

The range of the CI is also important for interpreting estimated associations, including the precision and statistical significance of the association. A very wide CI indicates great uncertainty in the value of the "true" risk estimate. This is usually due to a small number of observations. A narrow CI provides more certainty about where the "true" RR estimate lies. If the 95% CI does not include 1.0, the probability of an association being due to chance alone is 5% or lower and the result is considered statistically significant, as discussed above.

While a 95% CI is commonly applied, it provides marginal protection against falsely rejecting a hypothesis of no effect, so acceptance of a 99% CI level is recommended (e.g., Goodman, 1999).

Meta-analysis and pooled analysis

In scientific research, the results of smaller studies may be difficult to distinguish from normal, random variation. This is also the case for sub-group analyses where few cases are estimated to have high exposure levels, e.g., in case-control studies of childhood leukemia and TWA magnetic-field exposure greater than 3-4 mG. Meta-analysis is an analytic technique that combines the published results from a group of studies into one summary result. A pooled analysis, on the other hand, combines the raw, individual-level data from the original studies and analyzes the data from the studies altogether. These methods are valuable because they increase the number of individuals in the analysis, which allows for a more robust and stable estimate of association. Meta- and pooled analyses are an important tool for qualitatively synthesizing the results of a large group of studies.

The disadvantage of meta- and pooled analyses is that they can convey a false sense of consistency across studies if ***only*** the combined estimate of effect is considered (Rothman and Greenland, 1998). These analyses typically combine data from studies with different study populations, methods for measuring and defining exposure, and disease definitions. This is particularly true for analyses that combine data from case-control studies, which often use very different methods for the selection of cases and controls and exposure assessment. Therefore, in addition to the synthesis or combining of data, meta- and pooled analyses should be used to understand what factors cause the results of the studies to vary (i.e., publication date, study design, possibility of selection bias), and how these factors affect the associations calculated from the data of all the studies combined (Rothman and Greenland, 1998).

Meta- and pooled analyses are a valuable technique in epidemiology; however, in addition to calculating a summary RR, they should follow standard techniques (Stroup et al., 2001) and analyze the factors that contribute to any heterogeneity between the studies.

Bias in epidemiology studies

One key reason that the results of epidemiology studies cannot directly provide evidence for cause-and-effect is the presence of bias. Bias is defined as "any systematic error in the design, conduct or analysis of a study that results in a mistaken estimate of an exposure's effect on the risk of disease" (Gordis, 2000, p. 204). In other words, sources of bias are factors or research situations that can mask a true association or cause an association that does not truly exist. As a result, the extent of bias, as well as its types and sources, is one of the most important considerations in the interpretation of epidemiology studies. Since it is not possible to fully control human populations, perfectly measure their exposures, or control for the effects of all other risk factors, bias will exist in some form in all epidemiology studies of human health. Laboratory studies, on the other hand, more effectively manage bias because of the tight control the researchers have over most study variables.

One important source of bias occurs in epidemiology studies when a third variable confuses the relationship between the exposure and disease of interest because of its relationship to both. Consider an example of a researcher whose study finds that people who exercise have a lower risk of diabetes compared to people who do not exercise. It is known that people who exercise more tend to also consume healthier diets and healthier diets may lower the risk of diabetes. If the researcher does not control for the impact of diet, it is not possible to say with certainty that the lower risk of diabetes is due to exercise and not to a healthier diet. In this example, diet is the confounding variable.

Cause vs. association and evaluating evidence regarding causal associations

Epidemiology studies can help suggest factors that may contribute to the risk of disease, but they are not used as the sole basis for drawing inferences about cause-and-effect relationships. Since epidemiologists do not have control over the many other factors to which people in are exposed in their studies, and diseases can be caused by a complex interaction of many factors, the results of epidemiology studies must be interpreted with caution. A single epidemiology study is rarely unequivocally supportive or non-supportive of causation; rather, a weight is assigned to the study based on the validity of its methods and all relevant studies (epidemiology, ***in vivo***, and ***in vitro***) must be considered together in a weight-of-evidence review to arrive at a conclusion about possible causality between an exposure and disease.

In 1964, the Surgeon General of the United States published a landmark report on smoking-related diseases (HEW, 1964). As part of this report, nine criteria for evaluating epidemiology studies (along with experimental data) for causality were outlined. In a more recent version of this report, these criteria have been reorganized into seven criteria. In the earlier version, which was based on the commonly referenced Hill criteria (Hill, 1965), coherence, plausibility, and analogy were considered as distinct items, but are now summarized together because they have been treated in practice as essentially reflecting one concept (HHS, 2004). Table 1 provides a listing and brief description of each criterion.

Table 1. Criteria for evaluating whether an association is causal

Criteria	Description
Consistency	Repeated observation of an association between exposure and disease in multiple studies of adequate statistical power, in different populations, and at different times.
Strength of the association	The larger (stronger) the magnitude and statistical strength of an association is between exposure and disease, the less likely such an effect is the result of chance or unmeasured confounding.
Specificity	The exposure is the single (or one of a few) cause of disease.
Temporality	The exposure occurs prior to the onset of disease.
Coherence, plausibility, and analogy	The association cannot violate known scientific principles and the association must be consistent with experimentally demonstrated biologic mechanisms.
Biologic gradient	This is also known as a dose-response relationship, i.e., the observation that the stronger or greater the exposure is, the stronger or greater the effect.
Experiment	Observations that result from situations in which natural conditions imitate experimental conditions. Also stated as a change in disease outcome in response to a non-experimental change in exposure patterns in population.

Source: Department of Health and Human Services, 2004

The criteria were meant to be applied to statistically significant associations that have been observed in the cumulative epidemiologic literature (i.e., if no statistically significant association has been observed for an exposure then the criteria are not relevant). It is important to note that these criteria were not intended to serve as a checklist but as guide to evaluate associations for causal inference. Theoretically, it is possible for an exposure to meet all seven criteria, but still not be deemed a causal factor. Also, no one criterion can provide indisputable evidence for causation, nor can any single criterion, aside from temporality, rule out causation.

In summary, the judicious consideration of these criteria is useful in evaluating epidemiology studies, but they cannot be used as the sole basis for drawing inferences about cause-and-effect relationships. In line with the criteria of "coherence, plausibility, and analogy," epidemiology studies are considered along with ***in vivo*** and ***in vitro*** studies in a comprehensive weight-of-evidence review. Epidemiologic support for causality is usually based on high-quality studies reporting consistent results across many different populations and study designs that are supported by the experimental data collected from ***in vivo*** and ***in vitro*** studies.

Biological response vs. disease in human health

When interpreting research studies, it is important to distinguish between a reported biological response and an indicator of disease. This is relevant because exposure to ELF EMF may elicit a biological response that is simply a normal response to environmental conditions. This response, however, may not be a disease, cause a disease, or be otherwise harmful. There are many exposures or factors encountered in day-to-day life that elicit a biological response, but the response is neither harmful nor a cause of disease. For example, when an individual walks from a dark room indoors to a sunny day outdoors, the pupils of the eye naturally constrict to limit the amount of light passing into the eye. This constriction of the pupil is considered a biological response to the change in light conditions. Pupil constriction, however, is neither a disease itself, nor is it known to cause disease.

5 The WHO 2007 Report: Methods and Conclusions

The WHO is a scientific organization within the United Nations system whose mandate includes providing leadership on global health matters, shaping health research agendas, and setting norms and standards. The WHO established the International EMF Project in 1996, in response to public concern about exposure to ELF EMF and possible adverse health outcomes. The project's membership includes 8 international organizations, 8 collaborating institutions, and over 54 national authorities. The overall purpose of the Project is to assess health and environmental effects of exposure to static and time varying fields in the frequency range of 0 Hz to 300 gigahertz. A key objective of the Project is to evaluate the scientific literature and make periodic status reports on health effects to be used as the basis for a coherent international response, including the identification of important research gaps and the development of internationally acceptable standards for ELF EMF exposure.

In 2007, the WHO published their Environmental Health Criteria (EHC) 238 on EMF summarizing health research in the ELF range. The EHC used standard scientific procedures, as outlined in its Preamble and described above in Section 4, to conduct the review. The Task Group responsible for the report's overall conclusions consisted of 21 scientists from around the world with expertise in a wide range of scientific disciplines. They relied on the conclusions of previous weight-of-evidence reviews,[7] where possible, and mainly focused on evaluating studies published after an IARC review of ELF EMF and cancer in 2002.

The WHO Task Group and IARC use specific terms to describe the strength of the evidence in support of causality between specific agents and cancer. These categories are described here because, while they are meaningful to scientists who are familiar with the IARC process, they can create an undue level of concern with the general public. ***Sufficient evidence of carcinogenicity*** is assigned to a body of epidemiologic research if a positive association has been observed in studies in which chance, bias, and confounding can be ruled out with reasonable confidence. ***Limited evidence of carcinogenicity*** describes a body of epidemiologic research where the findings are inconsistent or there are outstanding questions about study design or other methodological issues that preclude making a conclusion. ***Inadequate evidence of carcinogenicity*** describes a body of epidemiologic research where it is unclear whether the data is supportive or unsupportive of causation because there is a lack of data or there are major quantitative or qualitative issues. A similar classification system is used for evaluating ***in vivo*** studies and mechanistic data for carcinogenicity.

Summary categories are assigned by considering the conclusions of each body of evidence (epidemiologic, ***in vivo,*** and ***in vitro***) together (see Figure 3). ***In vitro*** research is not described in Figure 3 because it provides ancillary information and, therefore, is used to a lesser degree in evaluating carcinogenicity and is classified simply as strong, moderate, or weak. Categories

[7] The term "weight-of-evidence review" is used in this report to denote a systematic review process by a multidisciplinary, scientific panel involving experimental and epidemiologic research to arrive at conclusions about possible health risks. The WHO EHC on EMF does not specifically describe their report as a weight-of-evidence review. Rather, they describe conducting a health risk assessment. A health risk assessment differs from a weight-of-evidence review in that it also incorporates an exposure and exposure-response assessment.

include (from highest to lowest risk): carcinogenic to humans, probably carcinogenic to humans, possibly carcinogenic to humans, unclassifiable, and probably not carcinogenic to humans. These categories are intentionally meant to err on the side of caution, giving more weight to the possibility that the exposure is truly carcinogenic and less weight to the possibility that the exposure is not carcinogenic. The category "possibly carcinogenic to humans" denotes exposures for which there is limited evidence of carcinogenicity in epidemiology studies and less than sufficient evidence of carcinogenicity in studies of experimental animals.

	Epidemiology Studies				Animal Studies			
	Sufficient evidence	Limited evidence	Inadequate evidence	Evidence suggesting lack of carcinogenicity	Sufficient evidence	Limited evidence	Inadequate evidence	Evidence suggesting lack of carcinogenicity
Known Carcinogen	✓							
Probable Carcinogen		✓			✓			
Possible Carcinogen		✓				✓	✓	
Not Classifiable			✓			✓	✓	
Probably not a Carcinogen				✓				✓

Sufficient evidence in epidemiology studies—A positive association is observed between the exposure and cancer in studies, in which chance, bias and confounding were ruled out with "reasonable confidence."

Limited evidence in epidemiology studies—A positive association has been observed between the exposure and cancer for which a causal interpretation is considered to be credible, but chance, bias or confounding could not be ruled out with "reasonable confidence."

Inadequate evidence in epidemiology studies—The available studies are of insufficient quality, consistency or statistical power to permit a conclusion regarding the presence or absence of a causal association between exposure and cancer, or no data on cancer in humans are available.

Evidence suggesting a lack of carcinogenicity in epidemiology studies—There are several adequate studies covering the full range of levels of exposure that humans are known to encounter, which are mutually consistent in not showing a positive association between exposure to the agent and any studied cancer at any observed level of exposure. The results from these studies alone or combined should have narrow confidence intervals with an upper limit close to the null value (e.g. a relative risk of 1.0). Bias and confounding should be ruled out with reasonable confidence, and the studies should have an adequate length of follow-up.

Sufficient evidence in animal studies—An increased incidence of malignant neoplasms is observed in (a) two or more species of animals or (b) two or more independent studies in one species carried out at different times or indifferent laboratories or under different protocols. An increased incidence of tumors in both sexes of a single species in a well-conducted study, ideally conducted under Good Laboratory Practices, can also provide sufficient evidence.

Limited evidence in animal studies—The data suggest a carcinogenic effect but are limited for making a definitive evaluation, e.g. (a) the evidence of carcinogenicity is restricted to a single experiment; (b) there are unresolved questions regarding the adequacy of the design, conduct or interpretation of the studies; etc.

Inadequate evidence in animal studies—The studies cannot be interpreted as showing either the presence or absence of a carcinogenic effect because of major qualitative or quantitative limitations, or no data on cancer in experimental animals are available

Evidence suggesting a lack of carcinogenicity in animal studies—Adequate studies involving at least two species are available which show that, within the limits of the tests used, the agent is not carcinogenic.

Figure 3. Basic IARC method for classifying exposures based on potential carcinogenicity.

The IARC has reviewed close to 1,000 substances and exposure circumstances to evaluate their potential carcinogenicity. Over 80% of exposures fall in the categories possible carcinogen

(29%) or non-classifiable (52%). This occurs because, as described above, it is nearly impossible to prove that something is completely safe, and few exposures show a clear-cut or probable risk, so most agents will end up in either of these two categories. Throughout the history of the IARC, only one agent has been classified as probably not a carcinogen, which illustrates the conservatism of the evaluations and the difficulty in proving the absence of an effect beyond all doubt.

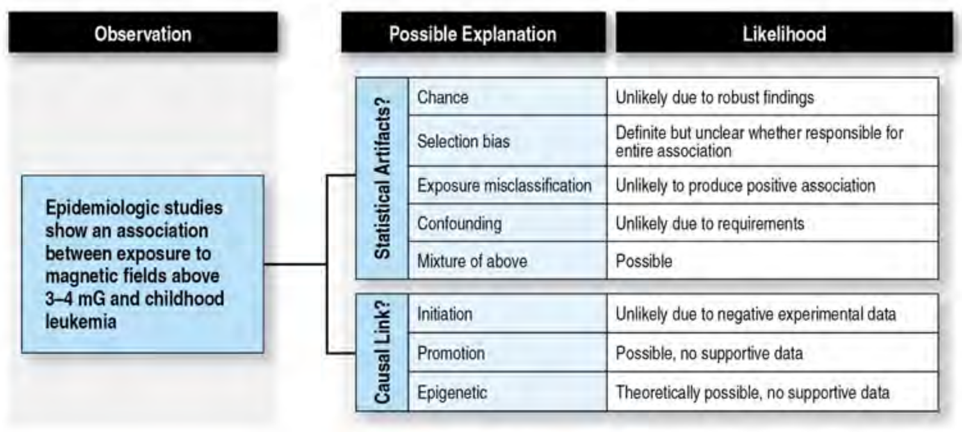
The WHO report provided the following overall conclusions with regard to ELF EMF:

> New human, animal, and in vitro studies published since the 2002 IARC Monograph, 2002 [***sic***] do not change the overall classification of ELF as a possible human carcinogen (p. 347).
>
> Acute biological effects [i.e., short-term, transient health effects such as a small shock] have been established for exposure to ELF electric and magnetic fields in the frequency range up to 100 kHz that may have adverse consequences on health. Therefore, exposure limits are needed. International guidelines exist that have addressed this issue. Compliance with these guidelines provides adequate protection. Consistent epidemiological evidence suggests that chronic low-intensity ELF magnetic field exposure is associated with an increased risk of childhood leukaemia. However, the evidence for a causal relationship is limited, therefore exposure limits based upon epidemiological evidence are not recommended, but some precautionary measures are warranted (p. 355, WHO, 2007).

With regard to specific diseases, the WHO concluded the following:

Childhood cancers. The WHO report paid particular attention to childhood leukemia because the most consistent epidemiologic association in the area of ELF EMF and health research has been reported between this disease and TWA exposure to high, magnetic-field levels. Two pooled analyses reported an association between childhood leukemia and TWA magnetic-field exposure >3-4 mG (Ahlbom et al., 2000; Greenland et al., 2000); it is these data, categorized as limited epidemiologic evidence, that resulted in the classification of magnetic fields as possibly carcinogenic by the IARC in 2002.

The WHO report systematically evaluated several factors that might be partially, or fully, responsible for the consistent association, including: chance, misclassification of magnetic-field exposure, confounding from hypothesized or unknown risk factors, and selection bias. The authors concluded that chance is an unlikely explanation since the pooled analyses had a larger sample size and decreased variability; control selection bias probably occurs to some extent in these studies and would result in an overestimate of the true association, but would not explain the entire observed association; it is less likely that confounding occurs, although the possibility that some yet-to-be identified confounder is responsible for the association cannot be fully excluded; and, finally, exposure misclassification would likely result in an underestimate of the true association, although it is not entirely clear (see Figure 4 below). The WHO concluded that reconciling the epidemiologic data on childhood leukemia and the negative (i.e., no hazard or risk observed) experimental findings through innovative research is currently the highest priority in the field of ELF EMF research. Given that few children are expected to have long-term ***average*** magnetic-field exposures greater than 3-4 mG, however, the WHO stated that the public health impact of magnetic fields on childhood leukemia would likely be minimal, if the association was determined to be causal.



Source: Adapted from Schüz and Ahlbom (2008)

Figure 4. Possible explanations for the observed association between magnetic fields and childhood leukemia.

Fewer studies have been published on magnetic fields and childhood brain cancer compared to studies of childhood leukemia. The WHO Task Group described the results of these studies as inconsistent and limited by small sample sizes and recommended a meta-analysis to clarify the research findings.

Breast cancer. The WHO concluded that the more recent studies they reviewed on breast cancer and ELF EMF exposure were higher in quality compared with earlier studies, and for that reason, they provide strong support to previous consensus statements that magnetic-field exposure does not influence the risk of breast cancer. In summary, the WHO stated "[w]ith these [more recent] studies, the evidence for an association between ELF magnetic-field exposure and the risk of female breast cancer is weakened considerably and does not support an association of this kind" (WHO, 2007, p. 9). The WHO recommended no further research with respect to breast cancer and magnetic-field exposure.

Adult leukemia and brain cancer. The WHO concluded, "In the case of adult brain cancer and leukaemia, the new studies published after the IARC monograph do not change the conclusion that the overall evidence for an association between ELF [EMF] and the risk of these disease remains inadequate" (WHO, 2007, p. 307). The WHO panel recommended updating the existing European cohorts of occupationally-exposed individuals and pooling the epidemiologic data on brain cancer and adult leukemia to confirm the absence of an association.

In vivo research on carcinogenesis. The WHO concluded the following with respect to ***in vivo*** research, "[t]here is no evidence that ELF [EMF] exposure alone causes tumours. The evidence that ELF field exposure can enhance tumour development in combination with carcinogens is inadequate" (WHO, 2007, p. 10). Recommendations for future research included the development of a rodent model for childhood acute lymphoblastic leukemia (ALL) and the continued investigation of whether magnetic fields can act as a co-carcinogen.

Reproductive and developmental effects. The WHO concluded that, overall, the body of research does not suggest that maternal or paternal exposures to ELF EMF cause adverse reproductive or developmental outcomes. The evidence from epidemiology studies on miscarriage was described as inadequate and further research on this possible association was recommended, although low priority was given to this recommendation.

Neurodegenerative diseases. The WHO reported that the majority of epidemiology studies have reported associations between occupational magnetic-field exposure and mortality from Alzheimer's disease and amyotrophic lateral sclerosis (ALS), although the design and methods of these studies were relatively weak (e.g., disease status was based on death certificate data, exposure was based on incomplete occupational information from census data, and there was no control for confounding factors). The WHO concluded that there is inadequate data in support of an association between magnetic-field exposure and Alzheimer's disease or ALS. The panel highly recommended that further studies be conducted in this area, particularly studies where the association between magnetic fields and ALS is estimated while controlling for the possible confounding effect of electric shocks.

Cardiovascular disease. It has been hypothesized that magnetic-field exposure reduces heart rate variability, which in turn increases the risk for acute myocardial infarction (AMI). With one exception (Savitz et al., 1999), however, none of the studies of cardiovascular disease morbidity and mortality that were reviewed show an association with exposure. Whether a specific association exists between exposure and altered autonomic control of the heart remains speculative and overall the evidence does not support an association. Experimental studies of both short- and long-term exposure indicate that, while electric shock is an obvious health hazard, other hazardous cardiovascular effects associated with ELF EMF are unlikely to occur at exposure levels commonly encountered environmentally or occupationally.

6 Current Scientific Consensus

The following sections identify and describe epidemiology and ***in vivo*** studies related to ELF EMF and health published between July 2013 and November 2014. The purpose of this section is to evaluate whether the findings of these recent studies alter the conclusions published by the WHO in their 2007 report, as described in Section 5. The previous Exponent report that summarized the literature up to July 2013[8] concluded that recent results did not provide sufficient evidence to alter the basic conclusion of the WHO EHC published in 2007.

A structured literature search was conducted using PubMed, a search engine provided by the National Library of Medicine and the National Institutes of Health that includes over 15 million up-to-date citations from MEDLINE and other life science journals for biomedical articles (http://www.pubmed.gov). A well-defined search strategy was used to identify literature indexed between July 2013 and November 2014.[9] All fields (e.g., title, abstract, keywords) were searched with various search strings that referenced the exposure and disease of interest.[10] A researcher with experience in this area reviewed the titles and abstracts of these publications for inclusion in this evaluation. Only peer-reviewed, epidemiology studies, meta-analyses, and human experimental studies of 50/60-Hz AC ELF EMF and recognized disease entities, along with whole animal ***in vivo*** studies of carcinogenesis, were included. The following specific inclusion criteria were applied:

1. **Outcome**. Included studies evaluated one of the following diseases: cancer; reproductive effects; neurodegenerative diseases; or cardiovascular disease. Research on other outcomes was not included (e.g., psychological effects, behavioral effects, hypersensitivity). Few studies are available in these research areas and, as such, research evolves more slowly.

2. **Exposure**. The study must have evaluated 50/60-Hz AC ELF EMF.

3. **Exposure assessment methods**. Exposure must have been evaluated beyond self-report of an activity or occupation. Included studies estimated exposure through various methods including calculated EMF levels using distance from power lines; time-weighted average EMF exposures; and average exposure estimated from JEMs.

4. **Study design**. Epidemiology studies, meta-analyses, human experimental studies, and ***in***

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8 Exponent, Inc. ***Current Status of Research on Extremely Low Frequency Electric and Magnetic Fields and Health: G-185S 115-kV Transmission Line***. Prepared for the Rhode Island Energy Facility Siting Board. October 31, 2013.

9 Since there is sometimes a delay between the publication date of a study and the date it is indexed in PubMed, it is possible that some studies not yet indexed, but published prior to November 2014, are not included in this update.

10 EMF OR magnetic fields OR electric fields OR electromagnetic OR power frequency OR transmission line AND cancer (cancer OR leukemia OR lymphoma OR carcinogenesis) OR neurodegenerative disease (neurodegenerative disease OR Alzheimer's disease OR amyotrophic lateral sclerosis OR Lou Gehrig's disease) OR cardiovascular effects (cardiovascular OR heart rate) OR reproductive outcomes (miscarriage OR reproduction OR developmental effects).

vivo studies were included. Only ***in vivo*** studies of carcinogenicity were evaluated in this review; the review relies on the conclusions of the WHO with regard to ***in vivo*** studies in the areas of reproduction, development, neurology, and cardiology. Further, this report relies on the conclusions of the WHO report (as described in Section 5) with regard to mechanistic data from ***in vitro*** studies since this field of study is less informative to the risk assessment process (IARC, 2002).

5. **Peer-review**. The study must have been peer-reviewed and published. Therefore, no conference proceedings, abstracts, or on-line material were included.

Epidemiology studies are evaluated below first by outcome (childhood cancer; adult cancer; reproductive or developmental effects; neurodegenerative disease; and cardiovascular effects), followed by an evaluation of ***in vivo*** research on carcinogenesis. Tables 3 through 9 list the relevant studies that were published between July 2013 and November 2014 in these areas.

Childhood health outcomes

Childhood leukemia

In 2002, the IARC assembled and reviewed research related to ELF EMF to evaluate the strength of the evidence in support of carcinogenicity. The IARC expert panel noted that, when studies with the relevant information were combined in a pooled analysis, a statistically significant two-fold association was observed between childhood leukemia and estimated exposure to high, average levels of magnetic fields (i.e., greater than 3-4 mG of average 24- and 48-hour exposure). This evidence was classified as "limited evidence" in support of carcinogenicity, falling short of "sufficient evidence" because chance, bias, and confounding could not be ruled out with "reasonable confidence." Largely as a result of the findings related to childhood leukemia, the IARC classified magnetic fields as "possibly carcinogenic," a category that describes exposures with limited epidemiologic evidence and inadequate evidence from ***in vivo*** studies. The classification of "possibly carcinogenic" was confirmed by the WHO in June 2007.

Recent studies (July 2013 to November 2014)

Childhood leukemia remains one of the most studied health outcomes in ELF EMF epidemiologic research. Three large case-control studies from France, Denmark, and the United Kingdom have assessed the risk of childhood leukemia in relation to residential proximity to high-voltage power lines (Sermage-Faure et al., 2013; Bunch et al., 2014; Pedersen et al., 2014). The French study, which was discussed in the previous update, included 2,779 cases of childhood leukemia diagnosed between 2002 and 2007 and 30,000 control children (Sermage-Faure et al., 2013). The authors used geocoded information on residential address at the time of diagnosis for cases and at time of selection for controls. They reported no statistically significant increase in leukemia risk with distance to power lines. The authors, however, noted a statistically non-significant risk increase in a sub-analysis within 50 meters of 225-400 kV lines, but this was based on a small number of cases (n=9). The ensuing scientific correspondence following the publication of the study focused on the magnitude of inaccuracies in distance assessment with geocoding as a main limitation of the study, and its implication on the inference that can be drawn from the study. The correspondence also addressed the statistical uncertainties of the results that are based on small numbers (Bonnet-Belfais et al. 2013; Magana Torres and Garcia, 2013).

A similar study from Denmark identified 1,698 cases of childhood leukemia from the Danish Cancer Registry and 3,396 individually matched healthy control children from the Danish Central Population Registry (Pedersen et al., 2014). The investigators used geographical information systems to determine the distance between birth addresses and the 132-400 kV overhead transmission lines of the seven Danish transmission companies. The authors reported no risk increases for childhood leukemia with residential distance to power lines; the reported ORs were 0.76 (95 % CI 0.40–1.45) and 0.92 (95% CI 0.67–1.25) for children who lived 0–199 meters and for those who lived 200–599 meters from the nearest power line compared to children who lived more than 600 meters away.

The third study by Bunch et al. (2014) provided an update and extension of the 2005 study conducted by Draper et al. (2005) in the United Kingdom. The update included 13 additional years of data, included Scotland in addition to England and Wales, and included 132-kV lines in addition to 275-kV and 400-kV transmission lines. Bunch et al. included over 53,000 childhood cancer cases, diagnosed between 1962 and 2008, and over 66,000 healthy children as controls, representing the largest study to date in this field of study. The authors reported no overall association with residential proximity to power lines with any of the voltage categories. The statistical association that was reported in the earlier study (Draper et al., 2005) was no longer apparent in the updated and extended study. An analysis by calendar time revealed that the association was apparent only in the earlier decades (1960s and 1970s) but not in the later decades starting from the 1980s (Bunch et al., 2014). This observation does not support the hypothesis that the associations observed earlier were due to the effects of magnetic-fields.

These three studies had a large sample size and they were population-based studies requiring no subject participation, which minimizes the potential for selection bias. The main limitation of all of these studies was the reliance on distance to power lines as the main exposure metric. Estimated distance to power lines is known to be a poor predictor of actual residential magnetic field exposure. Chang et al. (2014) recently provided a detailed discussion on exposure assessment methods based on geographical information systems and their potential to result in severe bias. Using data from the UK study, Swanson et al. (2014a) also showed that geocoding data may not be sufficiently reliable to accurately predict actual magnetic-field exposures due to inaccuracies in distance assessment, especially when the exact address is not available.

The meta-analysis conducted by Zhao et al. (2014a) included nine case-control studies of EMF exposure and childhood leukemia published between 1997 and 2013. Zhao et al. reported a statistically significant association between average exposure above 4 mG and all types of childhood leukemia (OR 1.57; 95% CI 1.03-2.4). The meta-analysis relied on published results from some of the same studies included in previous pooled analyses, and thus, provided little new insight.

Swanson et al. (2014b) investigated the potential role of corona ions from power lines in childhood cancer development in the largest-to-date epidemiologic study of childhood cancer conducted in the United Kingdom. The authors used an improved model to predict exposure to corona ions using meteorological data on wind conditions, power line characteristics and proximity to residential address. Swanson et al. concluded that their results provided no empirical support for the corona ion hypothesis

Methodological studies have also examined the potential role of alternative, non-causal explanations for the reported epidemiologic associations. Swanson (2013) examined differences in residential mobility among residents who lived at varying distances from power lines. Swanson attempted to assess if these differences in mobility may explain the statistical association of leukemia with residential proximity to power lines. Although some variations in residential mobility were observed, these were "only small ones, and not such as to support the hypothesis." Scientists in California evaluated whether selection bias may influence the association in an epidemiologic study of childhood leukemia and residential magnetic-field exposure (Slusky et al., 2014). Wire code categories were used to assess exposure among participant and nonparticipant subjects in the Northern California Childhood Leukemia Study. The authors reported systematic differences between participant and nonparticipant subjects in both wire code categories and socioeconomic status and concluded that these differences did not appear to explain the lack of an association between childhood leukemia and exposure estimates in this study. The main limitation of the study is the use of wire code categories for exposure assessment; wire code categories are known to be poor predictors for actual magnetic-field exposure.

In a recent review, Grellier et al. (2014) estimated that, if the association was causal, ~1.5% to 2% of leukemia cases might be attributable to ELF EMF in Europe. They conclude that "this contribution is small and is characterized by considerable uncertainty."

Assessment

While some of the recently published large and methodologically advanced studies showed no association (e.g., Bunch et al., 2014; Pedersen et al., 2014), and one showed weak associations in selected subgroups (Sermage-Faure et al., 2013), the previously observed association between childhood leukemia and magnetic fields reported in some studies (e.g., Ahlbom et al., 2000; Greenland et al., 2000; Kheifets et al., 2010) remains unexplained. Overall, the results of recent studies do not change the classification of the epidemiologic data as limited, which is consistent with the most recent assessment conducted by the Scientific Committee on Newly-Identified Health Risks (SCENIHR) in 2015.

One of the major limitations of recent work remains the limited validity of the exposure assessment methods. Magnetic-field estimates have largely been based on calculated levels from nearby power lines, distance from nearby power lines, and measured, short-term residential levels. Recent analyses (e.g., Swanson et al., 2014a) have further demonstrated the limitations of distance assessment in childhood cancer epidemiologic studies basing the exposure assessment on distance from power lines. Scientists have continued to examine the role of selection bias in the childhood leukemia association, but no conclusive evidence has emerged that could attribute the entire observed association to bias (e.g., Swanson, 2013; Slusky et al., 2014). Some scientists have opined that epidemiology has reached its limits in this area and any future research must demonstrate a significant methodological advancement (e.g., an improved exposure metric or a large sample size in high exposure categories) to be justified (Savitz, 2010; Schmiedel and Blettner, 2010).

The findings from the recent literature do not alter previous conclusions of the WHO and other reviews, including ours, that the epidemiologic evidence on magnetic fields and childhood leukemia is "limited" from the perspective of the IARC classification. Chance, confounding, and several sources of bias still cannot be ruled out. Conclusions from several published reviews (Kheifets and Oksuzyan, 2008; Pelissari et al., 2009; Schüz and Ahlbom, 2008; Calvente et al., 2010; Eden, 2010; Schüz, 2011) and scientific organizations (SSI, 2007; SSI, 2008; HCN, 2009a; SCENIHR, 2015; EFHRAN, 2012; SSM, 2013) support this conclusion.

Researchers will continue to investigate the association between exposure to magnetic fields and childhood leukemia. In recent assessments of the epidemiologic evidence of magnetic-field exposure and childhood leukemia, it has been concluded that only 1% to 3% of all childhood leukemia cases in Europe and North America could be due to magnetic-field exposure, should a causal relationship exist (Schüz, 2011; Grellier et al., 2014).

It is important to note that magnetic fields are just one area of study in the extensive body of research on the possible causes of childhood leukemia. There are several other hypotheses under investigation that point to possible genetic, environmental, and infectious explanations for childhood leukemia (e.g., McNally and Parker, 2006; Belson et al., 2007; Rossig and Juergens, 2008; Urayama et al., 2010; Bartley et al., 2010 [diagnostic x-rays]; Amigou et al., 2011 [road traffic]; Swanson, 2013).

Table 2. Relevant studies of childhood leukemia

Author	Year	Study Title
Bunch et al.	2014	Residential distance at birth from overhead high-voltage powerlines: childhood cancer risk in Britain 1962-2008.
Grellier et al.	2014	Potential health impacts of residential exposures to extremely low frequency magnetic fields in Europe
Pedersen et al.	2014	Distance from residence to power line and risk of childhood leukemia: a population-based case-control study in Denmark
Sermage-Faure et al.*	2013	Childhood leukaemia close to high-voltage power lines – the Geocap study, 2002–2007
Slusky et al.	2014	Potential role of selection bias in the association between childhood leukemia and residential magnetic fields exposure: a population-based assessment
Swanson	2013	Residential mobility of populations near UK power lines and implications for childhood leukaemia
Swanson et al.	2014a	Relative accuracy of grid references derived from postcode and address in UK epidemiological studies of overhead power lines

Author	Year	Study Title
Swanson et al.	2014b	Childhood cancer and exposure to corona ions from power lines: an epidemiological test
Zhao et al.	2014a	Magnetic fields exposure and childhood leukemia risk: a meta-analysis based on 11,699 cases and 13,194 controls
*Comments and Replies on Sermage-Faure et al.:		
Bonnet-Belfais et al.	2013	Comment: childhood leukaemia and power lines--the Geocap study: is proximity an appropriate MF exposure surrogate?
Magana Torres and Garcia	2013	Comment on 'Childhood leukaemia close to high-voltage power lines--the Geocap study, 2002-2007'--odds ratio and confidence interval.
Clavel and Hemon	2013	Reply: Comment on 'Childhood leukaemia close to high-voltage power lines--the Geocap study, 2002-2007'--odds ratio and confidence interval
Clavel et al.	2013	Reply: Comment on 'Childhood leukaemia close to high-voltage power lines--the Geocap study, 2002-2007'--is proximity an appropriate MF exposure surrogate?

Childhood brain cancer

Compared to the research on magnetic fields and childhood leukemia, there have been fewer studies of childhood brain cancer. The data are less consistent and limited by even smaller numbers of exposed cases compared with studies of childhood leukemia. The WHO review recommended the following:

> As with childhood leukaemia, a pooled analysis of childhood brain cancer studies should be very informative and is therefore recommended. A pooled analysis of this kind can inexpensively provide a greater and improved insight into the existing data, including the possibility of selection bias and, if the studies are sufficiently homogeneous, can offer the best estimate of risk (WHO 2007, p. 18).

Recent studies (July 2013 to November 2014)

There has been one new publication that specifically examined the potential relationship between residential proximity to transmission lines and childhood brain cancer among other childhood cancers. The Bunch et al. (2014) study, described above, also included cases of brain cancer (n=11,968) and other solid tumors (n=21,985) among children in the United Kingdom between 1962 and 2008. No association was reported by the authors for either brain cancer or for other cancers.

The results of the methodological study that investigated the accuracy of distance assessment in childhood cancer studies (Swanson et al., 2014a) are also relevant for childhood brain cancer. The study that investigated the role of corona ions in childhood cancer development, similarly to childhood leukemia, reported no consistent associations for childhood brain cancer (Swanson et al., 2014b).

Assessment

Overall, the weight-of-evidence does not support an association between magnetic-field exposures and the development of childhood brain cancer. The results of recent studies do not alter the classification of the epidemiologic data in this field as "inadequate."

Table 3. Relevant studies of childhood brain cancer

Authors	Year	Study
Bunch et al.	2014	Residential distance at birth from overhead high-voltage powerlines: childhood cancer risk in Britain 1962-2008.
Swanson et al.	2014a	Relative accuracy of grid references derived from postcode and address in UK epidemiological studies of overhead power lines
Swanson et al.	2014b	Childhood cancer and exposure to corona ions from power lines: an epidemiological test

Adult health outcomes

Breast cancer

The WHO reviewed studies of breast cancer and residential magnetic-field exposure, electric blanket usage, and occupational magnetic-field exposure. These studies did not report consistent associations between magnetic-field exposure and breast cancer. The WHO concluded that the recent body of research on this topic was less susceptible to bias compared with previous studies, and, as a result, it provided strong support to previous consensus statements that magnetic-field exposure does not influence the risk of breast cancer. Specifically, the WHO stated:

> Subsequent to the IARC monograph a number of reports have been published concerning the risk of female breast cancer in adults associated with ELF magnetic field exposure. These studies are larger than the previous ones and less susceptible to bias, and overall are negative. With these studies, the evidence for an association between ELF exposure and the risk of breast cancer is weakened considerably and does not support an association of this kind (WHO 2007, p. 307).

The WHO recommended no specific research with respect to breast cancer and magnetic-field exposure.

Recent studies (July 2013 to November 2014)

A Dutch study, that included a cohort of about 120,000 men and women in the Netherlands Cohort, investigated occupational exposure to ELF magnetic fields and cancer development (Koeman et al., 2014). The study was a case-cohort analysis of 2,077 breast cancer cases among women (no breast cancer was identified among men in the cohort). Job titles were used to assign estimates of ELF magnetic field exposures using a JEM. No association was reported for breast cancer with the level of estimated ELF magnetic-field exposure, the length of employment, or cumulative exposure in the exposed jobs.

A nested case-cohort analysis of breast cancer incidence was conducted in a large cohort of more than 267,000 female textile workers in Shanghai (Li et al., 2013). A total of 1,687 incident breast cancer cases were identified in the cohort between 1989 and 2000; their estimated exposure was compared with the estimated exposure of 4,702 non-cases. Exposure was assigned based on complete work history and a JEM specifically developed for the cohort. No association was reported between cumulative exposure and risk of breast cancer regardless of age, histological type, and whether a lag period was used or not. An accompanying editorial opined that this well-designed study further adds to the already large pool of data not supporting an association between ELF EMF and breast cancer (Feychting, 2013). The editorial suggests that further studies in breast cancer "have little new knowledge to add," following the considerable improvement in study quality over time in breast cancer epidemiologic studies, and with the evidence being "consistently negative."

Zhao et al. (2014b) reported the results of their meta-analysis of 16 case-control epidemiologic studies of ELF EMF and breast cancer published between 2000 and 2007. They reported a weak but statistically significant association, which appeared to be stronger among non-menopausal women. The conclusion of the authors that ELF magnetic fields might be related to breast cancer is contrary to the conclusion of the WHO and other risk assessment panels. This may be due to the inclusion of earlier and methodologically less advanced studies in the meta-analysis.

Assessment

The two large recently published studies (Li et al., 2013; Koeman et al., 2014) support the growing body of scientific evidence against a causal role for magnetic fields in breast cancer. The meta-analyses by Zhao et al. (2014b) include numerous limitations and therefore should be interpreted with great caution due to flaws within the individual studies and the crude pooling of data with a vast range of exposure definitions and cut-points. Several review papers (Feychting and Forssén 2006; Hulka and Moorman, 2008) and expert groups (SCENIHR, 2009) support the previous WHO (2007) conclusion that magnetic-field exposure does not influence the risk of breast cancer.

Table 4. Relevant studies of breast cancer

Authors	Year	Study
Koeman et al.	2014	Occupational extremely low-frequency magnetic field exposure and selected cancer outcomes in a prospective Dutch cohort
Feytching	2013	Invited commentary: extremely low-frequency magnetic fields and breast cancer--now it is enough!
Li et al	2013	Occupational exposure to magnetic fields and breast cancer among women textile workers in Shanghai, China
Zhao et al.	2014b	Relationship between exposure to extremely low-frequency electromagnetic fields and breast cancer risk: a meta-analysis.

Adult brain cancer

Brain cancer was studied along with leukemia in many of the occupational studies of ELF EMF. The findings were inconsistent, and there was no pattern of stronger findings in studies with more advanced methods, although a small association could not be ruled out. The WHO classified the epidemiologic data on adult brain cancer as inadequate and recommended (1) updating the existing cohorts of occupationally-exposed individuals in Europe and (2) pooling the epidemiologic data on brain cancer and adult leukemia to confirm the absence of an association.

The WHO stated the following:

> In the case of adult brain cancer and leukaemia, the new studies published after the IARC monograph do not change the conclusion that the overall evidence for an association between ELF [EMF] and the risk of these disease remains inadequate (WHO 2007, p. 307).

Recent studies (July 2013 to November 2014)

Epidemiology studies published since our last review on adult brain cancer and ELF EMF exposure are listed in Table 5 and include two cohort studies and one case-control study.

The large cohort study of occupational ELF EMF exposure in the Netherlands (Koeman et al., 2014) also investigated adult brain cancer development. The authors reported no association with adult brain cancer for any of the exposure metrics investigated for EMF exposure for either men or women.

Sorahan (2014a) reported the analysis of brain cancer incidence between 1973 and 2010 among more than 70,000 British electricity supply workers in a cohort analysis. The study reported no consistent association between brain cancer risk (glioma and meningioma) and estimated cumulative, recent and distant occupational exposure to ELF EMF.

Turner et al. (2014) investigated the association between occupational exposure to ELF EMF and brain cancer in a large international case-control epidemiologic study. While the authors reported both an increase (with exposure 1-4 years prior to diagnosis) and a decrease (with the highest maximum exposure) in associations with brain cancer in some of the sub-analyses, overall there was no association with lifetime cumulative or average exposure for either main type of brain cancer (glioma or meningioma).

Assessment

Findings from the recent literature predominantly support no association between exposure to ELF EMF and brain cancer in adults, but remain limited due to the exposure assessment methods and insufficient data available on specific brain cancer subtypes. Currently, the literature provides very weak evidence of an association in some studies, if any, between magnetic fields and brain cancer.[11] The overall evidence for brain cancer has not materially changed and remains inadequate as classified by the WHO in 2007.

Table 5. Relevant studies of adult brain cancer

Authors	Year	Study
Koeman et al.	2014	Occupational extremely low-frequency magnetic field exposure and selected cancer outcomes in a prospective Dutch cohort
Sorahan	2014a	Magnetic fields and brain tumour risks in UK electricity supply workers.
Turner et al	2014	Occupational exposure to extremely low frequency magnetic fields and brain tumour risks in the INTEROCC study

Adult leukemia

There is a vast amount of literature on adult leukemia and ELF EMF, most of which is related to occupational exposure. Overall, the findings of these studies are inconsistent—with some studies reporting a positive association between measures of ELF EMF and leukemia and other studies showing no association. No pattern has been identified whereby studies of higher quality or design are more likely to produce positive or negative associations. The WHO subsequently classified the epidemiologic evidence for adult leukemia as “inadequate.” They recommended updating the existing European occupation cohorts and updating a meta-analysis on occupational magnetic-field exposure.

Recent studies (July 2013 to November 2014)

The Dutch cohort study previously discussed (Koeman et al., 2014) identified 761 and 467 malignancies of the hematopoietic system among men and women, respectively. Overall, no increases in risk or trends were observed in association with cumulative exposure to ELF magnetic fields or duration of exposure among either men or women. In some sub-analyses by subtype, however, statistically significant associations were noted for acute myeloid leukemia and follicular lymphoma among men.

Sorahan also completed detailed analyses for leukemia incidence in the cohort of over 70,000 British electricity supply employees (Sorahan, 2014b). For all leukemias overall, there was no indication for risk increases with cumulative, recent or distant occupational exposure to magnetic fields. In some sub-analyses, however, the authors reported a statistically significant association for adult ALL.

Assessment

Recent studies of adult leukemia have not provided new evidence to support an association of magnetic field exposure with adult leukemia overall or with any leukemia sub-type. Thus, there

11 A consensus statement by the National Cancer Institute’s Brain Tumor Epidemiology Consortium confirms this statement. They classified residential power frequency EMF in the category “probably not risk factors” and described the epidemiologic data as “unresolved” (Bondy et al., 2008, p. 1958).

is no new evidence to alter the overall conclusion and the evidence remains inadequate for adult leukemia.

Table 6. Relevant studies of adult leukemia

Authors	Year	Study
Koeman et al.	2014	Occupational extremely low-frequency magnetic field exposure and selected cancer outcomes in a prospective Dutch cohort
Sorahan	2014b	Magnetic fields and leukaemia risks in UK electricity supply workers.

Reproductive and developmental effects

Two studies in the past have received considerable attention because of a reported association between peak magnetic-field exposure greater than approximately 16 mG and miscarriage—a prospective cohort study of women in early pregnancy (Li et al., 2002) and a nested case-control study of women who miscarried compared to their late-pregnancy counterparts (Lee et al., 2002).

These two studies improved on the existing body of literature because average exposure was assessed using 24-hour personal magnetic-field measurements (early studies on miscarriage were limited because they used surrogate measures of exposure, including visual display terminal use, electric blanket use, or wire code data). Following the publication of these two studies, however, a hypothesis was put forth that the observed association may be the result of behavioral differences between women with “healthy” pregnancies that went to term (less physically active) and women who miscarried (more physically active) (Savitz, 2002). It was proposed that physical activity is associated with an increased opportunity for peak magnetic-field exposures, and the nausea experienced in early, healthy pregnancies and the cumbersomeness of late, healthy pregnancies would reduce physical activity levels, thereby decreasing the opportunity for exposure to peak magnetic fields. Furthermore, nearly half of women who had miscarriages reported in the cohort by Li et al. (2002) had magnetic-field measurements taken after miscarriage occurred, when changes in physical activity may have already occurred, and all measurements in Lee et al. (2002) occurred post-miscarriage.

The scientific panels that have considered these two studies concluded that the possibility of this bias precludes making any conclusions about the effect of magnetic fields on miscarriage (NRPB, 2004; FPTRPC, 2005; WHO, 2007). The WHO concluded, “There is some evidence for increased risk of miscarriage associated with measured maternal magnetic-field exposure, but this evidence is inadequate” (WHO 2007, p. 254). The WHO stated that, given the potentially high public health impact of such an association, further epidemiologic research is recommended.

Recent studies (July 2013 to November 2014)

Two epidemiologic studies investigated the potential association between ELF EMF exposure and miscarriage or stillbirth. A hospital-based case-control study from Iran included 58 women with spontaneous abortion and 58 pregnant women (Shamsi Mahmoudabadi et al., 2013). The authors reported that measured magnetic-field levels were statistically significantly higher among the cases than among controls. The study was small and provided little information on subject recruitment, exposure assessment, type of metric used to summarize exposure, and potential confounders; thus, it contributes little weight to an overall assessment.

A Chinese study identified 413 pregnant women at 8 weeks of gestation between 2010 and 2012 (Wang et al., 2013). Magnetic-field levels were measured at the front door and the alley in front of the participants' homes. No statistically significant association was seen with average exposure at the front door, but the authors reported an association with maximum magnetic-field values measured in the alleys in front of the homes. The study provides a fairly limited contribution to our current knowledge as magnetic-field levels measured at the front door or outside the home are very poor predictors of in-home and personal exposures.

Two studies examined various birth outcomes in relation to ELF EMF exposure. A study from the United Kingdom investigated birth outcomes in relation to residential proximity to power lines during pregnancy between 2004 and 2008 in Northwest England (de Vocht et al., 2014). The researchers examined hospital records of over 140,000 births, and distance to the nearest power lines were determined using geographical information systems. The authors reported moderately lower birth weight within 50 meters of power lines, but observed no statistically significant increase in risk of any adverse clinical birth outcomes (such as preterm birth, small for gestational age, or low birth weight). The limitations of the study include its reliance on distance for exposure assessment and the potential for confounding by socioeconomic status, as also discussed by the authors. A study from Iran reported no association between ELF EMF and pregnancy and developmental outcomes, such as duration of pregnancy, birth weight and length, head circumference, and congenital malformations (Mahram and Ghazavi, 2013). The study, however, provided little information on subject selection and recruitment; thus, it is difficult to assess its quality.

Su et al. (2014) conducted a cross-sectional study in Shanghai to examine correlations between magnetic-field exposure and embryonic development. The authors identified 149 pregnant women who were seeking induced termination of pregnancy during the first trimester. Personal 24-hour measurements were conducted for women within four weeks of the termination. Ultrasound was used to determine embryonic bud and embryonic sac length prior to the termination. The authors reported an association with maternal daily magnetic-field exposure and embryonic bud length. The study has a number of severe limitations, including the cross-sectional design, which cannot distinguish if exposure measured after termination describes that experienced during the first trimester; thus, it is impossible to assess causality. Additionally, the lack of careful consideration for gestational age, which is a major determinant of embryonic bud length, is an issue. Overall, the study provides little, if any, weight in a weight-of-evidence assessment.

Lewis et al. (2014) analyzed magnetic field exposure data over 7 consecutive days among 100 pregnant women from an earlier study. They reported that measures of central tendency (e.g., mean, median) were relatively well correlated day-to-day, and a measurement on one day could be used reasonably well to predict exposure on another day. Peak exposure measures (e.g., maximum value) showed poorer performance. The study did not examine the outcomes of the pregnancies, but these results have implications for earlier studies that reported association for spontaneous abortions with peak measures but not with measures of central tendency.

Assessment

The recent epidemiologic studies have not provided sufficient evidence to alter the conclusion that the evidence for reproductive or developmental effects is inadequate.

Table 7. Relevant studies of reproductive and developmental effects

Authors	Year	Study
de Vocht et al.	2014	Maternal residential proximity to sources of extremely low frequency electromagnetic fields and adverse birth outcomes in a UK cohort
Lewis et al.	2014	Temporal variability of daily personal magnetic field exposure metrics in pregnant women.
Mortazavi et al.	2013	The study of the effects of ionizing and non-ionizing radiations on birth weight of newborns to exposed mothers
Shamsi Mahmoudabadi et al.	2013	Exposure to Extremely Low Frequency Electromagnetic Fields during Pregnancy and the Risk of Spontaneous Abortion: A Case-Control Study
Su et al.	2014	Correlation between exposure to magnetic fields and embryonic development in the first trimester
Wang et al.	2013	Residential exposure to 50 Hz magnetic fields and the association with miscarriage risk: a 2-year prospective cohort study

Neurodegenerative diseases

Research into the possible effect of magnetic fields on the development of neurodegenerative diseases began in 1995, and the majority of research since then has focused on Alzheimer's disease and a specific type of motor neuron disease called amyotrophic lateral sclerosis (ALS), which is also known as Lou Gehrig's disease. Early studies on ALS, which had no obvious biases and were well conducted, reported an association between ALS mortality and estimated occupational magnetic-field exposure. The review panels, however, were hesitant to conclude that the associations provided strong support for a causal relationship. Rather, they felt that an alternative explanation (i.e., electric shocks received at work) may be the source of the observed association.

The majority of the more recent studies discussed by the WHO reported statistically significant associations between occupational magnetic-field exposure and mortality from Alzheimer's disease and ALS, although the design and methods of these studies were relatively weak (e.g., disease status was based on death certificate data, exposure was based on incomplete occupational information from census data, and there was no control for confounding factors). Furthermore, there were no biological data to support an association between magnetic fields and neurodegenerative diseases. The WHO panel concluded that there is "inadequate" data in support of an association between magnetic fields and Alzheimer's disease or ALS. The panel recommended more research in this area using better methods; in particular, studies that enrolled incident Alzheimer's disease cases (rather than ascertaining cases from death certificates) and studies that estimated electrical shock history in ALS cases were recommended. Specifically, the WHO concluded, "When evaluated across all the studies, there is only very limited evidence of an association between estimated ELF exposure and [Alzheimer's] disease risk" (WHO 2007, p. 194).

Recent studies (July 2013 to November 2014)

Davanipour et al. (2014) have reported on a study of severe cognitive dysfunction and occupational ELF magnetic-field exposure, in which "[t]he study population consisted of 3,050 Mexican Americans, aged 65+, enrolled in Phase I of the Hispanic Established Population for the Epidemiologic Study of the Elderly (H-EPESE) study." Occupational history, along with data on other socio-demographic information, was obtained via in-home personal interviews. Occupational exposure to magnetic fields was classified as low, medium, and high. Cognitive function was evaluated with the use of a mini-mental state exam and cognitive dysfunction was defined as an exam score below 10. While the authors describe their study as a population-based case-control study, based on the provided description in the paper, the study appears to be a cross-sectional study. Based on their analyses, the authors reported a statistically significant association between estimated occupational magnetic-field exposure and severe cognitive dysfunction. This study had a number of limitations, including the cross-sectional study design, the lack of clear clinical diagnosis for case-definition, and the crude assessment of occupational exposure.

Seelen et al. (2014) conducted a large population-based case-control study of ALS and residential proximity to high-voltage power lines in the Netherlands. The authors included 1,139 ALS cases diagnosed between 2006 and 2013 and 2,864 frequency-matched controls selected from general practitioners' rosters. Lifetime residential history was determined for all cases and controls using data from the Municipal Personal Records Database. Addresses were geocoded and the shortest distance to a high-voltage power was determined for each address. High-voltage power lines with voltages between 50 kV and 150 kV (high voltage) and between 220 kV and 380 kV were analyzed. No statistically significant association was reported for ALS with residential proximity to power lines with any of the voltages included. The authors also conducted a meta-analysis including their own results along with those of two previously published studies (Marcilio et al., 2011; Frei et al., 2013) and reported an overall OR of 0.9 (95% CI 0.7-1.1) for living within 200 meters of a high voltage power line. Similar to the previous power-line studies, the main limitation of the current study is the use of distance to power lines as a surrogate for magnetic-field exposure. The authors, however, reconstructed lifetime residential history, which represents a methodological improvement.

The role of electric shocks in development of neurodegenerative diseases has been examined in three recent studies. Electric shocks have been hypothesized to be a potential etiologic agent, primarily for ALS, based on the observation that linked "electric occupations," but not estimates of magnetic-field exposure to ALS (Vergara et al., 2013). Researchers in the Netherlands conducted a hospital-based case-control study of Parkinson's disease and occupational exposure to electric shocks and ELF magnetic fields (van der Mark et al., 2014). The study included 444 cases of Parkinson's disease and 876 matched controls. Occupational history was determined based on telephone interviews. JEMs were used to categorize jobs for exposure to both electric shocks and magnetic fields. The authors reported no risk increases with any of the two investigated exposures and concluded that their results suggest no association with Parkinson's disease.

A mortality case-control study using death certificates between 1991 and 1999 was conducted in the United States (Vergara et al., 2014). The study analyzed 5,886 ALS deaths and 10-times as many matched control deaths. Exposure to electric shocks and ELF magnetic fields was classified based on job titles reported on the death certificates and using corresponding JEMs. While a statistically significant association was reported for "electrical occupations," no consistent associations were observed for either magnetic field or electric shock exposures. The main limitation of the study is its reliance on death certificates that may result in disease and exposure misclassifications.

Huss et al. (2014) reported results of their analysis of ALS mortality in the Swiss National Cohort between 2000 and 2008. The cohort included about 2.2 million workers with high, medium, or low exposure to ELF magnetic fields and electric shocks. For exposure classification, JEMs for magnetic-field exposure and electric shocks were applied to occupations reported by the subjects at the 1990 and 2000 censuses. The authors reported a statistically significant association of ALS mortality with estimated medium or high occupational magnetic-field exposure based at both censuses, but not with estimates of electric shock exposure. The main limitations of the study include the reliance on mortality data, which may result in disease misclassification, and the use of census data for exposure assessment, which may result in exposure misclassification.

Assessment

Overall, the recent literature does not alter the conclusion that there are "inadequate" data for a causal link between exposure to ELF magnetic fields and neurodegenerative diseases. Most of the recent studies provided no support for a potential association. Several recent studies have investigated the potential role of electric shocks in neurodegenerative disease development. None of these studies reported results that would support the hypothesis that electric shocks play an etiologic role.

With respect to Alzheimer's disease, the main limitations of the available literature remains: the difficulty in diagnosing Alzheimer's disease; the difficulty of identifying a relevant exposure window given the long and nebulous course of this disease; the difficulty of estimating magnetic-field exposure prior to the appearance of the disease; the under-reporting of Alzheimer's disease on death certificates; crude exposure evaluations that are often based on the recollection of occupational histories by friends and family given the cognitive impairment of the study participants; and the lack of consideration of both residential and occupational exposures or confounding variables.

Although the most-recently published studies on this topic in Table 8 below were not available for inclusion in the SCENIHR opinion (their cut-off date was June 2014), the authors concluded that "[a]lthough the new studies in some cases have methodological weaknesses, they do not provide support for the previous conclusion that ELF MF exposure increases the risk for Alzheimer´s disease" (SCENIHR, 2015, p. 166).

Table 8. Relevant studies of neurodegenerative disease

Authors	Year	Study
Davanipour et al.	2014	Severe cognitive dysfunction and occupational extremely low frequency magnetic field exposure among elderly Mexican Americans.
Huss et al.	2014	Occupational exposure to magnetic fields and electric shocks and risk of ALS: The Swiss National Cohort.
Seelen et al.	2014	Residential exposure to extremely low frequency electromagnetic fields and the risk of ALS
Van der Mark et al.	2014	Extremely low-frequency magnetic field exposure, electrical shocks and risk of Parkinson's disease
Vergara et al.	2014	Case-control study of occupational exposure to electric shocks and magnetic fields and mortality from amyotrophic lateral sclerosis in the US, 1991–1999

Cardiovascular disease

It has been hypothesized that magnetic-field exposure reduces heart rate variability, which in turn increases the risk for AMI. In a large cohort of utility workers, Savitz et al. (1999) reported an association with arrhythmia-related deaths and deaths due to AMI among workers with higher magnetic field exposure. Previous and subsequent studies did not report a statistically significant increase in cardiovascular disease mortality or incidence related to occupational magnetic-field exposure (WHO, 2007).

The WHO concluded:

> Experimental studies of both short- and long-term exposure indicate that, while electric shock is an obvious health hazard, other hazardous cardiovascular effects associated with ELF fields are unlikely to occur at exposure levels commonly encountered environmentally or occupationally. Although various cardiovascular changes have been reported in the literature, the majority of effects are small and the results have not been consistent within and between studies. With one exception [Savitz et al., 1999], none of the studies of cardiovascular disease morbidity and mortality has shown an association with exposure. Whether a specific association exists between exposure and altered autonomic control of the heart remains speculative. Overall, the evidence does not support an association between ELF exposure and cardiovascular disease." (WHO, 2007, p. 220)

Recent studies (July 2013 to November 2014)

Since our last review in July 2013, no newly published studies of ELF EMF and cardiovascular diseases have been identified by our literature search.

Assessment

The conclusion that there is no association between magnetic fields and cardiovascular diseases has not changed.

In vivo studies related to carcinogenesis

In the field of ELF EMF research, a number of research laboratories have exposed rodents, including those with a particular genetic susceptibility to cancer, to high levels of magnetic fields over the course of the animals' lifetime and performed tissue evaluations to assess the incidence of cancer in many organs. In these studies, magnetic-field exposure has been administered alone (to test for the ability of magnetic fields to act as a complete carcinogen), in combination with a known carcinogen (to test for a promotional or co-carcinogenetic effect), or in combination with a known carcinogen and a known promoter (to test for a co-promotional effect).

The WHO review described four large-scale, long-term studies of rodents exposed to magnetic fields over the course of their lifetime that did not report increases in any type of cancer (Mandeville et al., 1997; Yasui et al., 1997; Boorman et al., 1999a, 1999b; McCormick et al., 1999). No directly relevant animal model for childhood ALL existed at the time of the WHO report. Some animals, however, develop a type of lymphoma similar to childhood ALL and studies exposing predisposed transgenic mice to ELF magnetic fields did not report an increased incidence of this lymphoma type (Harris et al., 1998; McCormick et al., 1998; Sommer and Lerchel, 2004).

Studies investigating whether exposure to magnetic fields can promote cancer or act as a co-carcinogen used known cancer-causing agents, such as ionizing radiation, ultraviolet radiation, or other chemicals. No effects were observed for studies on chemically-induced preneoplastic liver lesions, leukemia or lymphoma, skin tumors, or brain tumors; however, the incidence of 7,12-dimethylbenz[a]anthracene (DMBA)-induced mammary tumors was increased with magnetic-field exposure in a series of experiments in Germany (Löscher et al., 1993, 1994, 1997; Mevissen et al., 1993a,1993b, 1996a, 1996b, 1998; Baum et al., 1995; Löscher and Mevissen, 1995), suggesting that magnetic-field exposure increased the proliferation of mammary tumor cells. These results were not replicated in a subsequent series of experiments in a laboratory in the United States (Anderson et al., 1999; Boorman et al.1999a, 1999b), possibly due to differences in experimental protocol and the species strain. In Fedrowitz et al. (2004), exposure enhanced mammary tumor development in one sub-strain (Fischer 344 rats), but not in another sub-strain that was obtained from the same breeder, which argues against a promotional effect of magnetic fields.[12]

Some studies have reported an increase in genotoxic effects among exposed animals (e.g., DNA strand breaks in the brains of mice [Lai and Singh, 2004]), although the results have not been replicated.

[12] The WHO concluded with respect to the German studies of mammary carcinogenesis, "Inconsistent results were obtained that may be due in whole or in part to differences in experimental protocols, such as the use of specific substrains" (WHO 2007, p. 321).

In summary, the WHO concluded the following with respect to ***in vivo*** research: "There is no evidence that ELF [EMF] exposure alone causes tumours. The evidence that ELF field exposure can enhance tumour development in combination with carcinogens is inadequate" (WHO, 2007, p. 322). Recommendations for future research included the development of a rodent model for childhood ALL and the continued investigation of whether magnetic fields can act as a promoter or co-carcinogen.

Recent studies (July 2013 to November 2014)

No new animal bioassays of tumor development due to magnetic-field exposure alone or in combination with known cancer initiators have been conducted since the study by Bernard et al. (2008) that was the first study to use an animal model of ALL, the most common leukemia type in children, reviewed in the previous update. Instead, various ***in vivo*** studies examining potential mechanisms that could precipitate cancer development have been conducted. These studies are listed in Table 9.

Two recent animal studies examined the ability of magnetic-field exposure to cause DNA damage. Saha et al. (2014) exposed pregnant mice to one of three different magnetic field (50-Hz) exposure conditions: 1,000 mG for 2 hours on day 13.5 of gestation, 3,000 mG (continuous) for 15 hours on day 12.5 of gestation, or 3,000 mG (intermittent: 5 minutes on, 10 minutes off) for 15 hours on day 12.5 of gestation. Controls were either untreated or sham-exposed under these same conditions, but with the exposure equipment turned off. Additional animals were exposed to either 10 or 25 Gray of X-irradiation on day 13.5 of gestation; however, the amount of time for which these treatments were given is not known. Although X-irradiation was associated with increased DNA double strand breaks and cell apoptosis in the embryonic brain cells of the ventricular and subventricular zones, none of the magnetic field conditions had a significant effect on these parameters. These analyses were not conducted in a blinded manner; however, the potential influence of the animal litter was taken into account in the statistical analysis.

In a related study, Korr et al. (2014) continuously exposed mice for 8 weeks to either 1,000 mG or 10,000 mG, 50-Hz magnetic fields. Controls were not sham-exposed, but maintained in the same room as the magnetic-field-exposed animals. At the end of the exposure period, the animals were injected with radiolabeled thymidine to look for DNA single-strand breaks and unscheduled DNA synthesis in the liver, kidneys, and brain using an autoradiographic method. A slight reduction in mitochondrial DNA synthesis was observed in the epithelial cells of the kidney collecting ducts at 1,000 mG, but no increase in DNA single-strand breaks was observed. At 10,000 mG, a slight reduction in unscheduled DNA synthesis (likely related to reduced mitochondrial DNA synthesis) was observed in the epithelial cells of the choroid plexus of the brain's fourth ventricle and the kidney collecting duct, but again, there was no difference in the degree of DNA single-strand breaks observed between treated and control animals. These investigations were conducted in a blinded manner.

Oxidative stress is a condition in which oxygen free radical levels in the body are elevated and is one mechanism by which DNA damage, as well as other forms of cellular damage, may occur. Numerous recent ***in vivo*** studies have evaluated whether magnetic-field exposure may be associated with oxidative stress, with mixed results. Seifirad et al. (2014) examined the expression of various markers, including the lipid peroxidation markers malondialdehyde, conjugated dienes, and total antioxidant capacity, in the blood following exposure of rats to a 5,000 mG, 60-Hz magnetic fields for either 4 hours (acute) or 14 days (chronic). The acute exposure was associated with increased total antioxidant capacity, while the chronic exposure was associated with increased malondialdehyde levels and a reduced total antioxidant capacity. Although the controls were reportedly sham-exposed, it is not known if this was for the acute or chronic exposure condition, making interpretation difficult. Blinded analyses and control of environmental conditions also were not reported.

In another study, Glinka et al. (2013) examined the expression of various antioxidant markers in the blood and liver of male rats following 30 minutes of exposure to 100,000 mG, 40-Hz magnetic fields, for 6, 10, or 14 days. The purpose of this analysis was to examine the potential role of magnetic fields in the treatment of wounds; thus, the rats were first wounded surgically prior to exposure. Controls were sham exposed, but blinded analyses were not reported. Further, no details on the preparation of liver homogenates or the methods used to analyze the various samples were reported. Differences from control in the expression of the antioxidant markers superoxide dismutase, glutathione peroxidase, and malondialdehyde were reported in either the blood or the liver on various days, but no clear pattern of expression was apparent. No differences in the expression of glutathione S-transferase was observed. It should be noted, however, that control values varied considerably across the different study days, which may be related to a confounding effect associated with the wound healing process.

Hassan and Abdelkawi (2014) exposed male rats to 100,000 mG, 50-Hz magnetic fields for 1 hour per day for 30 days. Other groups of rats were treated with cadmium chloride or both cadmium chloride and magnetic-field exposure. Although it was reported that the controls were sham-exposed, based on the methods description, this does not appear to be the case; also, analyses were not conducted in a blinded manner. Both magnetic-field exposure and cadmium treatment were reported to increase the total oxidant status and protein carbonyls present in the blood; both exposures combined results in an increased response over either single condition alone. Deng et al. (2013) conducted a similar study in which mice were exposed to 20,000 mG, 50-Hz magnetic fields for 4 hours per day, 6 days per week for 8 weeks. In this case, other treatment groups were exposed to aluminum or both magnetic fields and aluminum. Control mice were not reported to have been sham-exposed and analyses were not reported to have been conducted in a blinded manner. Both brain and serum levels of superoxide dismutase were reported to be lower in all exposure conditions compared to controls. In contrast, malondialdehyde levels were increased in all exposure groups. Other analyses looking at behavior and brain pathology were also conducted in this study, but are not reported here.

Manikonda et al. (2014) looked at the effects in rats of continuous, 90-day exposure to much lower magnetic field strengths (500 mG and 1,000 mG, 50-Hz). Controls were sham exposed in a similar exposure apparatus, but with the equipment turned off. Analyses were not reported to have been conducted in a blinded manner. Reactive oxygen species, thiobarbituric acid reactive substances (a marker of lipid peroxidation), and glutathione peroxidase were significantly increased compared to control levels in the hippocampus and cerebellum with both exposure conditions; they were also increased in the cortex, but at 1,000 mG only. Superoxide dismutase levels were also increased in all three tissues at 1,000 mG, while the thiol status (GSH/GSSG) was reduced with exposure in these tissues. Generally, the cortex was less responsive than the other brain tissues examined. It should be noted, however, that the exposed rats showed significantly higher levels of physical activity than the controls, which may have confounded the study results. Finally, Akdag et al. (2013) examined the effects of more long-term magnetic-field exposure. Rats were continuously exposed to a 1,000 or 5,000 mG, 50-Hz magnetic field for 2 hours per day for 10 months. Control rats were sham exposed (with the exposure system turned off) and analyses were reported to have been conducted in a blinded manner. Neither exposure condition affected the expression of various oxidant/anti-oxidant markers in the testes, although expression of an apoptosis marker seemed to be increased in an exposure-related manner.

Overall, it is hard to draw any conclusions from these studies of oxidative stress markers because the numbers of animals per group were generally low, the exposure parameters and oxidative stress markers examined varied across the studies, reported effects were contradictory across studies in some cases, and none of the analyses (with the exception of that by Akdag et al., 2013) were reported to have been conducted in a blinded manner. The equivocal nature of these data is similar to that of earlier studies investigating the influence of magnetic-field exposure on the expression of oxidative stress markers. Independent replications of findings in studies with greater sample sizes and blinded analyses are needed as well as a better understanding of how such markers may be related to health and disease processes.

Assessment

As previously noted, no new animal bioassays of long-term magnetic-field exposure as a possible carcinogen or co-carcinogen have been conducted since the last update. Rather, more recent animal studies have investigated two potential mechanisms related to carcinogenesis: genotoxicity and oxidative stress. The studies of oxidative stress generally suffer from various methodological deficiencies, including small samples sizes, the absence of sham-exposure treatment groups, and analyses that were not conducted in a blinded manner. Further, the results are generally inconsistent across the body of studies, with some studies reporting effects and other studies showing no change. Even in the studies showing alterations, these changes are not necessarily consistent from one study to the next. While these dissimilarities could be a function of the differences in exposure conditions employed across the body of studies, the equivocal nature of the findings on oxidative stress is consistent with that of earlier studies.

One particularly well-conducted study on genotoxicity found no effect of magnetic-field exposure on DNA double strand breaks. This study employed positive control X-irradiation, sham exposure of negative controls, and blinded analyses. Further, the results are generally consistent with those of another recent investigation that found no influence of magnetic-field exposure on the induction of DNA single strand breaks in the brain, liver, or kidneys of exposed mice.

Overall, the ***in vivo*** studies published since the last update do not alter the previous conclusion of the WHO that there is inadequate evidence of carcinogenicity due to ELF EMF exposure. Further, the limited recent investigations suggest that DNA single and double strand breaks do not occur as a result of magnetic-field exposure.

Table 9. Relevant *in vivo* studies related to carcinogenesis

Authors	Year	Study
Akdag et al.	2013	Can safe and long-term exposure to extremely low frequency (50 Hz) magnetic fields affect apoptosis, reproduction, and oxidative stress?
Deng et al.	2013	Effects of aluminum and extremely low frequency electromagnetic radiation on oxidative stress and memory in brain of mice
Glinka et al.	2013	Influence of extremely low-frequency magnetic field on the activity of antioxidant enzymes during skin wound healing in rats
Hassan and Abdelkawi	2014	Assessing of plasma protein denaturation induced by exposure to cadmium, electromagnetic fields and their combined actions on rat
Korr et al.	2014	No evidence of persisting unrepaired nuclear DNA single strand breaks in distinct types of cells in the brain, kidney, and liver of adult mice after continuous eight-week 50 Hz magnetic field exposure with flux density of 0.1 mT or 1.0 mT
Manikonda et al.	2014	Extremely low frequency magnetic fields induce oxidative stress in rat brain
Saha et al.	2014	Increased apoptosis and DNA double-strand breaks in the embryonic mouse brain in response to very low-dose X-rays but not 50 Hz magnetic fields
Seifirad et al.	2014	Effects of extremely low frequency electromagnetic fields on paraoxonase serum activity and lipid peroxidation metabolites in rat

7 Reviews Published by Scientific Organizations

A number of national and international scientific organizations have published reports or scientific statements with regard to the possible health effects of ELF EMF since January 2006. Although none of these documents represents a cumulative weight-of-evidence review of the caliber of the WHO review published in June 2007, their conclusions are of relevance. In general, the conclusions of these reviews are consistent with the scientific consensus articulated in Section 6.

The following list indicates the scientific organization and a link to the online reports or statements.

- **The European Health Risk Assessment Network on Electromagnetic Fields Exposure**
    - http://efhran.polimi.it/docs/D2_Finalversion_oct2012.pdf (EFHRAN, 2012 [human exposure])
    - http://efhran.polimi.it/docs/IMS-EFHRAN_09072010.pdf (EFHRAN, 2010 [***in vitro*** and ***in vivo*** studies])
- **The Health Council of Netherlands**
    - http://www.gezondheidsraad.nl/sites/default/files/200902.pdf (HCN, 2009a)
    - http://www.gezondheidsraad.nl/en/publications/advisory-letter-power-lines-and-alzheimer-s-disease (HCN, 2009b)
    - http://www.gezondheidsraad.nl/en/publications/bioinitiative-report-0 (HCN, 2008a)
    - http://www.gezondheidsraad.nl/en/publications/high-voltage-power-lines-0 (HCN, 2008b)
- **The Health Protection Agency (United Kingdom)**
    - http://www.hpa.org.uk/Publications/Radiation/DocumentsOfTheHPA/RCE01PowerFrequencyElectromagneticFieldsRCE1/ (HPA, 2006)
- **The International Commission on Non-Ionizing Radiation Protection**
    - http://www.icnirp.de/documents/LFgdl.pdf (ICNIRP, 2010)

- **The Scientific Committee on Emerging and Newly Identified Health Risks (European Union)**
    - http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_007.pdf (SCENIHR, 2007)
    - http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_022.pdf (SCENIHR, 2009)
    - http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_041.pdf (SCENIHR, 2015)

  The Swedish Radiation Protection Authority
    - http://www.who.int/peh-emf/publications/reports/SWEDENssi_rapp_2006.pdf (SSI, 2007)
    - http://www.who.int/peh-emf/publications/reports/SWEDENssi_rapp_2007.pdf (SSI, 2008)
- **The Swedish Radiation Safety Authority**
    - http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Rapport/Stralskydd/2009/SSM-Rapport-2009-36.pdf (SSM, 2009)
    - http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Rapport/Stralskydd/2010/SSM-Rapport-2010-44.pdf (SSM, 2010)
    - http://www.stralsakerhetsmyndigheten.se/Publikationer/Rapport/Stralskydd/2013/201319/ (SSM, 2013)

8 Standards and Guidelines

Following a thorough review of the research, scientific agencies develop exposure standards to protect against known health effects. The major purpose of a weight-of-evidence review is to identify the lowest exposure level below which no health hazards have been found (i.e., a threshold). Exposure limits are then set well below the threshold level to account for any individual variability or sensitivities that may exist.

Several scientific organizations have published guidelines for exposure to ELF EMF based on acute health effects that can occur at very high field levels. [13] The ICNIRP reviewed the epidemiologic and experimental evidence and concluded that there was insufficient evidence to warrant the development of standards or guidelines on the basis of hypothesized long-term adverse health effects such as cancer; rather, the guidelines put forth in their 2010 document set limits to protect against acute health effects (i.e., the stimulation of nerves and muscles) that occur at much higher field levels. The ICNIRP recommends a residential screening value of 2,000 mG and an occupational exposure screening value of 10,000 mG (ICNIRP, 2010). If exposure exceeds these screening values, then additional dosimetry evaluations are needed to determine whether basic restrictions on induced current densities are exceeded. For reference, in a national survey conducted by Zaffanella and Kalton (1998) for the National Institute for Environmental Health and Safety's EMF Research and Public Information Dissemination program, only about 1.6% of the general public in the United States experienced exposure to magnetic fields of at least 1,000 mG during a 24-hour period.

The ICES also recommends limiting magnetic field exposures at high levels because of the risk of acute effects, although their guidelines are higher than ICNIRP's guidelines; the ICES recommends a residential exposure limit of 9,040 mG and an occupational exposure limit of 27,100 mG (ICES, 2002). Both guidelines incorporate large safety factors.

The ICNIRP and ICES guidelines provide guidance to national agencies and only become legally binding if a country adopts them into legislation. The WHO strongly recommends that countries adopt the ICNIRP guidelines, or use a scientifically sound framework for formulating any new guidelines (WHO, 2006).

There are no national or state standards in the United States limiting exposures to ELF EMF based on health effects. Two states, Florida and New York, have enacted standards to limit magnetic fields at the edge of the right-of-way from transmission lines (NYPSC, 1978; FDER, 1989; NYPSC, 1990; FDEP, 1996), however, the basis for these limits was to maintain the "status quo" so that fields from new transmission lines would be no higher than those produced by existing transmission lines.

[13] Valberg et al. (2011) provides a listing of guidelines provided by health and safety organizations.

Neither Rhode Island nor Massachusetts has EMF standards for transmission lines but the Energy Facility Siting Boards have encouraged the use of practical and cost-effective designs to minimize magnetic field levels along the edges of transmission rights-of-way. This approach is consistent with recommendations of the WHO (2007) for addressing ELF EMF.

Table 10. Screening guidelines for EMF exposure

Organization	Exposure (60 Hz)	Magnetic field
ICNIRP	Occupational	10,000 mG
	General Public	2,000 mG
ICES	Occupational	27,100 mG
	General Public	9,040 mG

Sources: ICNIRP, 2010; ICES, 2002

9 Summary

A significant number of epidemiology and ***in vivo*** studies have been published on ELF EMF and health since the WHO 2007 report was released in June 2007. The weak statistical association between high, average magnetic fields and childhood leukemia has not been appreciably strengthened or substantially diminished by subsequent research, although the most recent studies tended to show no overall associations. The previously reported association remains unexplained and unsupported by the experimental data. The recent ***in vivo*** studies confirm the lack of experimental data supporting a leukemogenic risk associated with magnetic-field exposure. Recent publications on other cancer and non-cancer outcomes provided no substantial new information to alter the previous conclusion that the evidence is inadequate to link outcomes to ELF EMF exposure.

In conclusion, recent studies when considered in the context of previous research do not provide evidence to alter the conclusion that ELF EMF exposure is not a cause of cancer or any other disease process at the levels we encounter in our everyday environment.

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APPENDIX B

Agency Correspondence

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Power Engineers, Inc.

Northern Long-eared

Bat Agency

Correspondence

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Erin Whoriskey
Lead Environmental Scientist
NE Environmental Permitting

July 19, 2016

Ms. Susi von Oettingen
Endangered Species Biologist
U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301

Subject: **The Narragansett Electric Company d/b/a National Grid Clear River 345kV Line from the Existing Sherman Farm Road Switching Station to the Proposed Clear River Energy Center, Burrillville, RI**

Dear Ms. von Oettingen,

The Narragansett Electric Company d/b/a National Grid (TNEC) is proposing to construct a new 345 kV transmission line in the Town of Burrillville, RI, to interconnect the proposed Clear River Energy Center (Invenergy LLC) to the existing electric transmission grid (the "Project"). This proposed transmission line would begin at TNEC's existing Sherman Farm Road Switching Station in Burrillville, RI and extend approximately 6 miles within existing TNEC right-of-way (ROW) to the proposed Clear River Energy Center site which is proposed to be located off of Wallum Lake Road in Burrillville, RI. The Project also includes approximately one mile of new ROW required to connect the Clear River facility to the existing TNEC transmission facilities. The attached map and shapefile show the location of the proposed 345 kV transmission line corridor in United States Geological Survey (USGS) 7.5 minute series topographic mapping (Figure 1).

Construction of the Project will necessitate widening, tree clearing, and vegetation removal along an approximate 6-mile section of existing electric transmission line and along a 1-mile section of new ROW. Below is a description of the clearing required to accommodate the Project:

- approximately 4.4 miles of existing ROW, spanning an area from the Sherman Farm Road Switching Station to just west of the Clear River, will have approximately 85 feet of vegetation cleared to the south of the existing ROW for the new 345 kV transmission line;

- approximately 1.6 miles of existing ROW from just west of the Clear River to the junction with the 1 mile of the new ROW will have approximately 55 feet of vegetation cleared to the north of the current ROW to accommodate the new 345 kV transmission line; and,
- the proposed 1 mile of new ROW will be cleared of trees to a width of 150 feet.

Former USFWS Correspondence and Studies in Portions of the Project Area
From 2007-2012 as part of TNEC's and New England Power Company's d/b/a National Grid (collectively "National Grid") Interstate Reliability Project, a portion of the Project area including the Sherman Farm Road Substation and the approximately 6 miles of existing TNEC ROW was reviewed for the presence of Federal-listed and/or proposed, endangered, or threatened species, or critical habitat data (refer to Appendix A). On behalf of National Grid, the environmental consulting company, ENSR/AECOM, consulted with the USFWS. Correspondence from the USFWS dated September 4, 2007, May 13, 2009, January 3, 2011, and January 17, 2012, included a review of the United States Fish and Wildlife Service (USFWS) Endangered Species Consultation Procedure, available on their former website (http://www.fws.gov/northeast/newenglandfieldoffice/EndangeredSpecConsultation_Project_Review.htm). The review indicated that no Federal-listed and/or proposed, endangered, or threatened species, or critical habitat were known to occur in the Project area at that time.

Power Engineers, Inc. has reviewed the current United States Fish and Wildlife Endangered Species (USFWS) Consultation website (http://www.fws.gov/newengland/EndangeredSpec-Consultation.htm). The USFWS website identifies one Federal-listed species, the Northern Long-eared Bat (*Myotis septentrionalis*), documented in the Town of Burrillville which may occur in the Project location due to the unfragmented forested habitat**.** Power Engineers, Inc. obtained data from the environmental consulting and engineering firm, ESS Group, Inc. on an acoustic bat survey conducted under the Interim 4(d) Rule by ESS Group, Inc. during late July-early August 2015 at the proposed Clear River Energy Center facility in Burrillville, RI, as well as on the proposed one mile new ROW connecting the existing TNEC line to the proposed Clear River facility. The report was reviewed by the USFWS, and USFWS agreed with study results that Northern Long-eared Bats are not present in the Project area. Please refer to email correspondence between USFWS and ESS Group, Inc. dated December 18, 2015 which is provided in Appendix B. In addition, Charles Brown, a Wildlife Biologist with the Rhode Island Department of Environmental Management Division of Fish and Wildlife confirmed in a March 16, 2016 email correspondence with ESS Group, Inc. that there are no known Northern Long-eared Bat maternity roost trees in Rhode Island and there are no known Northern Long-eared Bat hibernacula in the Town of Burrillville or Providence County (refer to Appendix B).

Request for Data on Rare, Threatened and Endangered Species, and Critical Habitats
TNEC is seeking input from the USFWS on any known rare, threatened or endangered species or their critical habitats within the Project area. Can you please provide comment on the necessity for further consultation under Section 7 of the Endangered Species Act, including confirmation

on the status of the Northern Long-eared Bat in the Project area, and the need, if any, for supplemental field surveys along the existing electric transmission line corridor?

This request specifically addresses the requirement for documented consultation with regard to compliance with the Endangered Species Act ("ESA") of 1973.

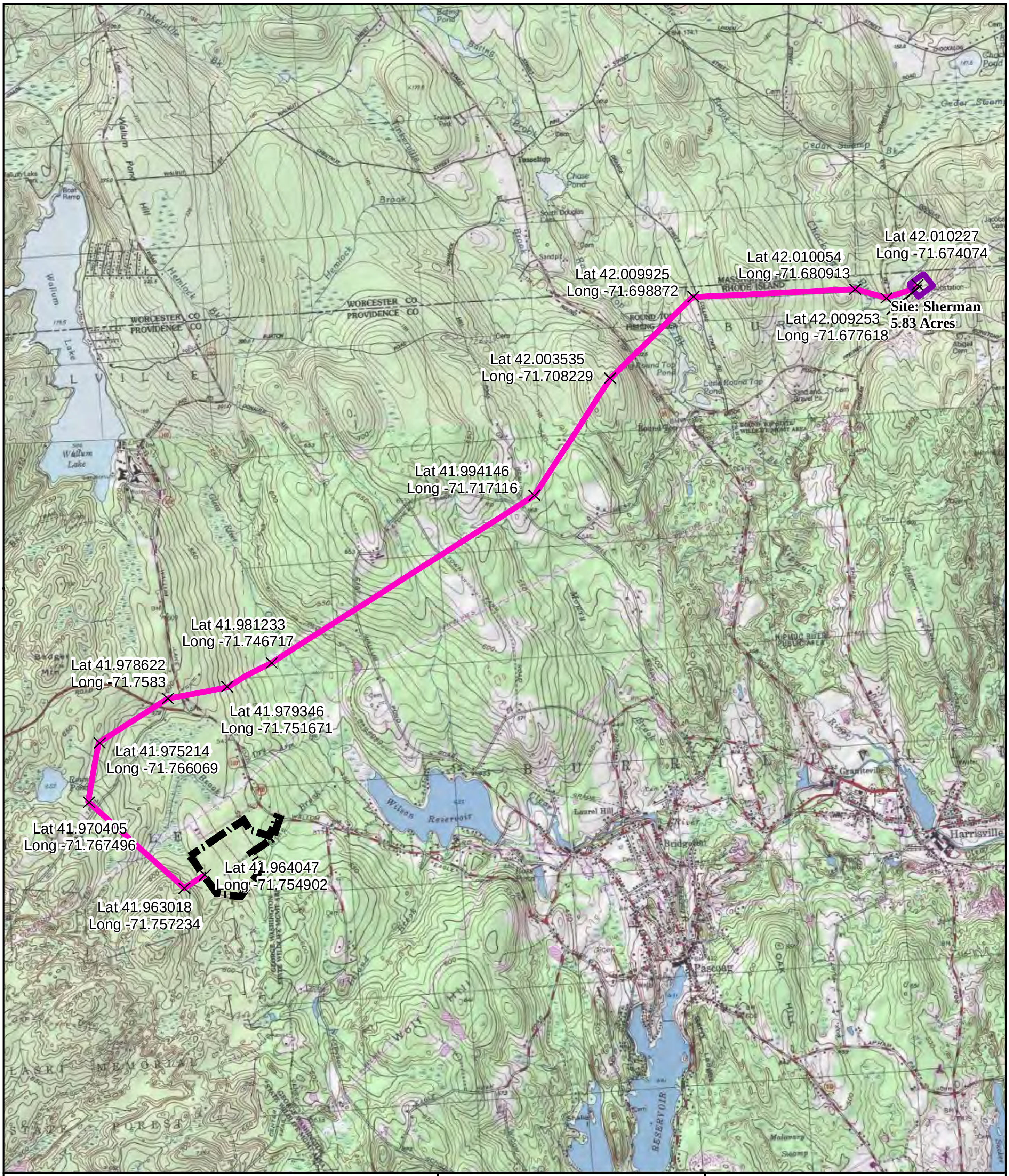
If you have any questions or would like more information, please do not hesitate to contact me at (781) 907-3598 (Erin.Whoriskey@nationalgrid.com), or Jamie Durand at (401) 439-3020 (jamie.durand@powereng.com).

Sincerely,

Erin Whoriskey
Lead Environmental Scientist
National Grid

Attachments

Cc: Jamie Durand, POWER Engineers
David Beron, National Grid
John Niland, Invenergy LLC
Mike Feinblatt, ESS Group, Inc.
Meaghan Lamothe, POWER Engineers
Steve Pasquine, POWER Engineers



Legend

- Existing Substation Site
- Proposed Transmission Line
- Proposed Site

The State of Rhode Island

Providence County
Burrillville Township

NAD 1983 UTM Zone 18N USFt
Foot US
Transverse Mercator
North American 1983

Figure 1

Project Location

0 0.5 1 1.5
Miles

N W E S

POWER ENGINEERS

nationalgrid

Date: 7/6/2016

Path: W:\135269_SEMARI\GIS\Apps\Clear_River\Project_Locus_Map_Clear_River.mxd

Meaghan Lamothe 1864

From:	Brown, Charles (DEM) <charles.brown@dem.ri.gov>
Sent:	Wednesday, August 31, 2016 3:57 PM
To:	Meaghan Lamothe 1864
Subject:	RE: Northern Long-eared Bats in Burrillville, RI Consultation

Hi Meaghan,
There are no known maternity roost trees or hibernacula within the project area. I have one specimen record, from 2010, from Roosevelt Avenue in Burrillville which I would estimate is about 2.5-3 miles from the site.
Given the amount of habitat in the area I would expect NLEB to be present, but likely in much lower numbers than before the onset of WNS. I know acoustic surveys were conducted and no NLEB were detected within the project area but I think it would be prudent to do additional surveys in the area proposed for tree removal. If not, it would be nice to limit tree removal and clearing to that period outside the maternity season (June-July) to the extent possible to minimize any take or disturbance not just to bats but to songbirds and other wildlife.
Charlie Brown
Wildlife Biologist
DEM Division of Fish and Wildlife
401-789-0281

From: meaghan.lamothe@powereng.com [mailto:meaghan.lamothe@powereng.com]
Sent: Friday, August 26, 2016 11:06 AM
To: Brown, Charles (DEM) <charles.brown@dem.ri.gov>
Subject: Northern Long-eared Bats in Burrillville, RI Consultation

Hello Mr. Brown,

I am contacting you to inquire about the presence/absence of hibernacula and maternity roosting sites of Northern Long-eared Bats in Burrillville, RI.

The Narragansett Electric Company d/b/a National Grid (TNEC) is proposing to construct a new 345 kV transmission line in the Town of Burrillville, RI, to interconnect the proposed Clear River Energy Center (Invenergy LLC) to the existing electric transmission grid (the "Project"). This proposed transmission line would begin at TNEC's existing Sherman Farm Road Switching Station in Burrillville, RI and extend approximately 6 miles within existing TNEC right-of-way to the proposed Clear River Energy Center site which is proposed to be located off of Wallum Lake Road in Burrillville, RI. The Project also includes approximately one mile of new right-of-way required to connect the Clear River facility to the existing TNEC transmission facilities. Construction of the Project will necessitate widening, tree clearing, and vegetation removal along an approximate 6-mile section of existing electric transmission line and along a 1-mile section of new right-of-way.

Power Engineers, Inc. has been in contact with Susi von Oettingen from the USFWS, who suggested we consult with you about the presence or absence of Northern Long-eared Bats in Burrillville, RI. In addition, we have also contacted RIDEM and received a GIS shapefile of natural heritage species in the Project area.

Can you please provide confirmation on the status of the Northern Long-eared Bat in Burrillville, and the need, if any, for supplemental field surveys along the existing electric transmission line corridor?

If you have any questions or would like more information, please do not hesitate to contact me. Thank you very much for your time.

Meaghan

MEAGHAN LAMOTHE
BIOLOGIST

774-643-1864
413-358-0364 cell

POWER Engineers, Inc.
www.powereng.com
Energy ▪ Facilities ▪ Communications ▪ Environmental
www.powereng.com

USFWS IPac

Results and

Streamlined

Consultation Form

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
PHONE: (603)223-2541 FAX: (603)223-0104
URL: www.fws.gov/newengland

Consultation Code: 05E1NE00-2016-SLI-2149 January 20, 2017
Event Code: 05E1NE00-2017-E-01158
Project Name: Clear River 345 kV Transmission Line

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

Official Species List

Provided by:

New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
(603) 223-2541
http://www.fws.gov/newengland

Consultation Code: 05E1NE00-2016-SLI-2149
Event Code: 05E1NE00-2017-E-01158

Project Type: TRANSMISSION LINE

Project Name: Clear River 345 kV Transmission Line
Project Description: The Narragansett Electric Company d/b/a National Grid (TNEC) is proposing to construct a new 345 kV transmission line in the Town of Burrillville, RI, to interconnect the proposed Clear River Energy Center (Invenergy LLC) to the existing electric transmission grid (the "Project"). This proposed transmission line would begin at TNEC's existing Sherman Farm Road Switching Station in Burrillville, RI and extend approximately 6 miles within existing TNEC right-of-way (ROW) to the proposed Clear River Energy Center site which is proposed to be located off of Wallum Lake Road in Burrillville, RI. The Project also includes approximately one mile of new ROW required to connect the Clear River facility to the existing TNEC transmission facilities.

Construction of the Project will necessitate widening, tree clearing, and vegetation removal along an approximate 6-mile section of existing electric transmission line and along a 1-mile section of new ROW. Below is a description of the clearing required to accommodate the Project:

• approximately 4.4 miles of existing ROW, spanning an area from the Sherman Farm Road Switching Station to just west of the Clear River, will have approximately 85 feet of vegetation cleared to the south of the existing ROW for the new 345 kV transmission line;
• approximately 1.6 miles of existing ROW from just west of the Clear River to the junction with the 1 mile of the new ROW will have approximately 55 feet of vegetation cleared to the north of the current ROW to accommodate the new 345 kV transmission line; and,
• the proposed 1 mile of new ROW will be cleared of trees to a width of approximately 165 feet.

Federal, state, and local permit applications are anticipated to be filed in the Fall 2016 and Winter 2016/2017 timeframe, with an anticipated commencement of construction in 2018.

Please Note: The FWS office may have modified the Project Name and/or Project Description, so it may be different from what was submitted in your previous request. If the Consultation Code matches, the FWS considers this to be the same project. Contact the office in the 'Provided by' section of your previous Official Species list if you have any questions or concerns.

Project Location Map:

Project Coordinates: The coordinates are too numerous to display here.

Project Counties: Providence, RI

Endangered Species Act Species List

There are a total of 1 threatened or endangered species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

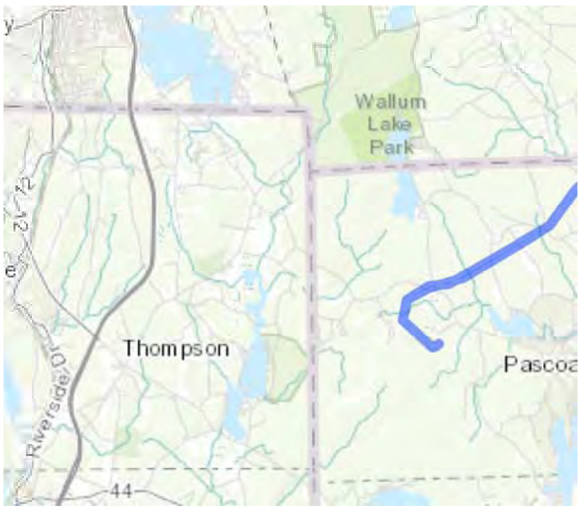
Mammals	Status	Has Critical Habitat	Condition(s)
Northern long-eared Bat *(Myotis septentrionalis)* Population: Wherever found	Threatened		

Critical habitats that lie within your project area

There are no critical habitats within your project area.

IPaC **U.S. Fish & Wildlife Service**

Clear River 345 kV Transmission Line Providence County, Rhode Island



This project potentially impacts **20 resources** managed or regulated by the U.S. Fish & Wildlife Service.

Tasks

Review potentially impacted resources
To see endangered species, migratory birds, wetlands, or refuges which may be impacted by this project

This project could impact:

- 1 endangered species
- 18 migratory birds
- Known wetlands

View the complete resource list to see more information.

Request an official species list ✔ List delivered

Local office

New England Ecological Services Field Office
(603) 223-2541

70 Commercial Street, Suite 300
Concord, NH 03301-5094

(603) 223-0104

http://www.fws.gov/ne

To receive an official letter and species list from the New England Ecological Services Field Office

An official species list was generated 15 minutes ago (8/30/2016 1:00:00 PM)

Request an updated list from the page.

Analyze the impacts of your project
Provide additional details and get recommended conservation measures for your project

There are no species in your project area with conservation measure recommendations available. Please contact the local U.S. Fish & Wildlife Service office to review impacts for this project.

Northern Long-Eared Bat 4(d) Rule Streamlined Consultation Form

Federal agencies should use this form for the optional streamlined consultation framework for the northern long-eared bat (NLEB). This framework allows federal agencies to rely upon the U.S. Fish and Wildlife Service's (USFWS) January 5, 2016, intra-Service Programmatic Biological Opinion (BO) on the final 4(d) rule for the NLEB for section 7(a)(2) compliance by: (1) notifying the USFWS that an action agency will use the streamlined framework; (2) describing the project with sufficient detail to support the required determination; and (3) enabling the USFWS to track effects and determine if reinitiation of consultation is required per 50 CFR 402.16.

This form is not necessary if an agency determines that a proposed action will have no effect to the NLEB or if the USFWS has concurred in writing with an agency's determination that a proposed action may affect, but is not likely to adversely affect the NLEB (i.e., the standard informal consultation process). Actions that may cause prohibited incidental take require separate formal consultation. Providing this information does not address section 7(a)(2) compliance for any other listed species.

Information to Determine 4(d) Rule Compliance:	YES	NO
1. Does the project occur wholly outside of the WNS Zone[1]?	☐	☑
2. Have you contacted the appropriate agency[2] to determine if your project is near known hibernacula or maternity roost trees?	☑	☐
3. Could the project disturb hibernating NLEBs in a known hibernaculum?	☐	☑
4. Could the project alter the entrance or interior environment of a known hibernaculum?	☐	☑
5. Does the project remove any trees within 0.25 miles of a known hibernaculum at any time of year?	☐	☑
6. Would the project cut or destroy known occupied maternity roost trees, or any other trees within a 150-foot radius from the maternity roost tree from June 1 through July 31.	☐	☑

You are eligible to use this form if you have answered yes to question #1 **or** yes to question #2 **and** no to questions 3, 4, 5 and 6. The remainder of the form will be used by the USFWS to track our assumptions in the BO.

Agency and Applicant[3] (Name, Email, Phone No.): For the project (IPaC Consultation Code: 05E1NE00-2016-SL-2149) described below, TNEC anticipates needing a permit from the US Army Corps of Engineers (Corps) and therefore has provided this Consultation Form with responses anticipated to be submitted by the Corps.

Project Name: Clear River 345 kV Transmission Line

Project Location (include coordinates if known): Burrillville, RI from Sherman Farm Rd. Switching Station (42.010227, -71.674074) to the proposed Clear River Energy Center (41.964047, -71.754902). Coordinates are in decimal degrees.

Basic Project Description (provide narrative below or attach additional information):

The Narragansett Electric Company d/b/a National Grid (TNEC) is proposing to construct a new 345 kV transmission line in the Town of Burrillville, RI, to interconnect the proposed Clear River Energy Center (Invenergy LLC) to the existing electric transmission grid (the "Project"). This proposed transmission line would begin at TNEC's existing Sherman Farm Road Switching Station in Burrillville, RI and extend approximately 6 miles within existing TNEC right-of-way to the proposed Clear River Energy Center site which is proposed to be located off of Wallum Lake Road in Burrillville, RI. The Project also includes approximately one mile of new right-of-way required to connect the Clear River facility to the existing TNEC transmission facilities. Construction of the Project will necessitate widening, tree clearing, and vegetation removal along an approximate 6-mile section of existing electric transmission line and along a 1-mile section of new right-of-way.

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[1] http://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf

[2] See http://www.fws.gov/midwest/endangered/mammals/nleb/nhisites.html

[3] If applicable - only needed for federal actions with applicants (e.g., for a permit, etc.) who are party to the consultation.

General Project Information	YES	NO
Does the project occur within 0.25 miles of a known hibernaculum?	☐	☑
Does the project occur within 150 feet of a known maternity roost tree?	☐	☑
Does the project include forest conversion[4]? (if yes, report acreage below)	☑	☐
Estimated total acres of forest conversion	~ 57 acres	
If known, estimated acres[5] of forest conversion from April 1 to October 31		
If known, estimated acres of forest conversion from June 1 to July 31[6]		
Does the project include timber harvest? (if yes, report acreage below)	☐	☑
Estimated total acres of timber harvest		
If known, estimated acres of timber harvest from April 1 to October 31		
If known, estimated acres of timber harvest from June 1 to July 31		
Does the project include prescribed fire? (if yes, report acreage below)	☐	☑
Estimated total acres of prescribed fire		
If known, estimated acres of prescribed fire from April 1 to October 31		
If known, estimated acres of prescribed fire from June 1 to July 31		
Does the project install new wind turbines? (if yes, report capacity in MW below)	☐	☑
Estimated wind capacity (MW)		

Agency Determination:

By signing this form, the action agency determines that this project may affect the NLEB, but that any resulting incidental take of the NLEB is not prohibited by the final 4(d) rule.

If the USFWS does not respond within 30 days from submittal of this form, the action agency may presume that its determination is informed by the best available information and that its project responsibilities under 7(a)(2) with respect to the NLEB are fulfilled through the USFWS January 5, 2016, Programmatic BO. The action agency will update this determination annually for multi-year activities.

The action agency understands that the USFWS presumes that all activities are implemented as described herein. The action agency will promptly report any departures from the described activities to the appropriate USFWS Field Office. The action agency will provide the appropriate USFWS Field Office with the results of any surveys conducted for the NLEB. Involved parties will promptly notify the appropriate USFWS Field Office upon finding a dead, injured, or sick NLEB.

Signature: ______________________________ Date Submitted: ______________

---

[4] Any activity that temporarily or permanently removes suitable forested habitat, including, but not limited to, tree removal from development, energy production and transmission, mining, agriculture, etc. (see page 48 of the BO).

[5] If the project removes less than 10 trees and the acreage is unknown, report the acreage as less than 0.1 acre.

[6] If the activity includes tree clearing in June and July, also include those acreage in April to October.

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ESS Group, Inc.

Northern Long-eared Bat

Agency Correspondence

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From: vonOettingen, Susi
To: Matt Robertson
Cc: charles.brown@dem.ri.gov; Mike Feinblatt
Subject: Re: NLEB Acoustic Report - Burrillville, Rhode Island
Date: Friday, December 18, 2015 8:51:46 AM

Good morning, Matt.

I just reviewed the report, thank you very much for sending it. I agree, the survey was consistent with Service guidelines (and thank you for the conservative approach). I also appreciate that the bat call data were vetted. Based on your analyses, I would agree that NLEB are not present in the project area and no minimization or mitigation measures will be necessary.

Susi

****
Susi von Oettingen
Endangered Species Biologist
New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301
(W) 603-223-2541 ext. 6418
Please note my new extension.

www.fws.gov/newengland

On Mon, Dec 14, 2015 at 12:09 PM, Matt Robertson <MRobertson@essgroup.com> wrote:

> Good Afternoon,
>
> ESS Group, Inc., on behalf of Invenergy Thermal Development, LLC., is pleased to submit the results of an acoustic bat survey conducted at a proposed energy development site in Burrillville, Rhode Island. If you have any questions or concerns please feel free to contact me at any time. Also, could you please provide an approximate timeframe for your review of the report?
>
> Best Regards,
>
> **Matt Robertson | Project Scientist**

ESS Group, Inc.

10 Hemingway Drive, 2nd Floor, East Providence, RI 02915 | p 401.330.1212

www.essgroup.com

From:	Brown, Charles (DEM)
To:	Matt Robertson
Subject:	RE: NLEB Acoustic Report - Burrillville, Rhode Island
Date:	Wednesday, March 16, 2016 1:29:23 PM

Hi Matt,
There are no known maternity roost trees in Rhode Island and there are no known hibernacula in Burrillville or Providence County. Feel free to cal if you have any questions.
Charlie Brown
Wildlife Biologist
DEM Division of Fish and Wildlife
401-789-0281

From: Matt Robertson [mailto:MRobertson@essgroup.com]
Sent: Wednesday, March 16, 2016 1:25 PM
To: Brown, Charles (DEM) <charles.brown@dem.ri.gov>
Subject: RE: NLEB Acoustic Report - Burrillville, Rhode Island

Good Afternoon Mr. Brown,

Since we submitted the NLEB acoustic report (see email below), the ruling on NLEBs has been updated. To remain in compliance with the new rule can you please provide any information on any known hibernacula or maternity roost tree locations in or adjacent to the town of Burrillville? In previous research I could not identify any hibernacula or roost trees in Providence County at large. More recent research has shown that you have been doing surveys and identified some overwintering locations in the state so I wanted to confirm the status on hibernacula and roost tree locations. Thank you very much for your time.

All the Best,

Matt Robertson
ESS Group, Inc.
mrobertson@essgroup.com

From: Brown, Charles (DEM) [mailto:charles.brown@dem.ri.gov]
Sent: Tuesday, December 15, 2015 7:47 AM
To: Matt Robertson
Subject: RE: NLEB Acoustic Report - Burrillville, Rhode Island

HI Matt,
Thank you. I will try to review it this week or next and get back to you with any comments or questions.
Charlie Brown

From: Matt Robertson [mailto:MRobertson@essgroup.com]
Sent: Monday, December 14, 2015 12:09 PM

To: Brown, Charles (DEM) <charles.brown@dem.ri.gov>; vonOettingen, Susi <susi_vonoettingen@fws.gov>
Cc: Mike Feinblatt <MFeinblatt@essgroup.com>
Subject: NLEB Acoustic Report - Burrillville, Rhode Island

Good Afternoon,

ESS Group, Inc., on behalf of Invenergy Thermal Development, LLC., is pleased to submit the results of an acoustic bat survey conducted at a proposed energy development site in Burrillville, Rhode Island. If you have any questions or concerns please feel free to contact me at any time. Also, could you please provide an approximate timeframe for your review of the report?

Best Regards,

Matt Robertson | Project Scientist
ESS Group, Inc.
10 Hemingway Drive, 2nd Floor, East Providence, RI 02915 | p 401.330.1212
www.essgroup.com

Interstate Reliability Project

Agency Correspondence

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ENSR | AECOM

ENSR
10 Orms Street, Providence, Rhode Island, 02904
T 401.274.5685 F 401.521.2730 www.ensr.aecom.com

July 30, 2007

Mr. Michael J. Amaral
Endangered Species Specialist
U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

Subject: **National Grid USA 345-kV Transmission Line Construction RI/MA State Line to RI/CT State Line via the West Farnum and Sherman Road Substations**

Dear Mr. Amaral,

National Grid USA ("National Grid") is proposing to construct new 345-kV transmission lines beginning at the RI/MA state boundary in North Smithfield, RI and extending approximately 23.4 miles via the West Farnum (North Smithfield) and Sherman Road (Burrillville) Substations, ending at the RI/CT state boundary in Burrillville, RI. The new transmission line will be approximately 23.4 miles in length and will be located entirely within the existing transmission line easement. The existing easement is typically 300 feet in width, approximately half of which is cleared for existing transmission line service.

The attached maps show the location of the transmission line corridor on USGS 7.5 minute topographic mapping (Figures 1 – 7).

This request specifically addresses the requirement for documented consultation with regard to compliance with the Endangered Species Act ("ESA") of 1973. We request correspondence from your office regarding the occurrence of any threatened or endangered species ("T&E") or species of special concern and/or their critical habitats, for the Project area. If you have any questions, or require additional information, please contact me at (401) 274-5685, Ext. 17, or plockwood@ensr.aecom.com. Thank you.

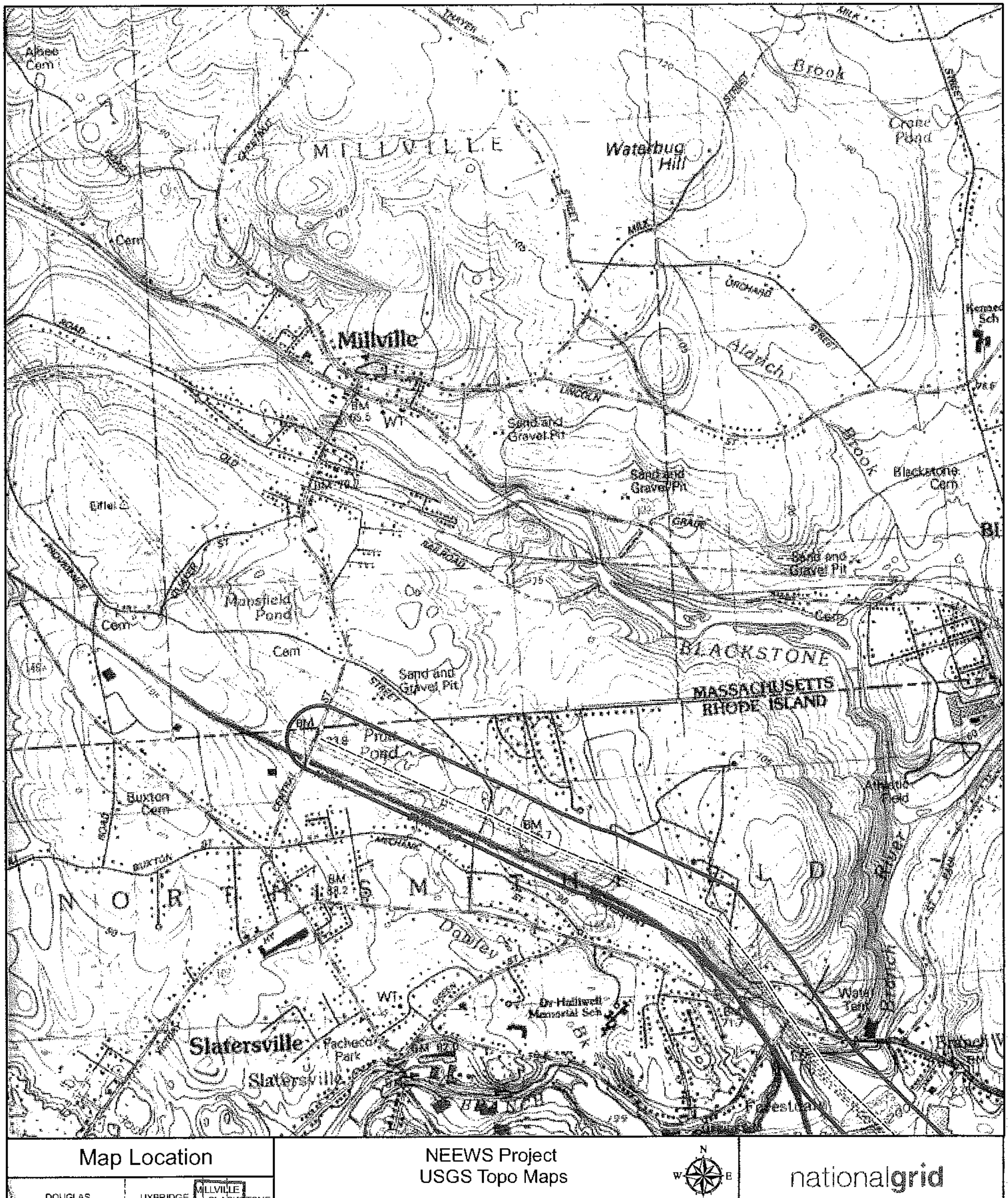
Sincere regards,

Peter Lockwood
Senior Project Specialist

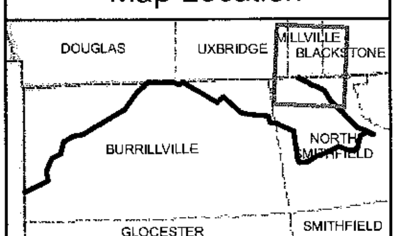
Attachments Figures 1 through 7 USGS Topo Maps

Cc: J. Durand, ENSR
D. McIntyre, National Grid
D. Beron, National Grid

I:\Northboro\PIPELINE\Filer2 Pipeline\PIPELINE\Projects\National Grid USA\NEEWS_New_345kV_Project\Agency Consultation\USFWS\USFWS_Project 1_073007.doc



Map Location



NEEWS Project
USGS Topo Maps

Substations

500ft Transmission Line Study Area

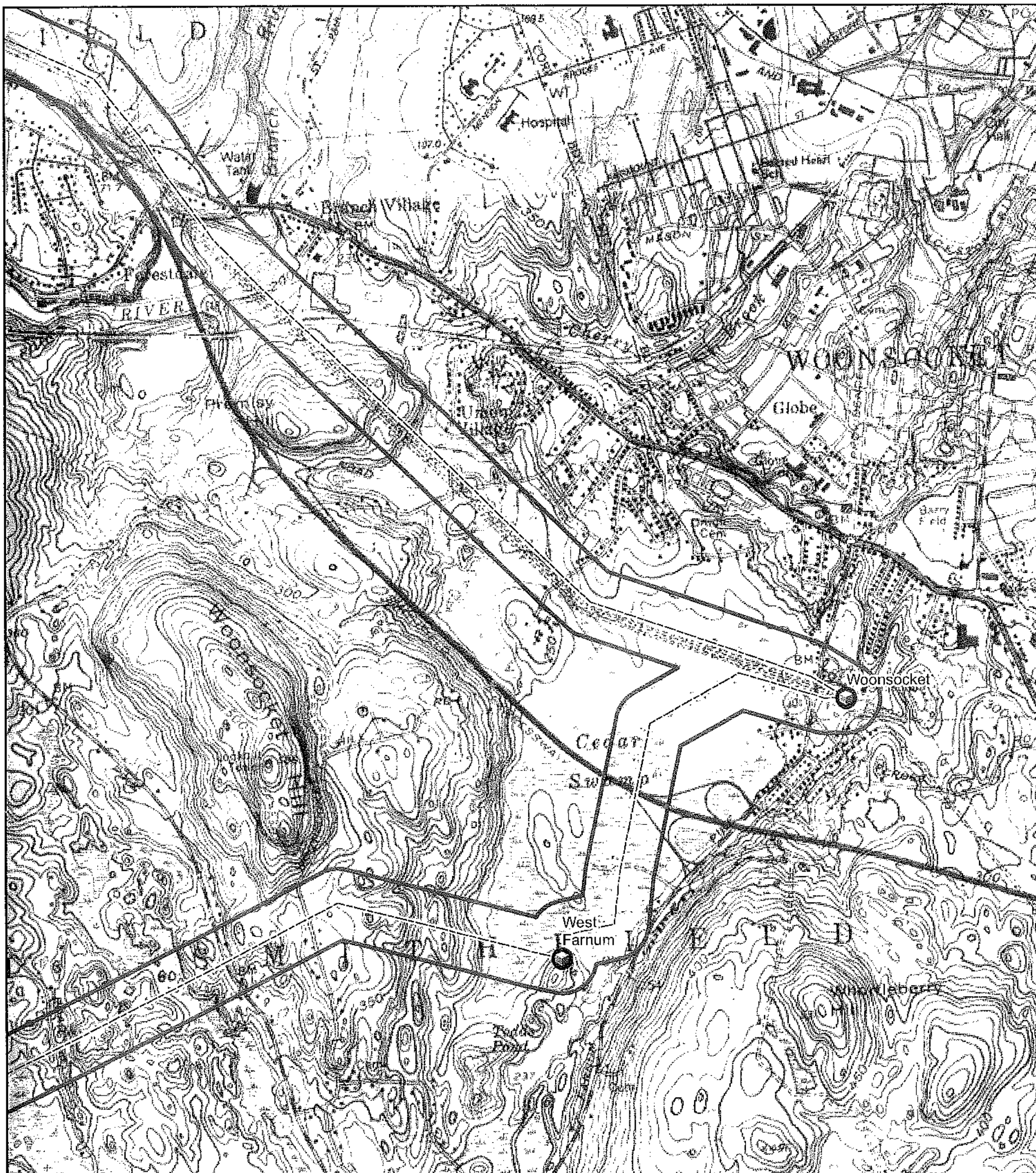
Transmission ROW Centerline

0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

ENSR | AECOM

Figure 1
Date: August 2007



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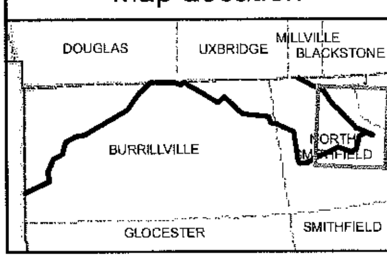


NEEWS Project
USGS Topo Maps

Substations

500ft Transmission Line Study Area

Transmission ROW Centerline

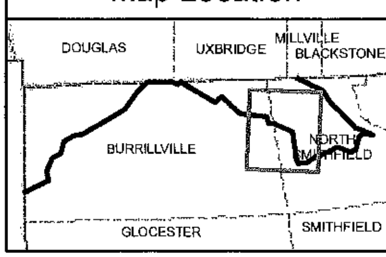
0 1,000 2,000 3,000 4,000 Feet 1:24,000

ENSR AECOM

Figure 2

Date: August 2007

Map Location



NEEWS Project
USGS Topo Maps

Substations

--- Transmission ROW Centerline

500ft Transmission Line Study Area

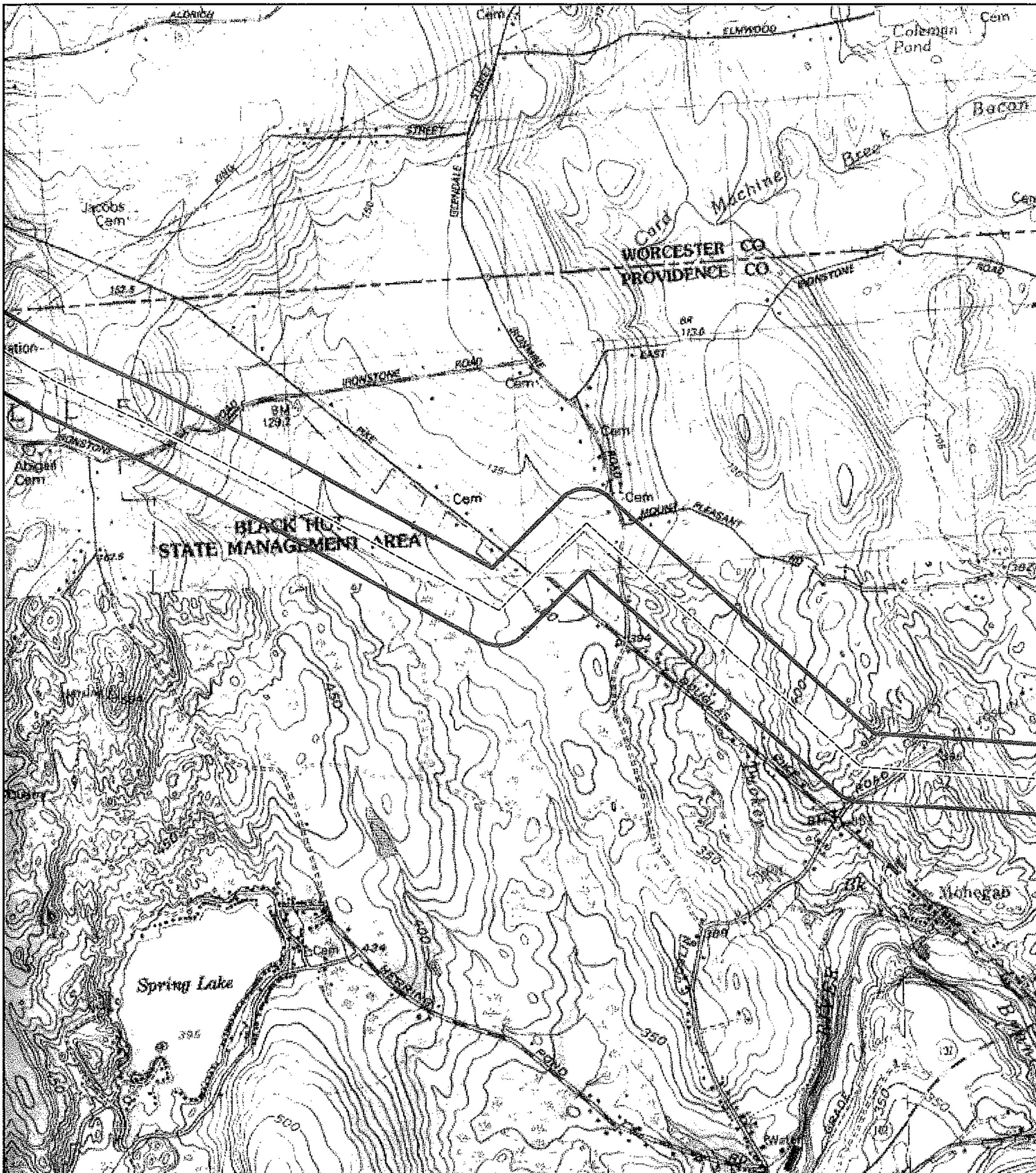
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

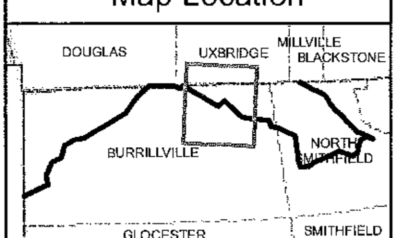
ENSR | AECOM

Figure 3

Date: August 2007



Map Location



NEEWS Project
USGS Topo Maps

Substations

500ft Transmission Line Study Area

Transmission ROW Centerline

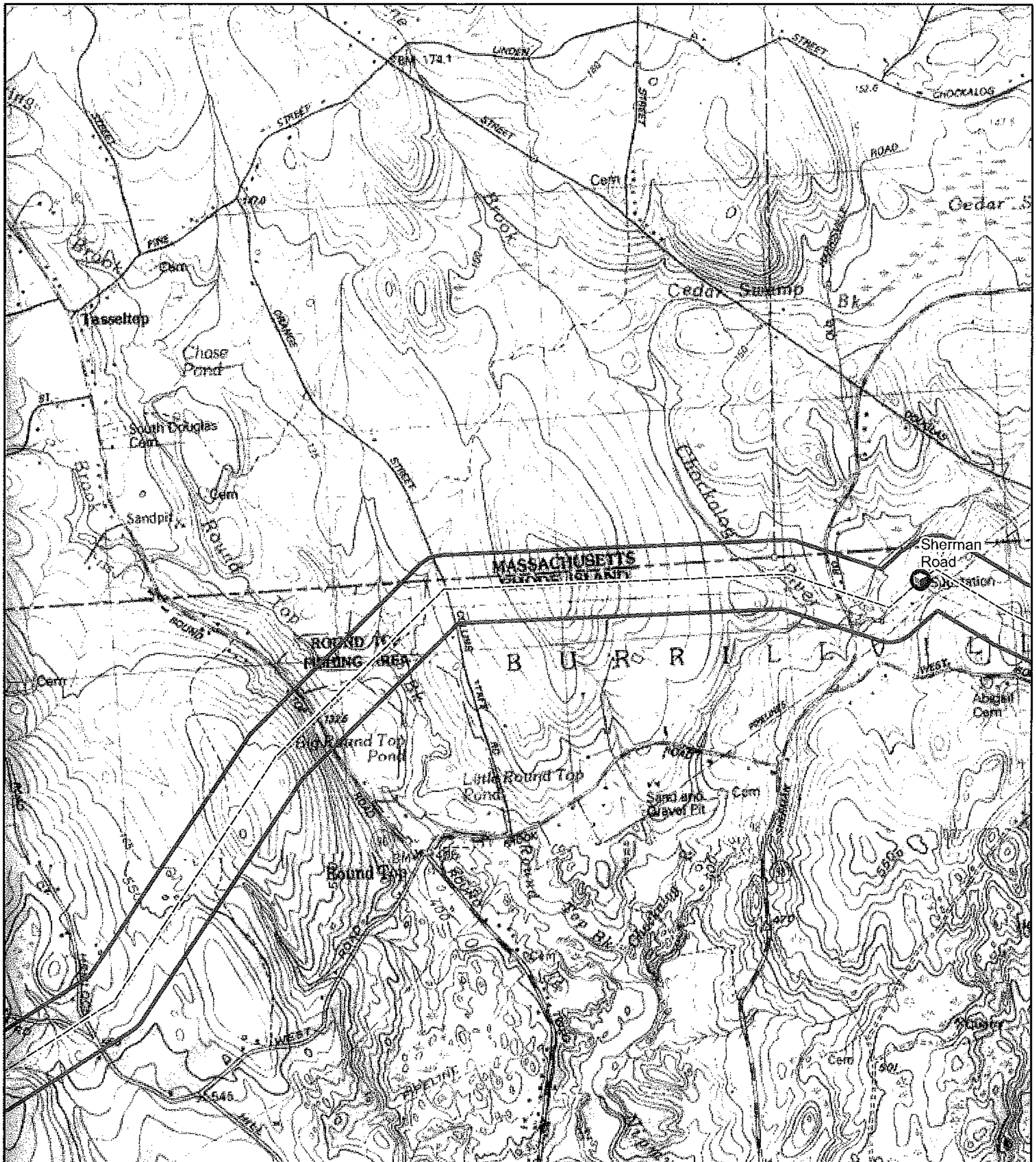
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

ENSR | AECOM

Figure 4

Date: August 2007



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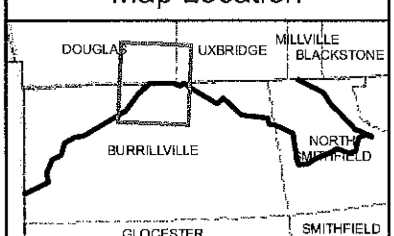


NEEWS Project
USGS Topo Maps

Substations

500ft Transmission Line Study Area

Transmission ROW Centerline

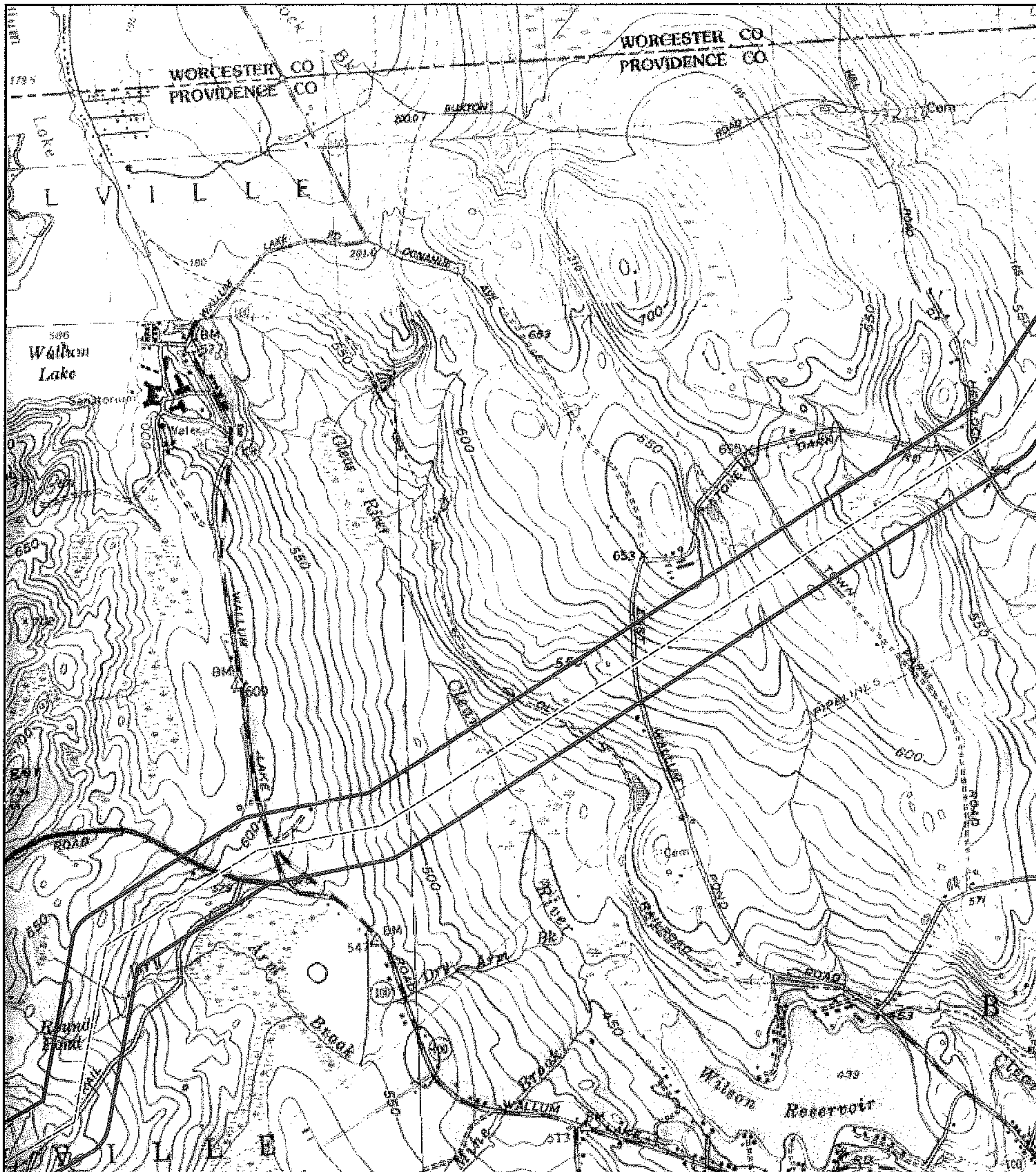
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

ENSR AECOM

Figure 5

Date: August 2007



Map Location

DOUGLAS | UXBRIDGE | MILLVILLE | BLACKSTONE | BURRILLVILLE | NORTH SMITHFIELD | GLOCESTER | SMITHFIELD

NEEWS Project
USGS Topo Maps

Substations

500ft Transmission Line Study Area

Transmission ROW Centerline

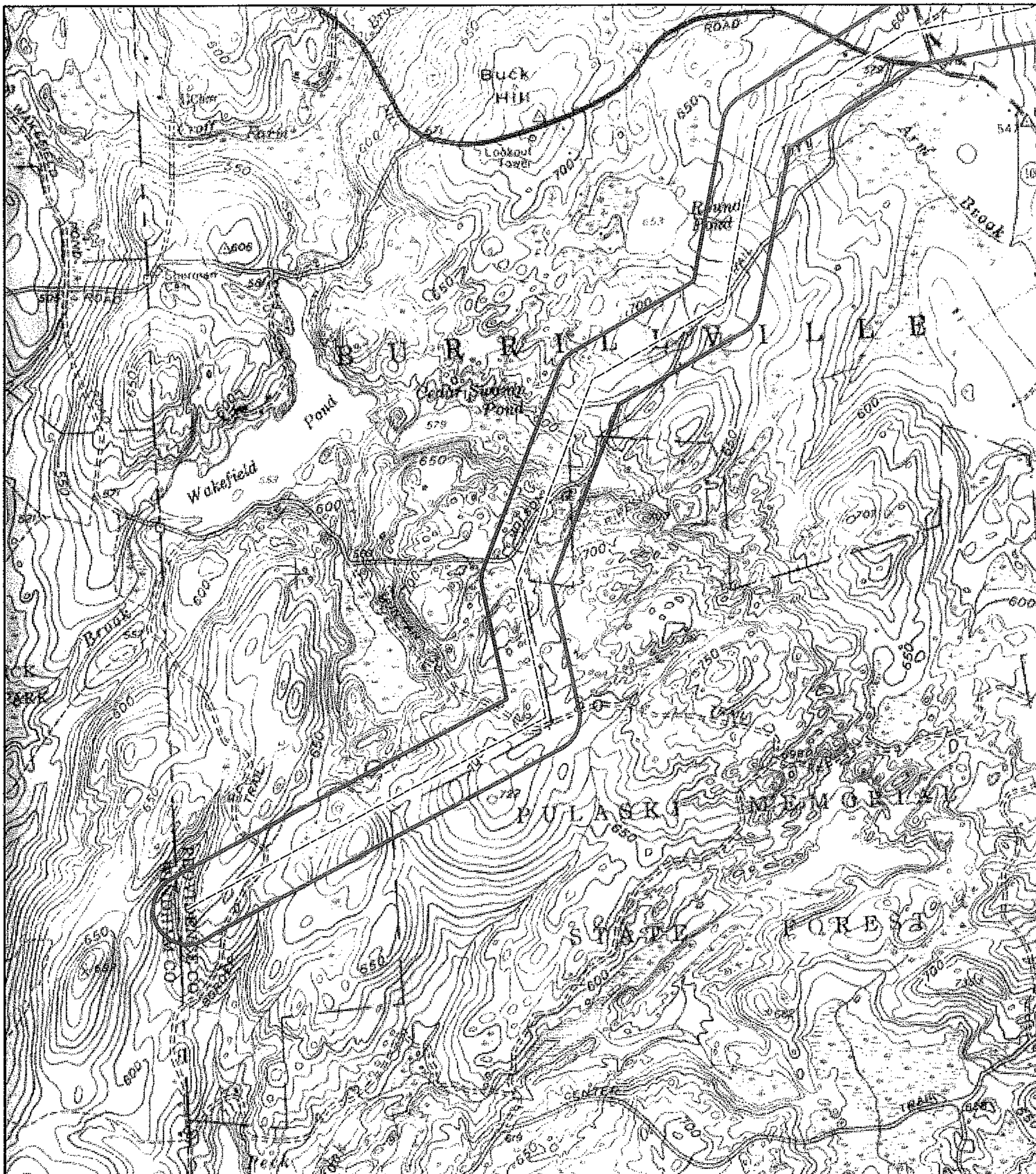
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

ENSR | AECOM

Figure 6

Date: August 2007



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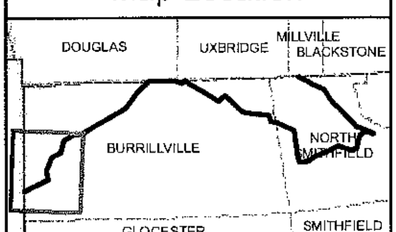


NEEWS Project
USGS Topo Maps

Substations
500ft Transmission Line Study Area
Transmission ROW Centerline

0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

ENSR | AECOM

Figure 7
Date: August 2007

ENSR
10 Orms Street, Providence, Rhode Island, 02904
T 401.274.5685 F 401.521.2730 www.ensr.aecom.com

July 30, 2007

Mr. Michael J. Amaral
Endangered Species Specialist
U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

Subject: **National Grid USA**
West Farnum Substation, North Smithfield, RI

Dear Mr. Amaral,

National Grid USA ("National Grid") is proposing work within and around the existing West Farnum 345/115-kV Substation located in North Smithfield, RI. The attached map shows the location of the existing Substation facility on a 7.5 minute series USGS quadrangle map.

This request specifically addresses the requirement for documented consultation with regard to compliance with the Endangered Species Act ("ESA") of 1973. We request correspondence from your office regarding the occurrence of any threatened or endangered species ("T&E") or species of special concern and/or their critical habitats, for the Project area.

If you have any questions, ore require additional information, please contact me at (401) 274-5685, Ext. 17, or plockwood@ensr.aecom.com. Thank you.

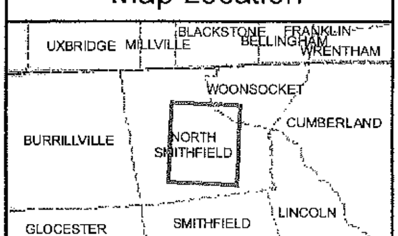
Sincere regards,

Peter Lockwood
Senior Project Specialist

Attachments Figure 1 USGS Topo

Cc: J. Durand, ENSR
D. McIntyre, National Grid
D. Beron, National Grid

Map Location



NEEWS Project
USGS Topo Maps

N S E W

Substations

West Farnum Substation 500ft Study Area

0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

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Figure 1

Date: August 2007

ENSR | AECOM

ENSR
10 Orms Street, Providence, Rhode Island, 02904
T 401.274.5685 F 401.521.2730 www.ensr.aecom.com

July 30, 2007

Mr. Michael J. Amaral
Endangered Species Specialist
U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

Subject: **National Grid USA 345-kV Transmission Line Construction 345-kV Transmission Line Reconductoring from the Sherman Road Substation to the RI/CT State Boundary**

Dear Mr. Amaral,

National Grid USA ("National Grid") is proposing to install new conductors along the existing 345-kV transmission line (# 347) for a distance of approximately 8.7 miles from the Sherman Road Substation in Burrillville, RI to the RI/CT state boundary in Burrillville, RI. The transmission line reconductoring will take place entirely within the existing transmission line easement.

The attached maps show the location of the transmission line corridor on USGS 7.5 minute series topographic mapping (Figures 1 - 3).

This request specifically addresses the requirement for documented consultation with regard to compliance with the Endangered Species Act ("ESA") of 1973. We request correspondence from your office regarding the occurrence of any threatened or endangered species ("T&E") or species of special concern and/or their critical habitats, for the Project area. If you have any questions, ore require additional information, please contact me at (401) 274-5685, Ext. 17, or plockwood@ensr.aecom.com. Thank you.

Sincere regards,

Peter Lockwood
Senior Project Specialist

Attachments Figures 1 through 3 USGS Topo Maps

Cc: J. Durand, ENSR
D. McIntyre, National Grid
D. Beron, National Grid

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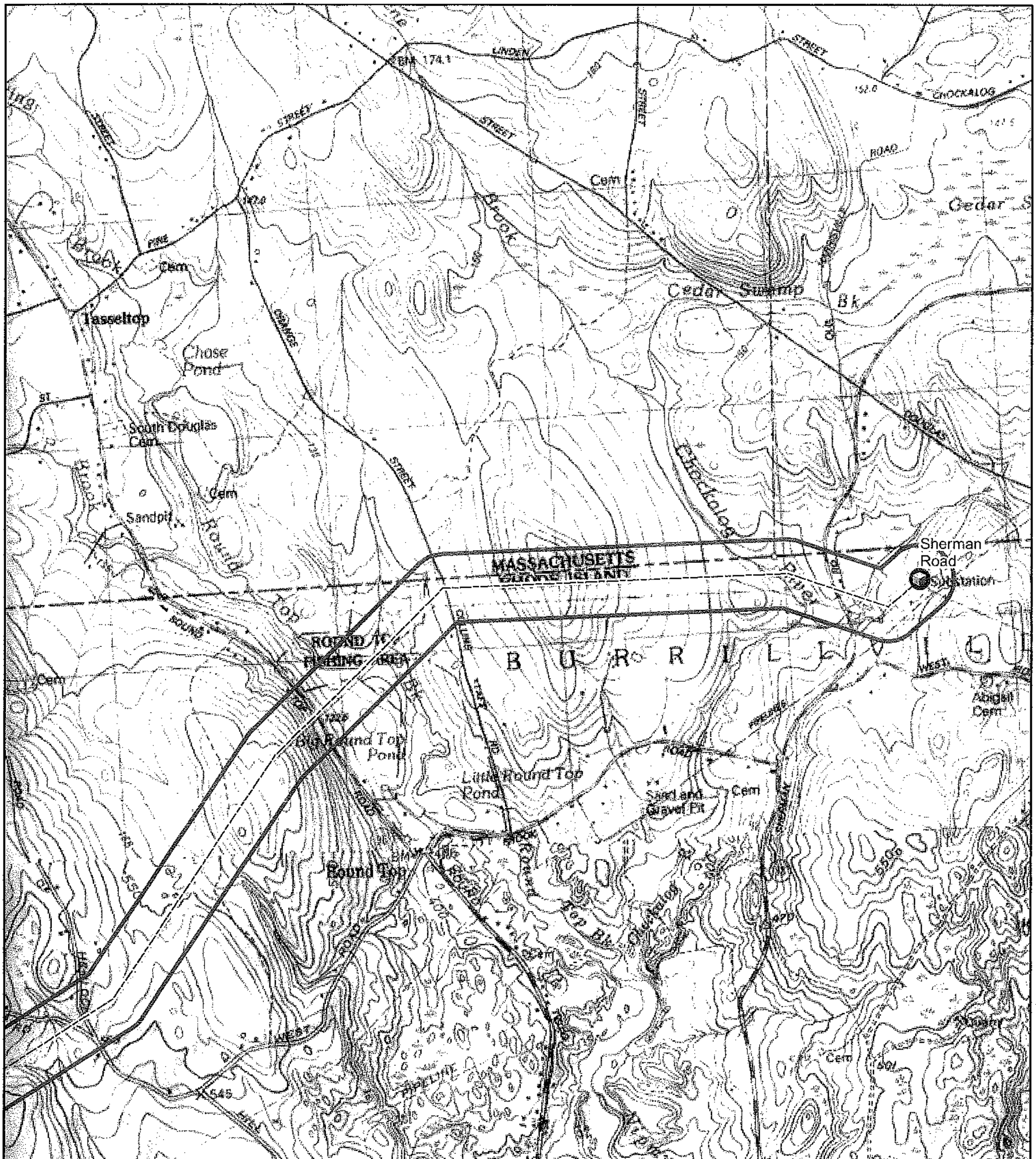
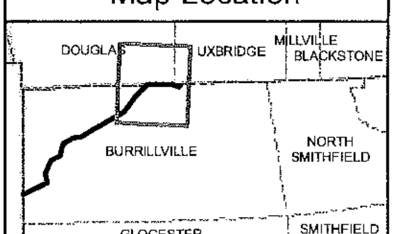


Map Location



NEEWS Project
USGS Topo Maps

N W E S

Substations

500ft Transmission Line Study Area

Transmission ROW Centerline

0 1,000 2,000 3,000 4,000 Feet 1:24,000

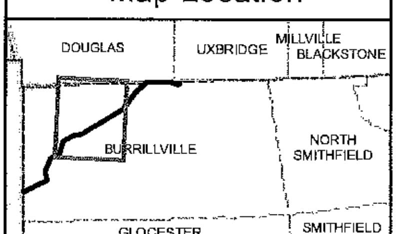
nationalgrid

ENSR | AECOM

Figure 1

Date: August 2007

Map Location



NEEWS Project
USGS Topo Maps

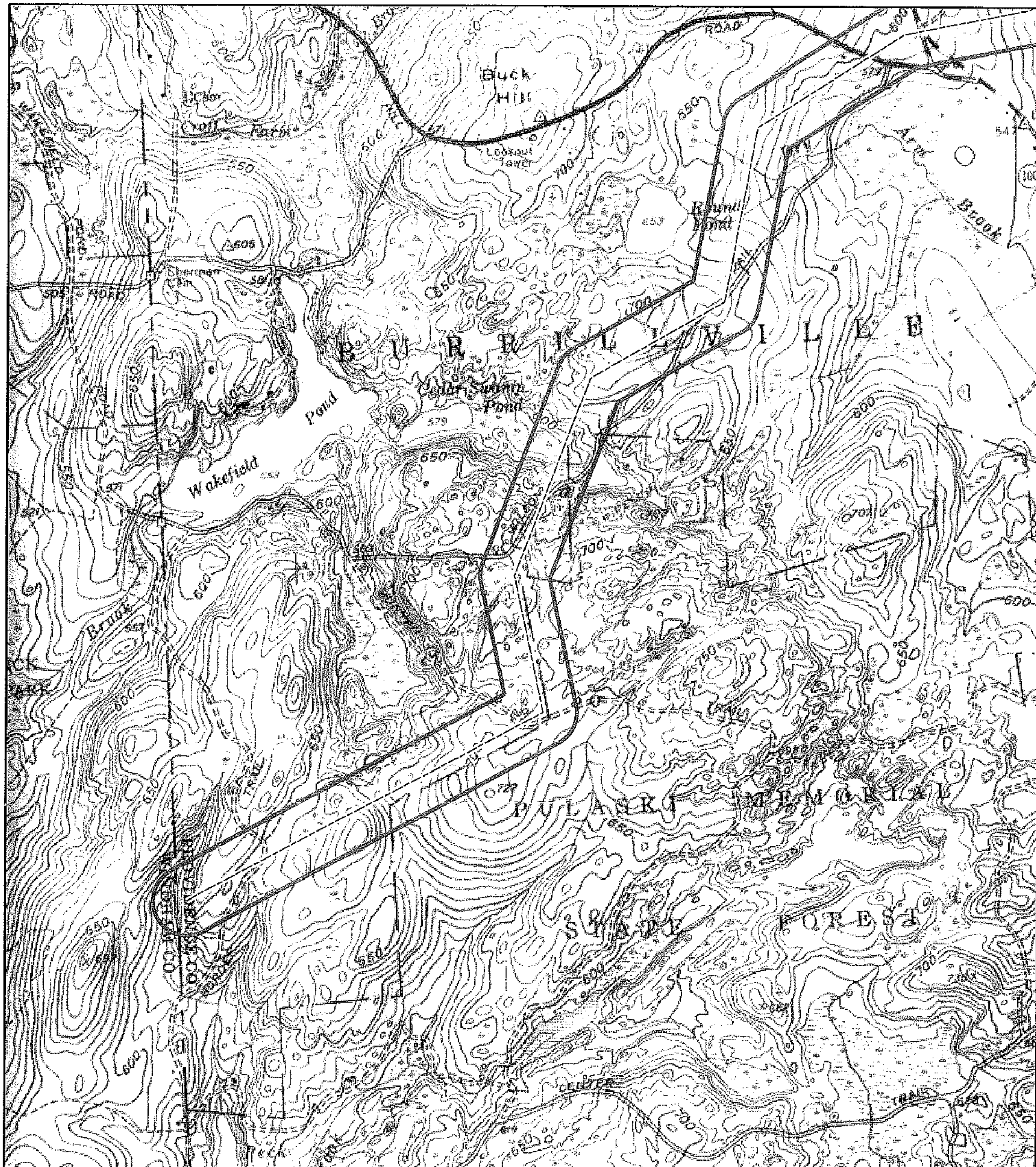
Substations
Transmission ROW Centerline
500ft Transmission Line Study Area

0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

ENSR AECOM

Figure 2
Date: August 2007



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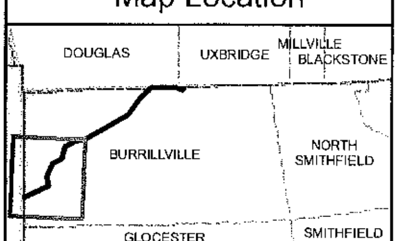


NEEWS Project
USGS Topo Maps

N W E S

Substations

500ft Transmission Line Study Area

Transmission ROW Centerline

0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

ENSR | AECOM

Figure 3

Date: August 2007

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087

September 4, 2007

Reference:	Project	Location
	Substation work	North Smithfield, RI
	Transmission line	North Smithfield-Burrillville, RI
	Transmission line	Burrillville, RI
	Transmission line	Pawtucket, RI-Somerset, MA

Peter Lockwood
ENSR
10 Orms St.
Providence, RI 02904

Dear Mr. Lockwood:

This responds to your recent correspondence requesting information on the presence of federally-listed and/or proposed endangered or threatened species in relation to the proposed activity(ies) referenced above.

Based on information currently available to us, no federally-listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area(s). Preparation of a Biological Assessment or further consultation with us under Section 7 of the Endangered Species Act is not required.

This concludes our review of listed species and critical habitat in the project location(s) and environs referenced above. No further Endangered Species Act coordination of this type is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

In order to curtail the need to contact this office in the future for updated lists of federally-listed or proposed threatened or endangered species and critical habitats, please visit the Endangered Species Consultation page on the New England Field Office's website:

www.fws.gov/northeast/newenglandfieldoffice/EndangeredSpec-Consultation.htm

In addition, there is a link to procedures that may allow you to conclude if habitat for a listed species is present in the project area. If no habitat exists, then no federally-listed species are present in the project area and there is no need to contact us for further consultation. If the above conclusion cannot be reached, further consultation with this office is advised. Information describing the nature and location of the proposed activity that should be provided to us for further informal consultation can be found at the above-referenced site.

Thank you for your coordination. Please contact us at 603-223-2541 if we can be of further assistance.

Sincerely yours,

Anthony P. Tur

Anthony P. Tur
Endangered Species Specialist
New England Field Office

AECOM

AECOM Environment
10 Orms Street, Suite 405, Providence, Rhode Island 02904
T 401.274.5685 F 401.521.2730 www.aecom.com

April 10, 2009

Mr. Michael J. Amaral
Endangered Species Specialist
U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

Subject: **National Grid Transmission Line Construction and Maintenance Projects Interstate Reliability Project and Q143/R144 Transmission Line Clearance Improvement Project**

Dear Mr. Amaral,

New England Power Company d/b/a National Grid (National Grid) is applying for permits required to construct new 345-kV transmission lines beginning at the Millbury, MA Substation and extending south through the Towns of Millbury, Sutton, Northbridge, Uxbridge, and Millville Massachusetts, and North Smithfield and Burrillville, Rhode Island to the RI/CT border. The new transmission line will be approximately 39 miles in length and will be located within the existing transmission line right-of-way (ROW). The existing ROW is generally 300 feet in width, approximately half of which is cleared for existing transmission line facilities.

The existing Q143/R144 115-kV transmission lines occupy the same transmission line ROW. The R144 transmission line begins at the Millbury Substation, and is joined by the Q143 transmission line approximately 10 miles south in Uxbridge. These lines then continue south for approximately 4.6 miles to the MA/RI border. From the MA/RI border, these transmission lines continue for approximately 4 miles to the Woonsocket Substation. National Grid is proposing maintenance activities on these existing lines. The purpose of the Q143/R144 Clearance Improvement Project is to replace damaged structures and structures that do not meet the clearance requirements of the 2007 National Electric Safety Code (NESC). The attached maps show the location of the transmission line corridor on United States Geological Survey (USGS) 7.5 minute topographic mapping (Figures 1–12). The Massachusetts portion of the Q143/R144 Clearance Improvement Project will be conducted under an Operation and Maintenance Plan that has been reviewed and approved by the Massachusetts Natural Heritage & Endangered Species Program (MA NHESP) under the Program's Massachusetts Endangered Species Act Regulations.

A request for information regarding the occurrence of threatened and endangered species/critical habitat in the proposed project area in Rhode Island was submitted to the U.S. Fish & Wildlife Service (USFWS) on July 30, 2007. National Grid received a response from USFWS on September 4, 2007 stating that no federally-listed threatened, or endangered species, or critical habitat under the jurisdiction of the USFWS were known to occur in the Project area.

As requested in response letters from USFWS, National Grid consulted the USFWS New England website to identify updated listed species occurrence information, if any. Based on this review, the small whorled pogonia (*Isotria medeoloides*) is the only listed species known to occur in Providence and

Worcester Counties. However this species is not known to occur in any of the towns traversed by the Project and was not identified in the initial USFWS correspondence. No other species were listed on the USFWS website to occur within the Project area.

Per the requirement for documented consultation in regard to compliance with the Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. 1531 et seq.), we respectfully request updated correspondence from your office regarding the occurrence of any threatened or endangered species and/or their critical habitat within and adjacent to the project area in both Rhode Island and Massachusetts, as currently depicted on the USGS mapping in Attachment A. If you have any questions, or require additional information, please contact me at (401) 274-5685, Extension 14. Thank you.

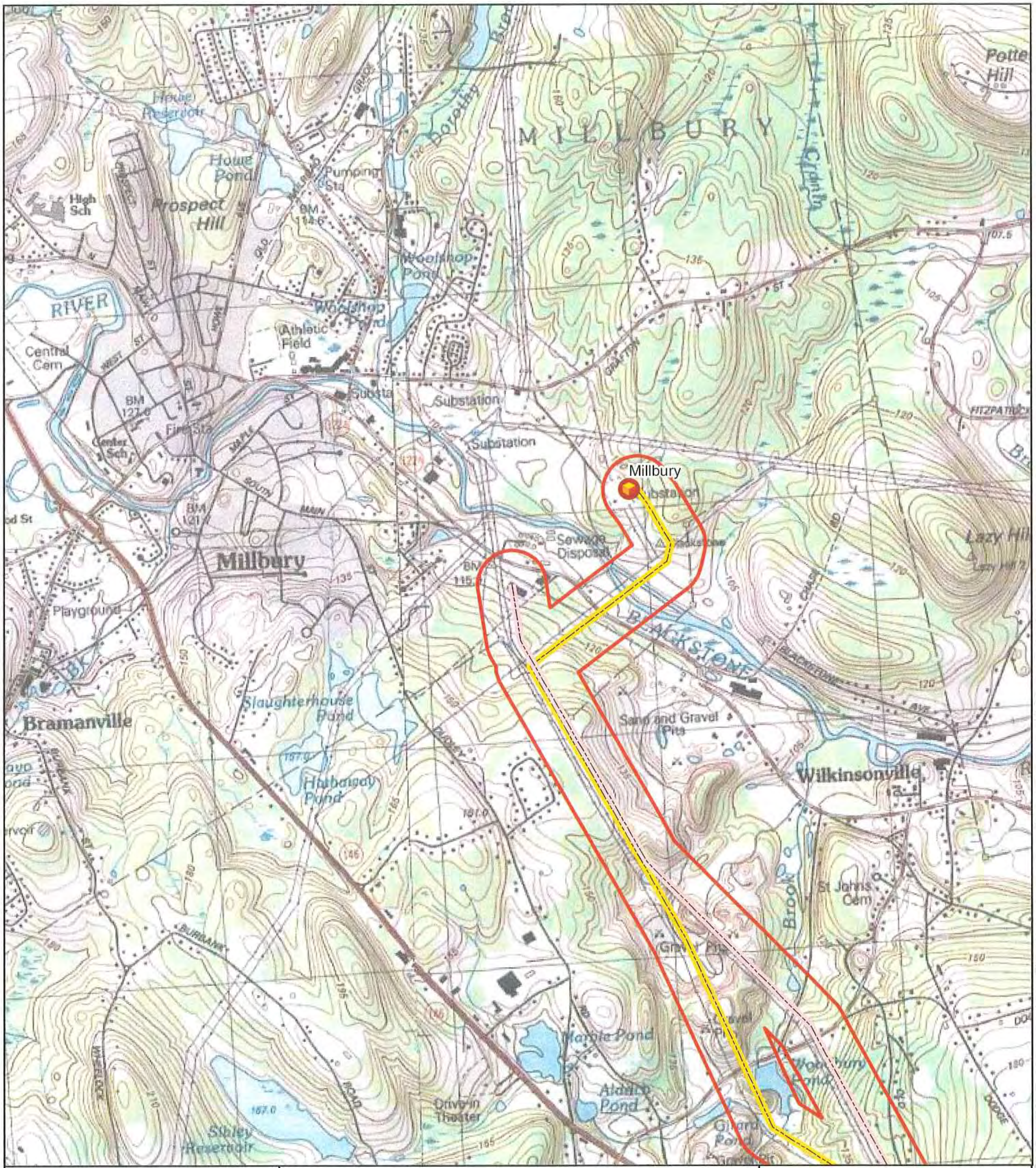
Sincere regards,

James Durand

James Durand
Project Manager

Attachments Figures 1 through 12 USGS Topographic Maps

Cc: D. Beron, National Grid
D. McIntyre, National Grid
J. Holden, National Grid
L. Sasur, National Grid
L. Curtis, BSC Group



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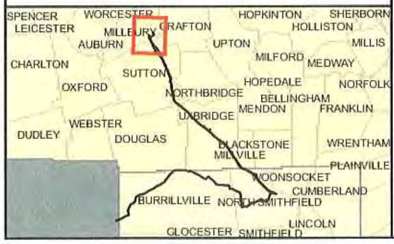


National Grid
USGS Project Area Mapping

N W E S

Substation

1000 ft Wide Study Corridor

New 345-kV Transmission Line

Q-143S 115-kV Transmission Line

R-144 115-kV Transmission Line

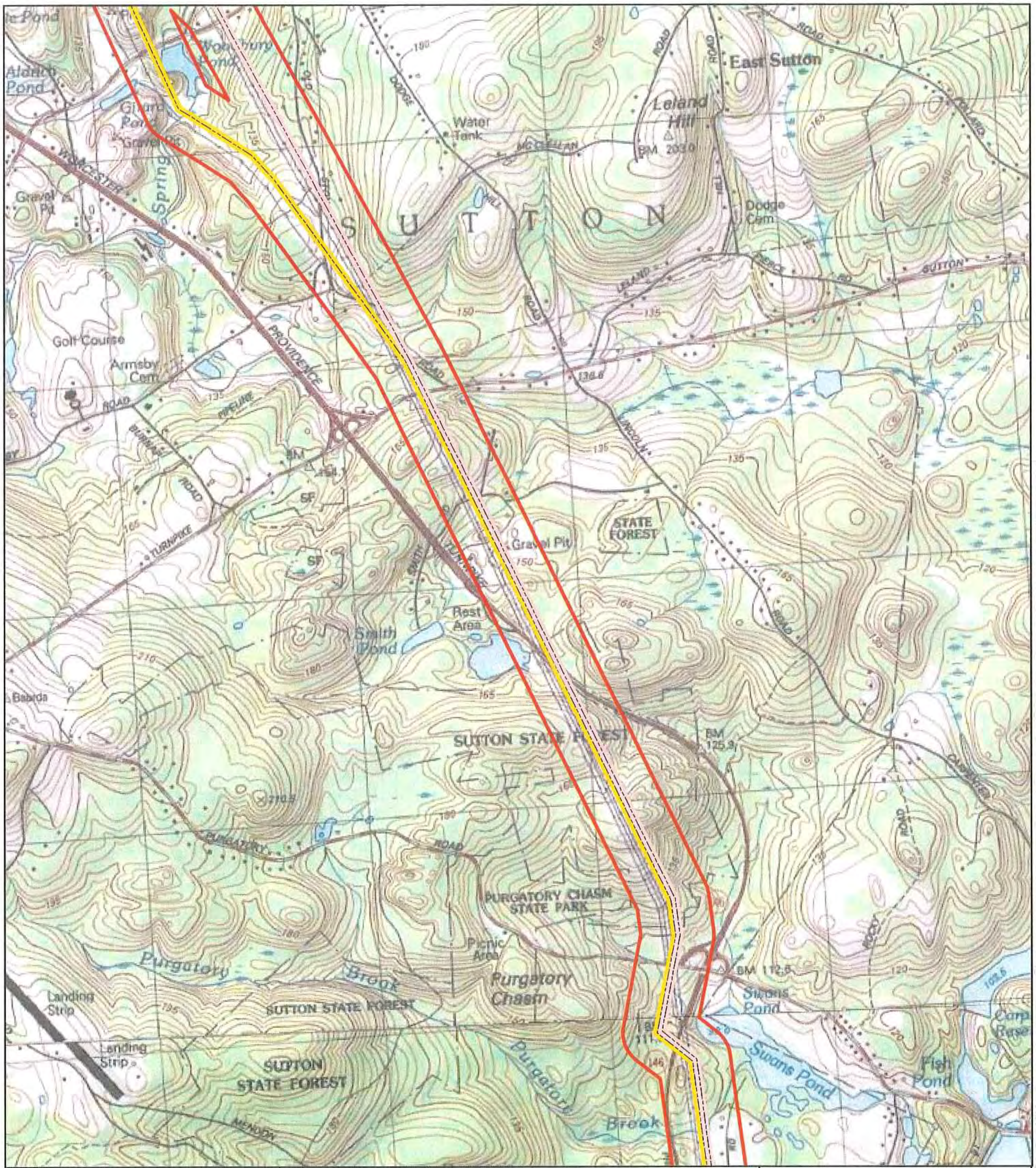
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

AECOM

Mapsheet 01 of 12

Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

N
W E
S

- Substation
- 1000 ft Wide Study Corridor
- New 345-kV Transmission Line
- Q-143S 115-kV Transmission Line
- R-144 115-kV Transmission Line

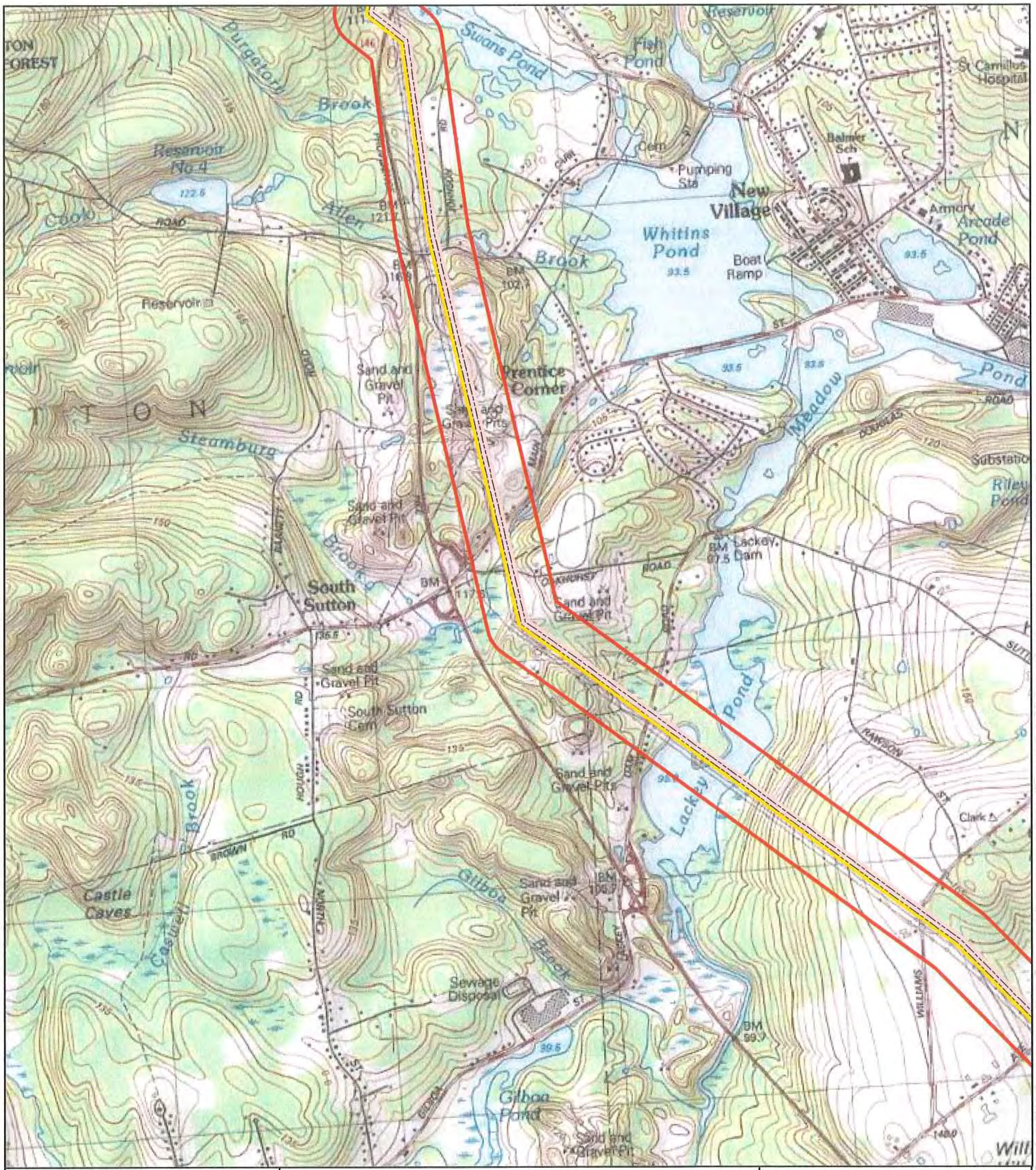
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

AECOM

Mapsheet 02 of 12

Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

N W E S

- Substation
- 1000 ft Wide Study Corridor
- New 345-kV Transmission Line
- Q-143S 115-kV Transmission Line
- R-144 115-kV Transmission Line

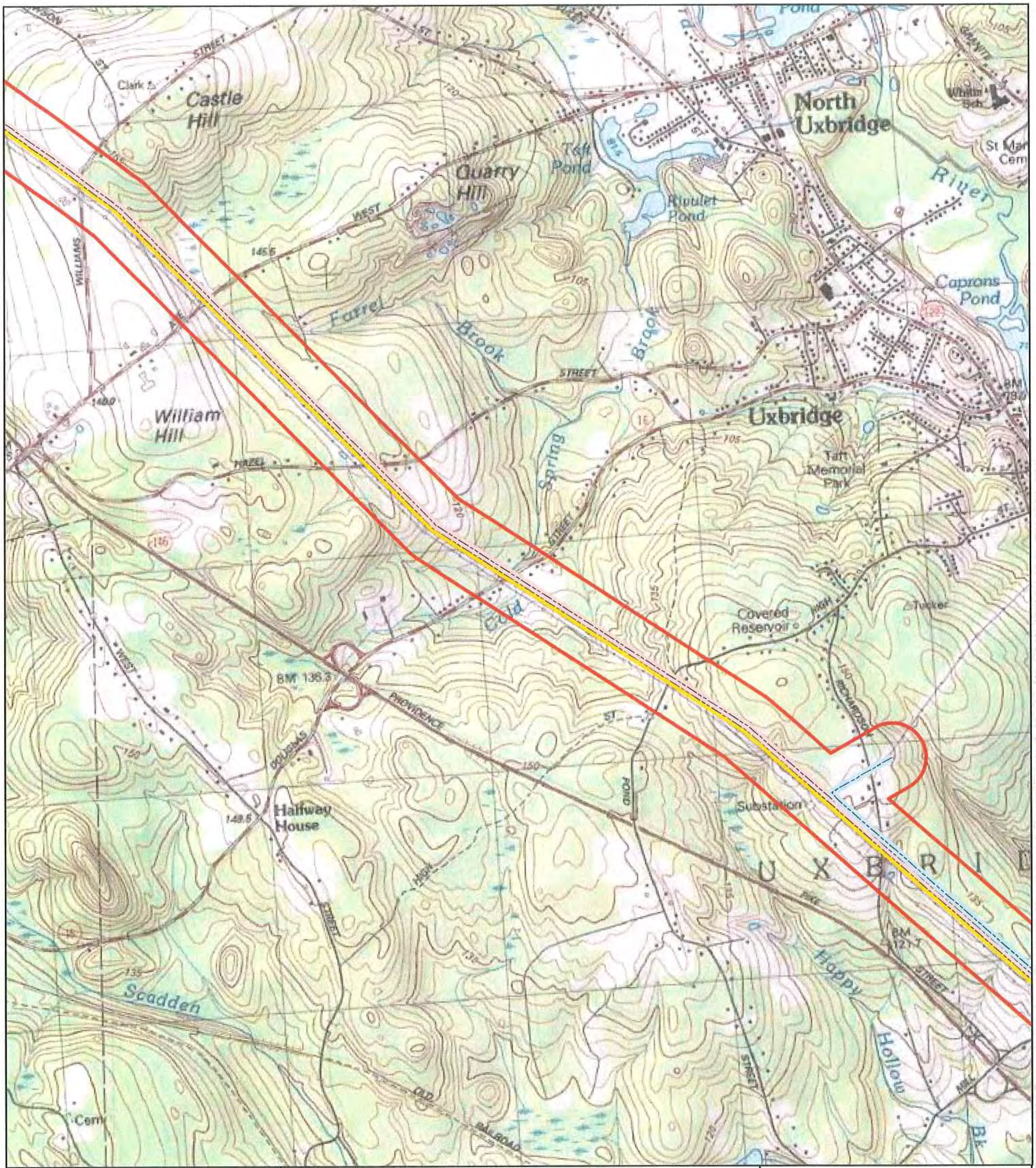
0 | 1,000 | 2,000 | 3,000 | 4,000 Feet | 1:24,000

nationalgrid

AECOM

Mapsheet 03 of 12

Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

N
W E
S

Substation

1000 ft Wide Study Corridor

New 345-kV Transmission Line

Q-143S 115-kV Transmission Line

R-144 115-kV Transmission Line

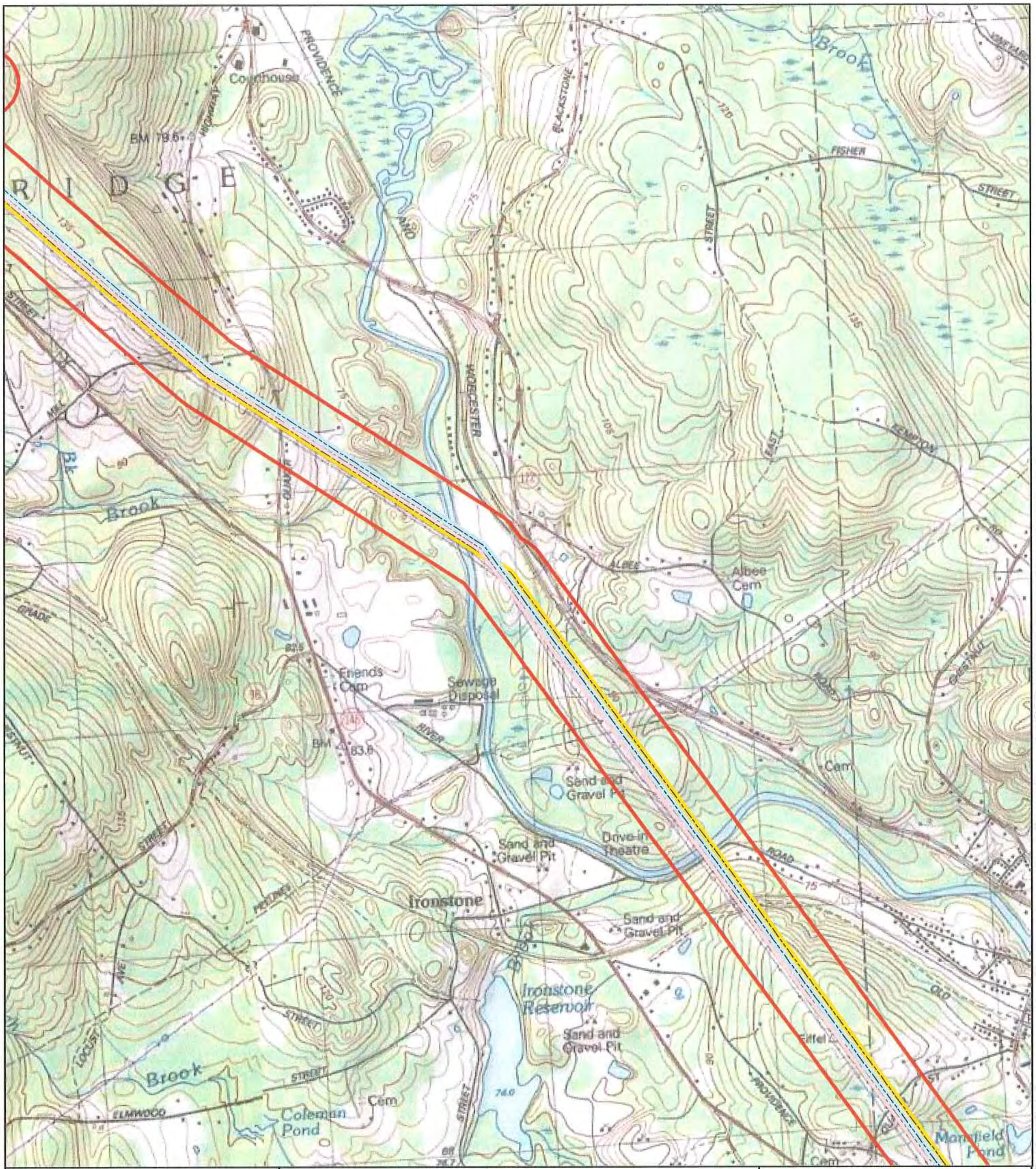
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

AECOM

Mapsheet 04 of 12

Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

N
W E
S

- Substation
- 1000 ft Wide Study Corridor
- New 345-kV Transmission Line
- Q-143S 115-kV Transmission Line
- R-144 115-kV Transmission Line

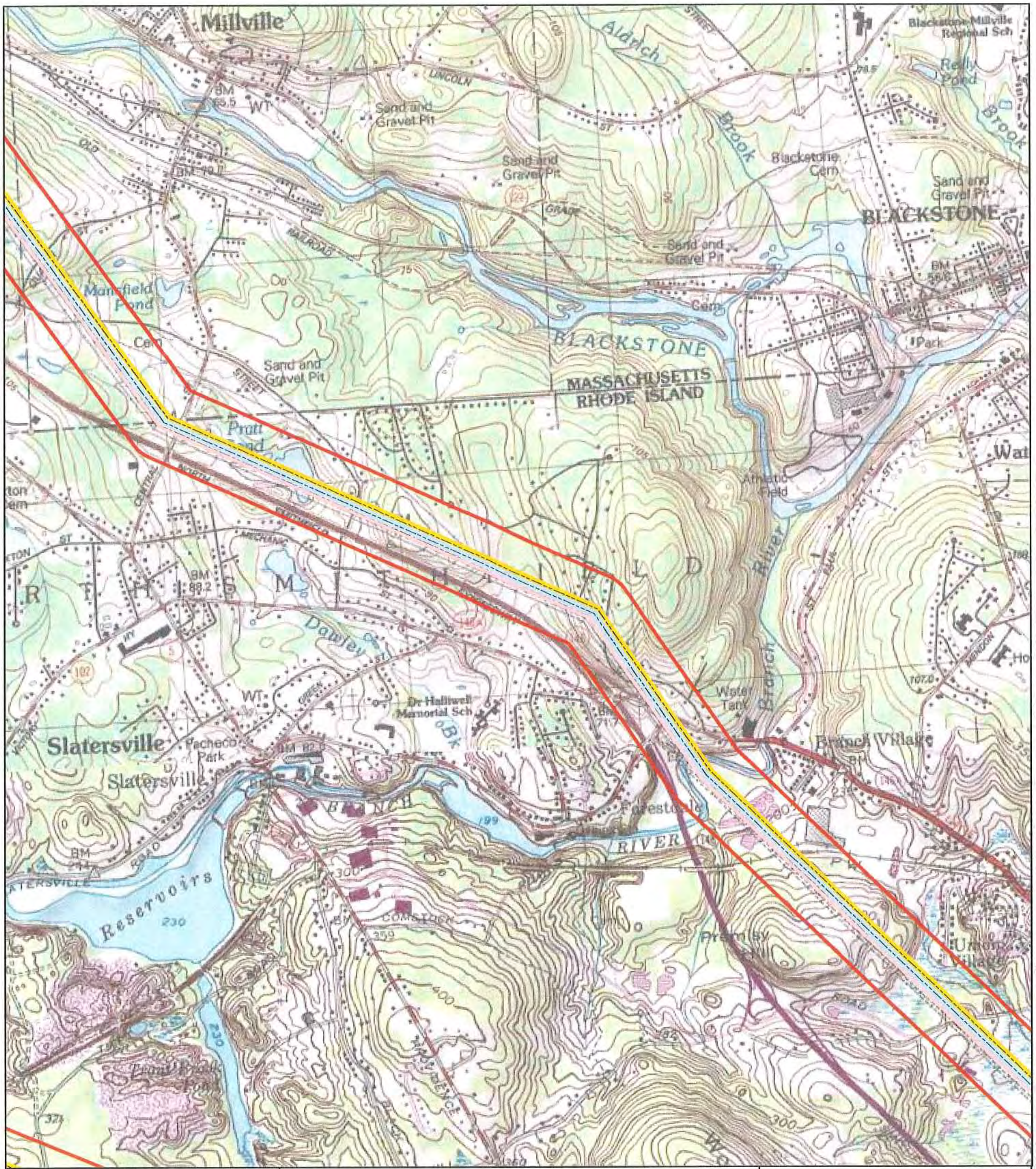
0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

AECOM

Mapsheet 05 of 12

Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

Substation
1000 ft Wide Study Corridor

New 345-kV Transmission Line
Q-143S 115-kV Transmission Line
R-144 115-kV Transmission Line

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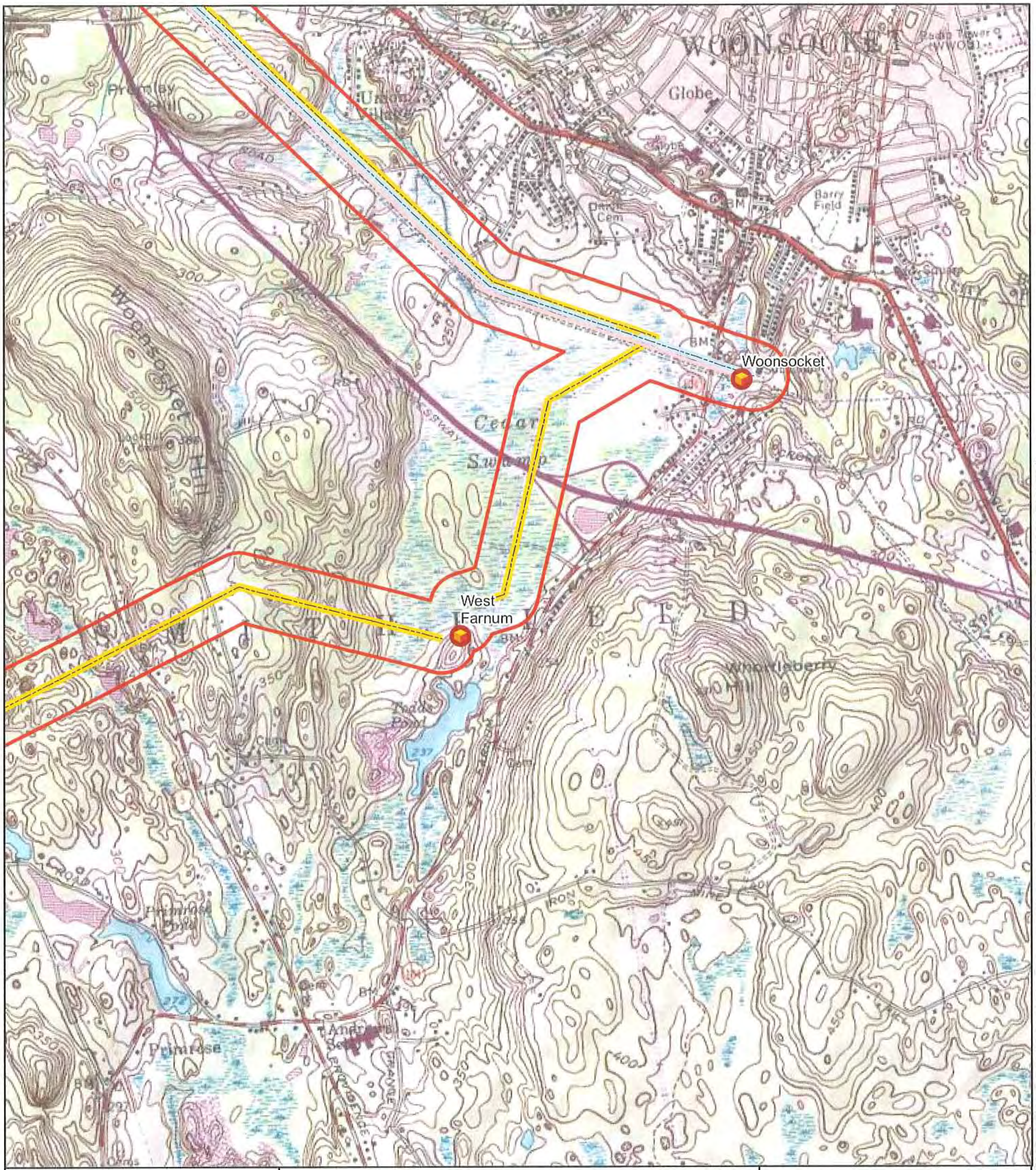
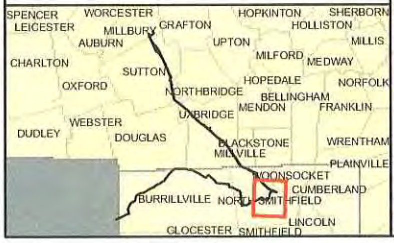
nationalgrid

AECOM

Mapsheet 06 of 12
Date: March 2009



Map Location



National Grid
USGS Project Area Mapping

N W E S

- Substation
- 1000 ft Wide Study Corridor
- New 345-kV Transmission Line
- Q-143S 115-kV Transmission Line
- R-144 115-kV Transmission Line

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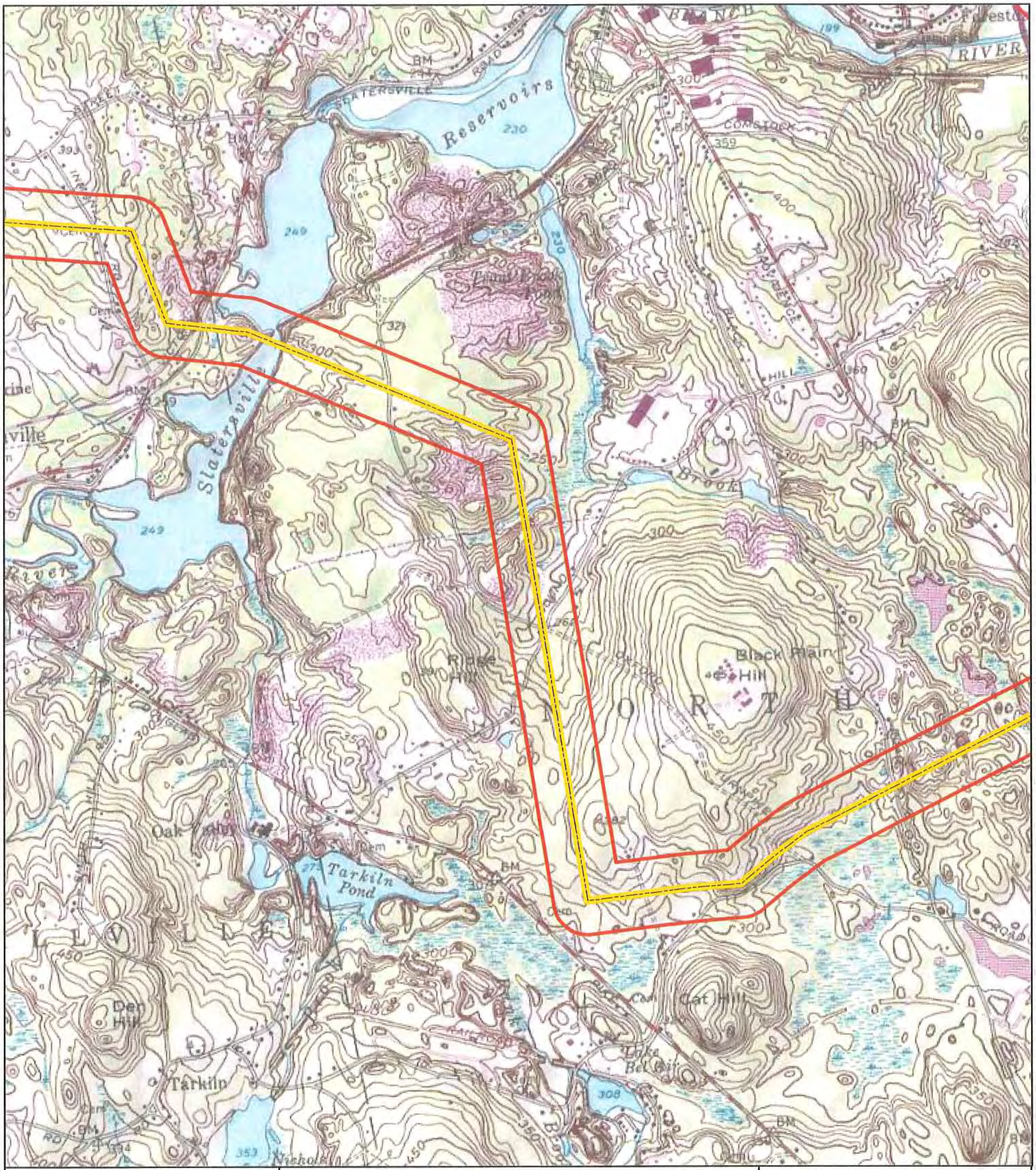
AECOM

Mapsheet 07 of 12
Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

N W E S

- Substation
- 1000 ft Wide Study Corridor
- New 345-kV Transmission Line
- Q-143S 115-kV Transmission Line
- R-144 115-kV Transmission Line

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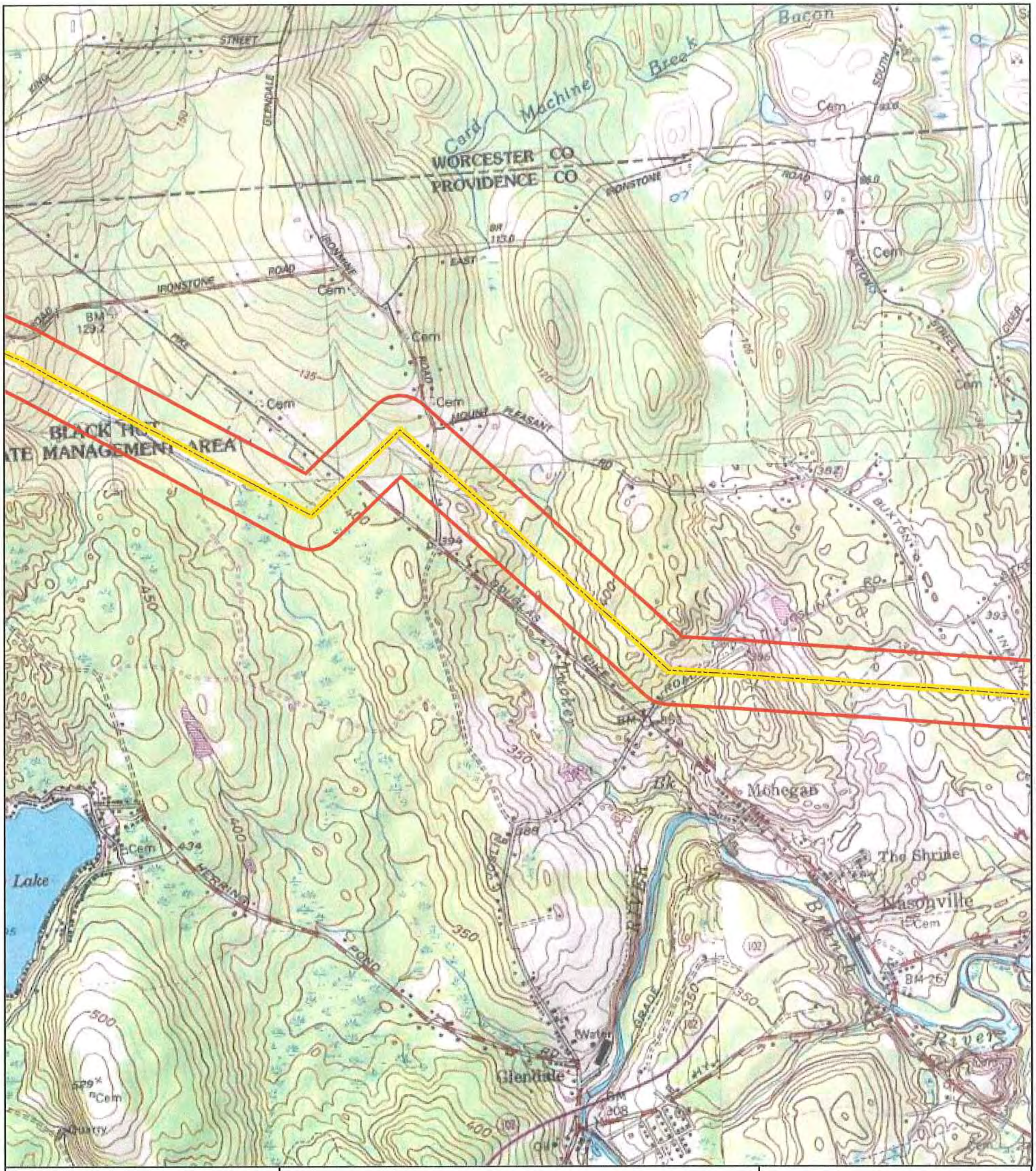
AECOM

Mapsheet 08 of 12
Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

N
W E
S

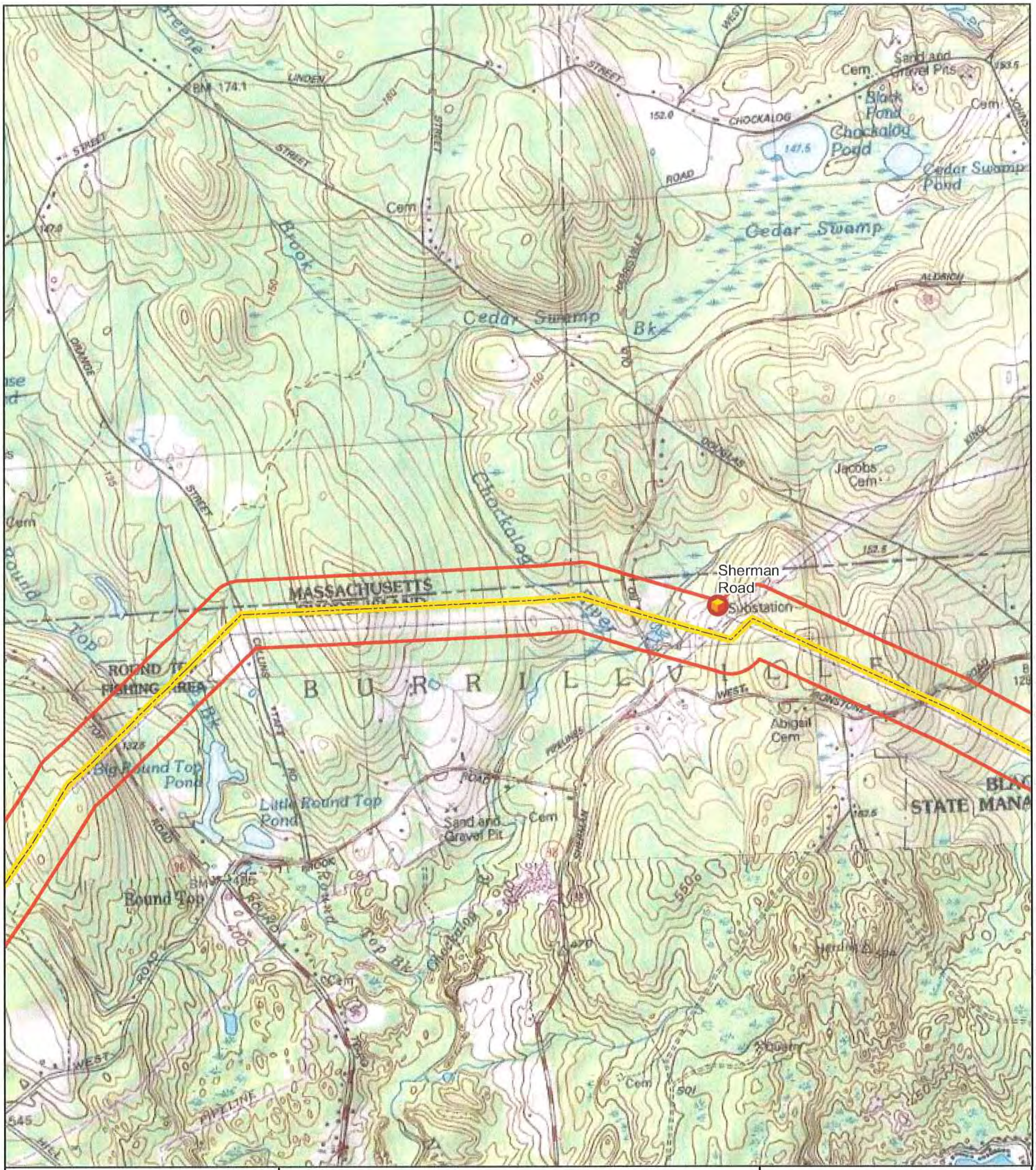
Substation
1000 ft Wide Study Corridor
New 345-kV Transmission Line
Q-143S 115-kV Transmission Line
R-144 115-kV Transmission Line

0 1,000 2,000 3,000 4,000 Feet 1:24,000

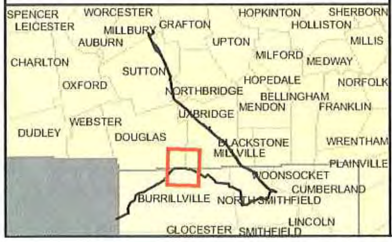
nationalgrid

AECOM

Mapsheet 09 of 12
Date: March 2009



Map Location



National Grid
USGS Project Area Mapping

N W E S

- Substation
- 1000 ft Wide Study Corridor
- New 345-kV Transmission Line
- Q-143S 115-kV Transmission Line
- R-144 115-kV Transmission Line

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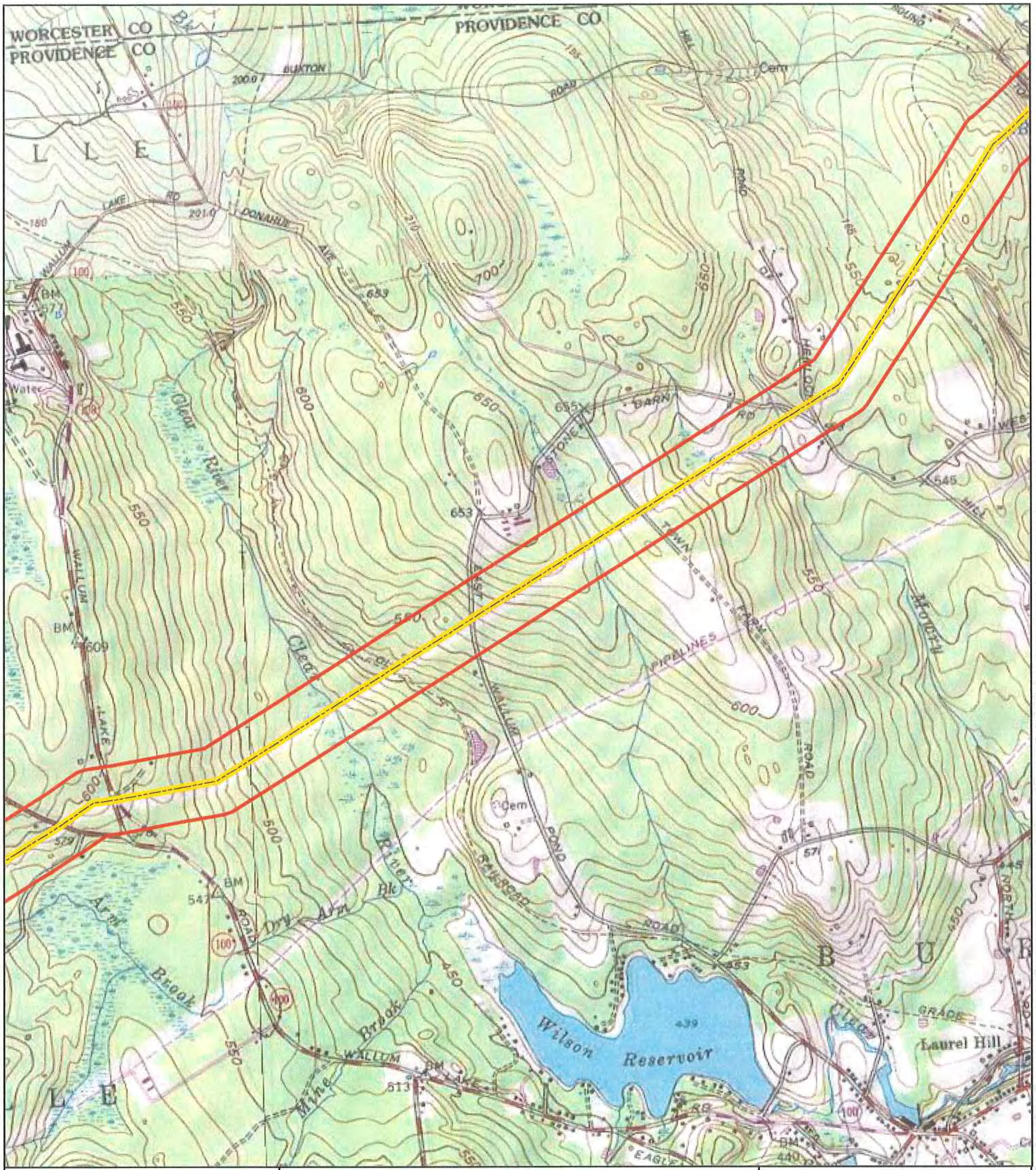
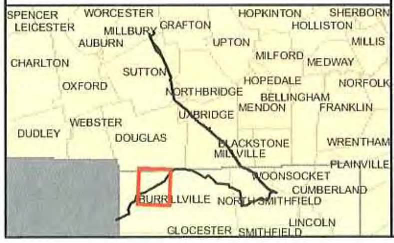
AECOM

Mapsheet 10 of 12
Date: March 2009



Map Location



National Grid
USGS Project Area Mapping

N W E S

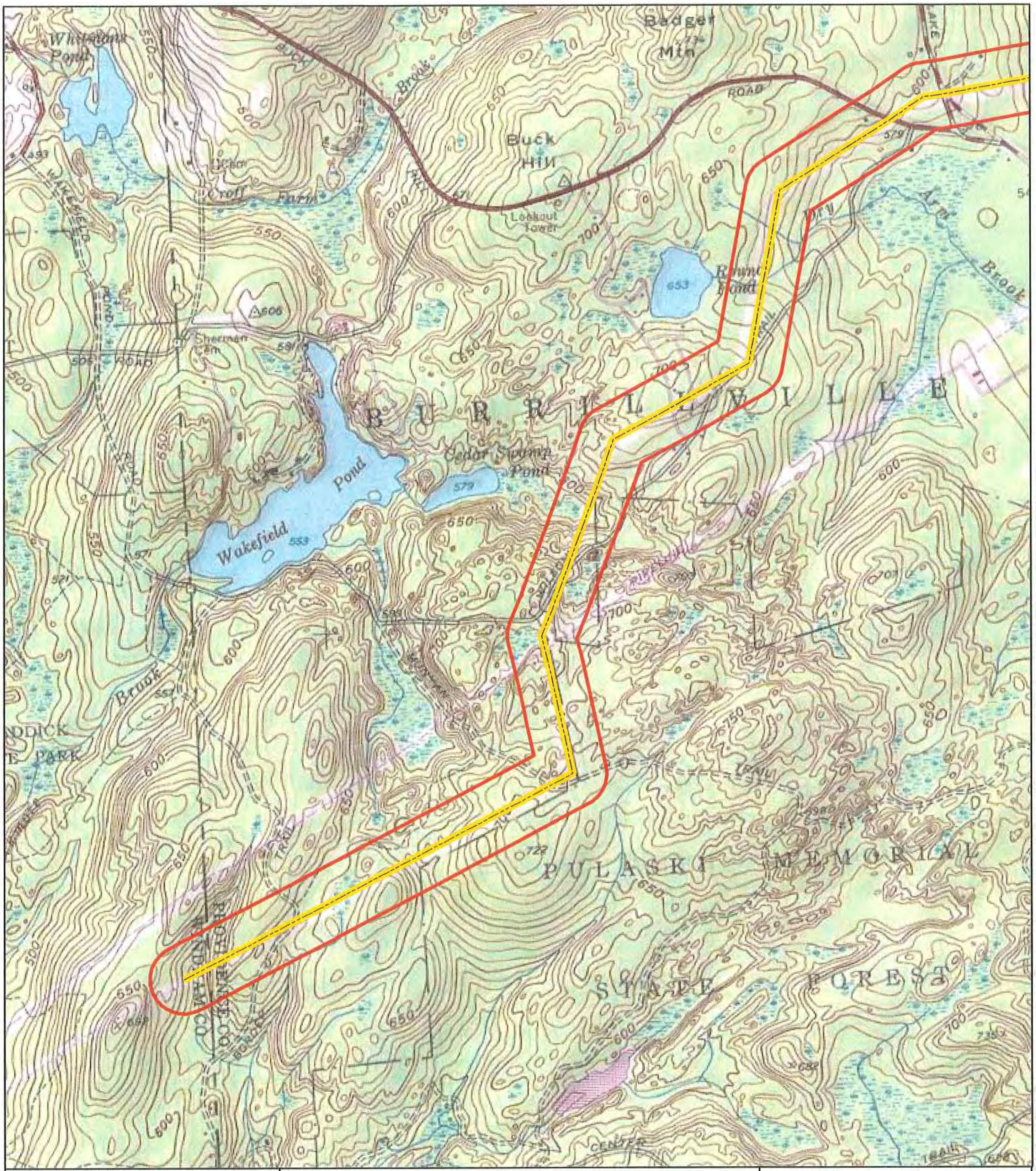
- Substation
- 1000 ft Wide Study Corridor
- New 345-kV Transmission Line
- Q-143S 115-kV Transmission Line
- R-144 115-kV Transmission Line

0 1,000 2,000 3,000 4,000 Feet 1:24,000

nationalgrid

AECOM

Mapsheet 11 of 12
Date: March 2009



Map Location

National Grid
USGS Project Area Mapping

N W E S

Substation

1000 ft Wide Study Corridor

New 345-kV Transmission Line

Q-143S 115-kV Transmission Line

R-144 115-kV Transmission Line

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nationalgrid

AECOM

Mapsheet 12 of 12

Date: March 2009

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087
http://www.fws.gov/northeast/newenglandfieldoffice

REF: Transmission line construction/maintenance
MA & RI

May 13, 2009

James Durand
AECOM Environment
10 Orms St., Suite 405
Providence, RI 02904

Dear Mr. Durand:

We received your letter (enclosed) requesting an endangered species review in regard to the proposed project identified above.

The New England Field Office has developed measures to streamline the endangered species consultation process and other requests for technical assistance. The information you have requested is available on our website at:

(http://www.fws.gov/northeast/newenglandfieldoffice/EndangeredSpec-Consultation.htm)

Please review these streamlining measures. We are confident they will adequately address your request. For assistance in navigating the website, please contact Phil Leeser at 603-223-2541.

Sincerely yours,

Eric L. Derleth

Eric L. Derleth
Acting Supervisor
New England Field Office

Enclosure

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

January 3, 2011

To Whom It May Concern:

This project was reviewed for the presence of federally-listed or proposed, threatened or endangered species or critical habitat per instructions provided on the U.S. Fish and Wildlife Service's New England Field Office website:

(http://www.fws.gov/newengland/EndangeredSpec-Consultation.htm)

Based on the information currently available, no federally-listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service (Service) are known to occur in the project area(s). Preparation of a Biological Assessment or further consultation with us under section 7 of the Endangered Species Act is not required.

This concludes the review of listed species and critical habitat in the project location(s) and environs referenced above. No further Endangered Species Act coordination of this type is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

Thank you for your cooperation. Please contact Mr. Anthony Tur of this office at 603-223-2541 if we can be of further assistance.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

January 17, 2012

To Whom It May Concern:

This project was reviewed for the presence of federally listed or proposed, threatened or endangered species or critical habitat per instructions provided on the U.S. Fish and Wildlife Service's New England Field Office website:

(http://www.fws.gov/newengland/EndangeredSpec-Consultation.htm)

Based on information currently available to us, no federally listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area(s). Preparation of a Biological Assessment or further consultation with us under section 7 of the Endangered Species Act is not required. No further Endangered Species Act coordination is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

Thank you for your cooperation. Please contact Mr. Anthony Tur of this office at 603-223-2541 if we can be of further assistance.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

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Power Engineers, Inc.

Agency Correspondence

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From:	David Gregg
To:	Meaghan Lamothe 1864
Cc:	Jamie Durand 1829
Subject:	Re: Contact Information for Obtaining Rare Species Data for a Project
Date:	Wednesday, June 08, 2016 11:10:57 AM

Meaghan,
Thank you for contacting RINHS about RI natural heritage data. It sounds like you may be in a screening phase of your project, in which case you would compare your area of interest with the natural heritage areas map available from RIGIS: http://www.rigis.org/data/natHeritage. If your project is in a natural heritage area and you want more information with regard to which listed species are known to occur there, you should ask Paul Jordan at RIDEM: paul.jordan@dem.ri.gov to help you identify them.

RINHS may be able to drill down into archival information to get more information once you know the specific species at specific locales but you should be aware that besides identifying the species involved and having observational information such as when they were last seen, what life stage, and in what number, no one in the heritage data partnership will be able to interpret the significance of a species in relation to a specific proposed project. You'll have to acquire the appropriate biological expertise from another source, probably a contractor if your firm doesn't have biologists internally.

I hope this information is helpful. Let me know if you have any questions and I can at least point you in the right direction.
Yours,
David

David W. Gregg, Ph.D., Exec. Dir.
Rhode Island Natural History Survey
URI East Farm, Building 14
P.O. Box 1858, Kingston, RI 02881
401-874-5800
dgregg@rinhs.org / www.rinhs.org

On Wed, Jun 8, 2016 at 8:59 AM, meaghan.lamothe@powereng.com <meaghan.lamothe@powereng.com> wrote:

> Dear Dr. Gregg,
>
> I am aware that the natural heritage and natural communities data in Rhode Island is now managed by a four-member consortium which includes the Rhode Island Natural History Survey, the Rhode Island Department of Environmental Management, the Rhode Island chapter of the Natural Conservancy, and the University of Rhode Island Environmental Data Center.   Based upon instructions about obtaining rare species data on the RINHS web page, I am writing to inquire which member of the consortium to contact to review my project for the presence of rare species.

Thank you very much for your time with this matter.

Meaghan

MEAGHAN LAMOTHE

BIOLOGIST

774-643-1864

413-358-0364 cell

POWER Engineers, Inc.

www.powereng.com

Energy ▪ Facilities ▪ Communications ▪ Environmental

www.powereng.com

Erin Whoriskey
Lead Environmental Scientist
NE Environmental Permitting

July 19, 2016

Mr. Paul Jordan
Rhode Island Department of Environmental Management
Division of Planning and Development
235 Promenade Street
Providence, RI 02908-5767

Subject: **The Narragansett Electric Company d/b/a National Grid Clear River 345kV Line from the Existing Sherman Farm Road Switching Station to the Proposed Clear River Energy Center, Burrillville, RI**

Dear Mr. Jordan,

The Narragansett Electric Company d/b/a National Grid (TNEC) is proposing to construct a new 345 kV transmission line in the Town of Burrillville, RI, to interconnect the proposed Clear River Energy Center (Invenergy LLC) to the existing electric transmission grid (the "Project"). This proposed transmission line would begin at TNEC's existing Sherman Farm Road Switching Station in Burrillville, RI and extend approximately 6 miles within existing TNEC right-of-way (ROW) to the proposed Clear River Energy Center site which is proposed to be located off of Wallum Lake Road in Burrillville, RI. The Project also includes approximately one mile of new ROW required to connect the Clear River facility to the existing TNEC transmission facilities. The attached map and shapefile show the location of the proposed 345 kV transmission line corridor in United States Geological Survey (USGS) 7.5 minute series topographic mapping (Figure 1).

Construction of the Project will necessitate widening, tree clearing, and vegetation removal along an approximate 6-mile section of existing electric transmission line and along a 1-mile section of new ROW. Below is a description of the clearing required to accommodate the Project:

- approximately 4.4 miles of existing ROW, spanning an area from the Sherman Farm Road Switching Station to just west of the Clear River, will have approximately 85 feet of vegetation cleared to the south of the existing ROW for the new 345 kV transmission line;

- approximately 1.6 miles of existing ROW from just west of the Clear River to the junction with the 1 mile of the new ROW will have approximately 55 feet of vegetation cleared to the north of the current ROW to accommodate the new 345 kV transmission line; and,
- the proposed 1 mile of new ROW will be cleared of trees to a width of 150 feet.

Power Engineers, Inc. has taken several steps to review the Project area. An email to Dr. David Gregg, Executive Director of the Rhode Island Natural History Survey (RINHS) was sent on June 8, 2016 where Dr. Gregg instructed Power to compare online natural heritage data available from the RIGIS website with the Project footprint (refer to Appendix A). Dr. Gregg further advised us to contact your office for additional information on the listed species if natural heritage data crossed our Project. We do have overlap between natural heritage data and our Project area and have attached a map showing the location of the proposed 345 kV transmission line corridor in United States Geological Survey (USGS) 7.5 minute series topographic mapping with RIGIS natural heritage data (Figure 1). In addition, we are providing a shapefile with the ROW data for your convenience.

We are sending this information with the understanding that all rare species data will remain confidential and will not be distributed.

Former Rhode Island Correspondence

From 2007-2012 as part of National Grid's Interstate Reliability Project, a portion of the Project area including the Sherman Farm Road Substation and the approximately 6 miles of existing TNEC ROW was reviewed for the presence of natural heritage data (refer to Appendix B). On behalf of National Grid, the environmental consulting company, ENSR/AECOM consulted with RINHS regarding state-listed species in the Project area. Correspondence from the RINHS (E. Endrulat, June 11, 2007, D. Gregg, March 25, 2011, and P. Jordan, March 12, 2012) indicated the presence of several state-listed plant species, and one state-listed threatened dragonfly species within a 5,000-foot buffer around the ROW.

Request for Data on Rare, Threatened and Endangered Species, and Natural Heritage Areas

TNEC is seeking input from the RIDEM on any known Element Occurrences and Natural Heritage Areas; and relevant information regarding taxa of conservation concern in the area, State or Federally-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas. Also, we would appreciate guidance on whether supplemental field surveys are warranted within the existing TNEC ROW.

This request specifically addresses the requirement for documented consultation with regard to compliance with the Endangered Species Act ("ESA") of 1973 and Rhode Island Endangered Species Statues (R.I. Gen. Law §§ 20-37-1-5 (1977)).

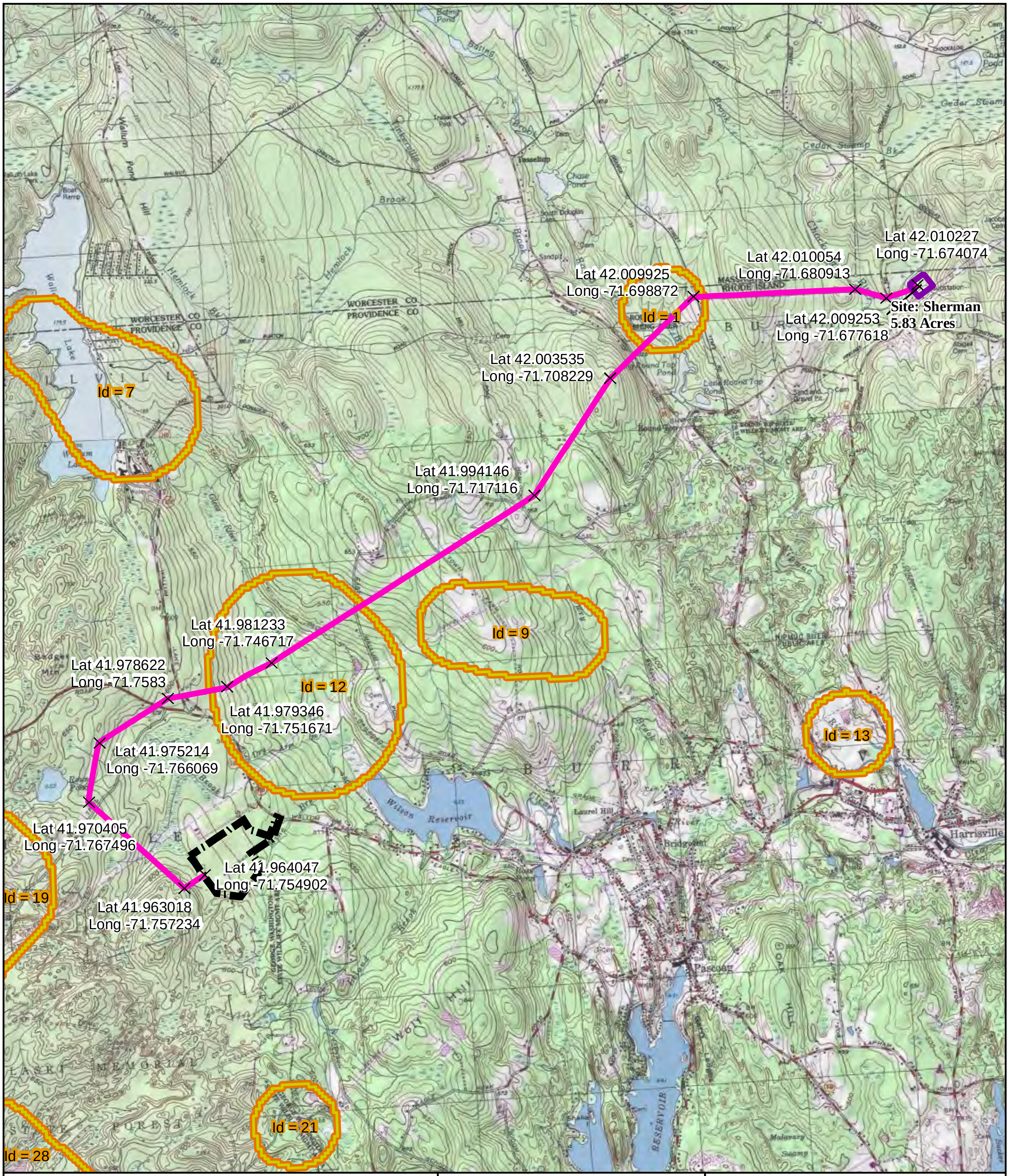
If you have any questions or would like more information, please do not hesitate to contact me at (781) 907-3598 (Erin.Whoriskey@nationalgrid.com), or Jamie Durand at (401) 439-3020 (jamie.durand@powereng.com).

Sincerely,

Erin Whoriskey
Lead Environmental Scientist
National Grid

Attachments

Cc: Jamie Durand, POWER Engineers
David Beron, National Grid
John Niland, Invenergy LLC
Mike Feinblatt, ESS Group, Inc.
Meaghan Lamothe, POWER Engineers
Steve Pasquine, POWER Engineers



Legend

- Existing Substation Site
- Proposed Transmission Line
- Proposed Site
- Rhode Island Natural Heritage Areas

The State of Rhode Island

Providence County
Burrillville Township

NAD 1983 UTM Zone 18N USFt
Foot US
Transverse Mercator
North American 1983

Figure 1

Natural Heritage Data

0 0.5 1 1.5
Miles

N W E S

POWER ENGINEERS

nationalgrid

Date: 7/6/2016

Path: W:\135269_SEMARI\GIS\Apps\Clear_River\Clear_River_Heritage_Data.mxd

Lamothe, Meaghan

From: Jessica Harrington
Sent: Wednesday, July 20, 2016 9:52 AM
To: Meaghan Lamothe 1864; Jamie Durand 1829
Subject: FW: Agency Review of Natural Heritage Data
Attachments: Heritage_2016.zip

From: Jordan, Paul (DEM) [mailto:paul.jordan@dem.ri.gov]
Sent: Wednesday, July 20, 2016 9:51 AM
To: Jessica Harrington
Subject: RE: Agency Review of Natural Heritage Data

Dear Ms. Harrington,

Please find attached a zipped shapefile of RI Natural Heritage data that may be relevant to the Clear River Transmission Line Project. Many of the locations are not proximate to the powerline but I wanted to give your biologist a broad sense of what to look for in the area. The dataset was last updated in June 2016.

Please give me a call if you have any questions.

PJ

Paul Jordan
Supervising GIS Specialist
RI Dept. of Environmental Management
235 Promenade Street
Providence, RI 02908
(401)222-2776 x4315
paul.jordan@dem.ri.gov

From: jessica.harrington@powereng.com [mailto:jessica.harrington@powereng.com]
Sent: Tuesday, July 19, 2016 5:11 PM
To: Jordan, Paul (DEM) <paul.jordan@dem.ri.gov>
Cc: jamie.durand@powereng.com; Erin Whoriskey (erin.whoriskey@nationalgrid.com) <erin.whoriskey@nationalgrid.com>; meaghan.lamothe@powereng.com
Subject: Agency Review of Natural Heritage Data

Dear Mr. Jordan,

Attached you find a detailed letter, 1 figure, 2 appendices, and a GIS shapefile of the proposed Clear River 345 kV Transmission Line Right-of-Way centerline located in Burrillville, RI. The Narragansett Electric Company d/b/a National Grid is seeking input from the RIDEM on any known Element Occurrences and Natural Heritage Areas; and relevant information regarding taxa of conservation concern in the area, State or Federally-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas within the project area.

If you have any questions or would like more information, please do not hesitate to contact Erin Whoriskey at (781) 907-3598 (Erin.Whoriskey@nationalgrid.com), or Jamie Durand at (401) 439-3020 (jamie.durand@powereng.com).

Thank you very much.

Meaghan Lamothe
Biologist

Enclosure(s): cd
Sent Via: Mail and Email

Interstate Reliability Project

Agency Correspondence

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Rhode Island Natural History Survey

RHODE ISLAND
NATURAL HISTORY SURVEY
Providing Ecosystem Science and Information

Erik Endrulat
101 Coastal Institute in Kingston
1 Greenhouse Rd, URI
Kingston, RI 02881

June 11, 2007

Peter Lockwood
ENSR Corporation
10 Orms St., Suite 405
Providence RI, 02904

Dear Peter Lockwood,

A review of the RI Natural Heritage Database has revealed 14 populations for 11 rare species associated with two ENSR projects. The project areas were defined by a 5000-foot buffer around an electrical transmission line running from the Pawtucket Substation along the Seekonk River in Pawtucket, east to the Massachusetts state line (Project 4), and from North Smithfield to Burrillville (Project 1).

Listed plant species in the vicinity of project area # 1 include one state-endangered species, *Dalibarda repens*, found in moist woods and sphagnum bogs, and two state threatened species: *Phegopteris connectilis* and *Streptopus roseus.* Four plants classified as Species of Concern, were also located in the project area. *Leucorrhinia glacialis,* a state-threatened dragonfly, occurs within the transmission line buffer. *Leucorrhinia* is most often associated with bogs, ponds, and lakes with sphagnum fringes.

Two Species of Concern were located in the study area for project # 4, Salt Reedgrass (*Spartina cynosuroides*) and the Sora (*Porzana carolina*).

Summary of Rare Species located within project area for ENSR Project #: 0490-128

Project	Name	Status[1]	Last Observed[2]	Number of Populations[3]
1	*Agalinis tenuifolia* (Common Agalinis, Slender Gerardia)	C	1994	3
1	*Corydalis sempervirens* (Pale or Tall Corydalis, Rock-harlequin)	C	2006	2
1	*Dalibarda repens* (Dewdrop, False Violet, Robin-run-away)	SE	1980	1
1	*Equisetum sylvaticum* (Wood- or Woodland-horsetail)	C	1995	1
1	*Phegopteris connectilis* (Long or Northern Beech-fern)	ST	2006	1
1	*Streptopus roseus* (Rose Twisted-stalk, Rose Mandarin)	ST	1978	1
1	*Taxus canadensis* (American Yew, Ground-hemlock)	C	1971	1
1	*Utricularia subulata* (Zigzag Bladderwort)	C	1995	1
1	*Leucorrhinia glacialis* (Crimson-ringed Whiteface Dragonfly)	ST	2001	1
4	Spartina cynosuroides (Salt Reedgrass, Big Cordgrass)	C	2001	1
4	*Porzana carolina* (Sora)	C	1978	1

[1] Rhode Island State Statuses (C= Species of Concern, SE= State Endangered, ST= State Threatened) from: Enser, R.W. 2002. Rare Native Plants of Rhode Island. Rhode Island Natural Heritage Program, RI Department of Environmental Management. Providence, RI 02908.

Enser, R.W. 2006. Rare Native Animals of Rhode Island. Rhode Island Natural Heritage Program, RI Department of Environmental Management. Providence, RI 02908.

[2] Year that species was last observed (if more than one population, most recent observation is listed).

[3] Number of distinct populations occurring within project area.

This letter summarizes all known occurrences of rare species and natural communities located on or nearby the proposed project area as described above. The data provided by the Rhode Island Natural History Survey are based solely on existing information in our databases. In the absence of field surveys, we cannot tell you whether a given site includes rare species or significant natural communities.

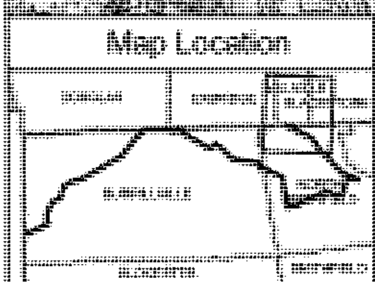
Sincerely,

Erik Endrulat Digitally signed by Erik Endrulat DN: CN = Erik Endrulat, C = US, O = Rhode Island Natural History Survey Reason: I am the author of this document Date: 2007.06.11 10:32:03 -04'00'

Erik Endrulat
Data Manager
(401)874-5822 (RINHS Data Management Office)
(401)874-4561 (fax)
Room 101 CIK, 1 Greenhouse Rd., URI
Kingston RI, 02881

DISCLAIMER

The Natural Heritage Database is the most current and comprehensive information source about the rare biota of Rhode Island. However, such databases are only as complete as the information that has been collected. We gratefully accept contributions to the Heritage database which can be made through our website (www.rinhs.org). The RI Natural Heritage Database is funded in part by a grant from the Rhode Island Foundation and by the RI Agricultural Experiment Station and URI College of Environmental and Life Sciences.



NEEWS Project
Project Location and RI Rare Species Habitats

Transmission ROW Centerline
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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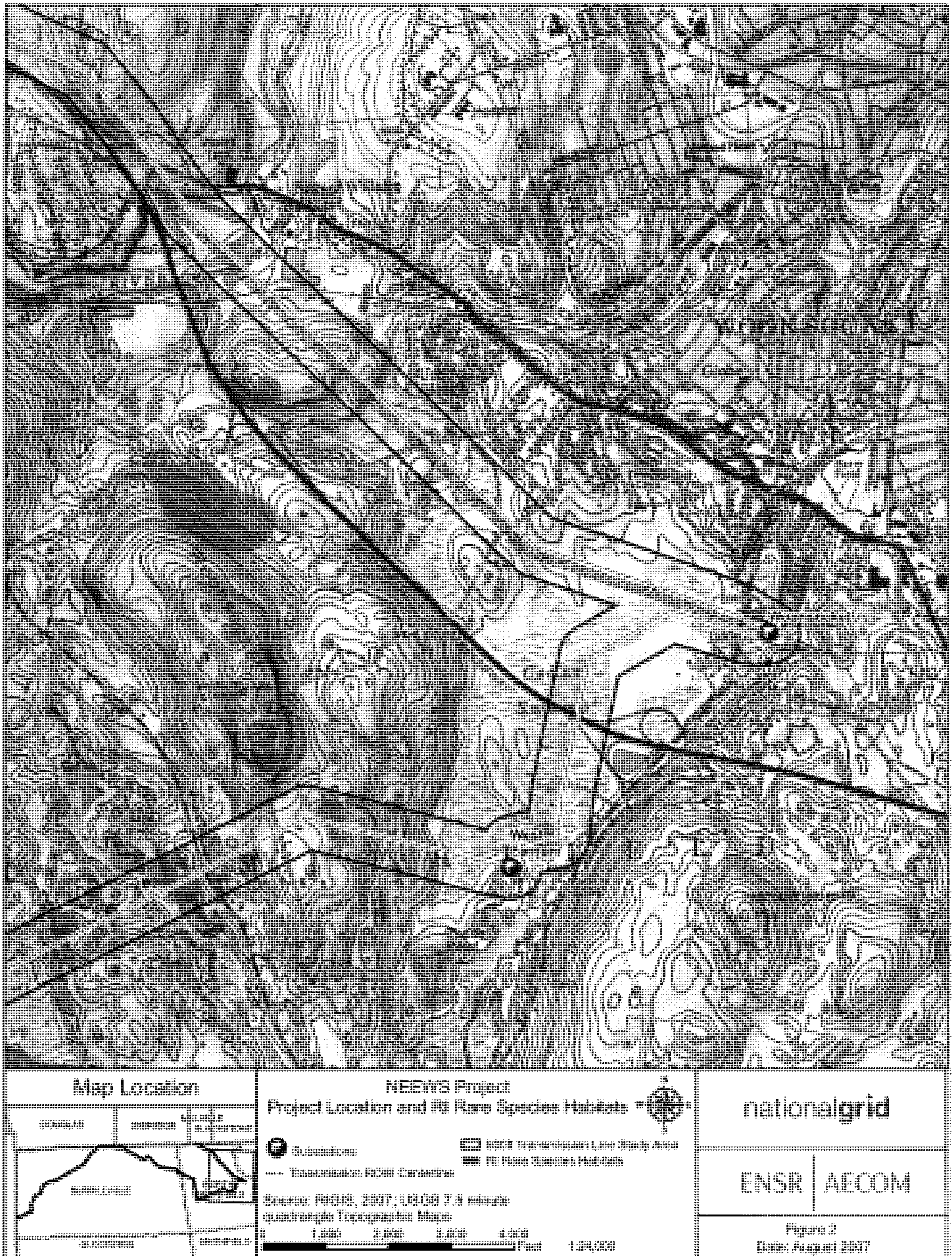
nationalgrid

ENSR | AECOM

Figure 1
Date: August 2007


Map Location
NEEWS Project
Project Location and RI Rare Species Habitats
Substation
Transmission ROW Centerline
NEEWS Transmission Line Study Area
RI Rare Species Habitats
Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps
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nationalgrid
ENSR | AECOM
Figure 2
Date: August 2007

From: David Gregg [dgregg@rinhs.org]
Sent: Friday, March 25, 2011 4:41 PM
To: Milliman, Alison
Subject: Re: AECOM SendFiles Notification: Alison Milliman has sent you files
Attachments: Powerline_AECOM_20110325.pdf; RINHS NS NG ROW.pdf; SpInfopowerline_AECOM_20110325.xls

Alison,
Sorry for the delay. Our contractor just was not able to get to this request before now. Attached are maps of the rare species localities noted in our database as well as a table with information about the species observed. Also included is the data license for this information. Please sign it and return a copy to RINHS at your convenience. Please let me know if something's not clear on the sheets provided or if you need more information about any of the rare species localities.
Yours,
David

David W. Gregg, Ph.D., Executive Director
Rhode Island Natural History Survey
200 Ranger Hall
P.O. Box 1858, Kingston, RI 02881
401-874-5800; FAX 401-874-5868
dgregg@rinhs.org / www.rinhs.org

On Tue, Mar 15, 2011 at 10:19 AM, <alison.milliman@aecom.com> wrote:
Alison Milliman has sent you 3 files using AECOM's File Transfer System.

Alison Milliman says:

Hi David and Kira,
Attached please find correspondence from July 2007 regarding a proposed National Grid Project in North Smithfield and Burrillville, RI. The Project has been idle for the past couple of years until now. We are requesting that the Project area be re-reviewed to make sure we have the most up to date species and critical habitat information. Please let me know if you need more information and if you will need me to send a check. Thank you.

Sincerely,
Alison Milliman
alison.milliman@aecom.com
401.274.5685 X19
401.742.0487 (cell)

These files will be available for download until 3/22/2011

File	Description	Size
Binder1.pdf		12,602KB
20100125151444002.pdf		107KB
RIDEM_Project 1_073007.doc		214KB

If you are having trouble accessing the links in this email, you can view this message as a web page by copying the following link and pasting it into your browser:

http://sendfiles.aecom.com/message.aspx?msgId=1eb78604-82f8-488c-a955-eaf6b821212f&u=dgregg%40rinhs.org

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Rhode Island Department of Environmental Management

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
235 Promenade Street, Providence, RI 02908-5767 TDD 401-222-4462

NOTICE

To: Requestors of Natural Heritage Information
Date: December 18, 2006

As of the date of this memorandum, the Rhode Island Natural Heritage Program, Division of Planning and Development, Department of Environmental Management, will no longer be fulfilling requests for information regarding the occurrence of rare, threatened, or endangered species, or exemplary natural community types, in Rhode Island.

Environmental Resource Mapping, available on the web site of the Department of Environmental Management, can be used to determine the locations of rare species habitats. This program is available at the following web address: http://www.dem.ri.gov/maps/index.htm. Follow the map tutorials to view various resource coverages, including a section with Regulatory Overlays that contains "Natural Heritage Areas."

Information on the location and status of species listed Federally as Endangered or Threatened (required for all projects utilizing Federal funds) can be obtained from the following:

Christopher Raithel, Principal Wildlife Biologist
Division of Fish and Wildlife
Great Swamp Field Headquarters
277 Great Neck Road
West Kingston, RI 02892

Richard W. Enser, Coordinator

Rhode Island Natural Heritage Program

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ENSR
10 Orms Street, Providence, Rhode Island, 02904
T 401.274.5685 F 401.521.2730 www.ensr.aecom.com

July 30, 2007

Mr. Richard Enser
Rhode Island Department of Environmental Management
Rhode Island Natural Heritage Program
Division of Planning and Development
235 Promenade Street
Providence, Rhode Island 02908-5767

Subject: **National Grid USA**
345-kV Transmission Line Construction
RI/MA State Line to RI/CT State Line via the West Farnum and Sherman Road Substations

Dear Mr. Enser:

National Grid USA ("National Grid") is proposing to construct new 345-kV transmission lines beginning at the RI/MA state boundary in North Smithfield, RI and extending approximately 23.4 miles via the West Farnum (North Smithfield) and Sherman Road (Burrillville) Substations, ending at the RI/CT state boundary in Burrillville, RI. The new transmission line will be approximately 23.4 miles in length and will be located within the existing transmission line easement. The existing easement is typically 300 feet in width, approximately half of which is cleared for existing transmission line service.

The attached maps show the location of the transmission line corridor on USGS 7.5 minute series topographic mapping (Figures 1 - 7).

ENSR has reviewed the current Rhode Island Geographic Information System ("RIGIS") Rare Species mapping for the project area traversed by the transmission line corridor in North Smithfield, Woonsocket, and Burrillville. The available RIGIS mapping indicates the presence of Element Occurrences to the northeast of the West Farnum Substation in North Smithfield and along the transmission line segment between West Farnum and Black Plain Road (Figure 2). Additionally the available mapping indicates that the proposed project traverses the Clear River Natural Heritage Area (Figure 6) and is located in proximity to two mapped Natural Heritage Areas at Cedar Swamp Pond and Pulaski Memorial State Forest in Burrillville (Figure 7).

This letter is a request for additional information about the subject Element Occurrences and Natural Heritage Areas such that we can perform reconnaissance for the taxa or communities as appropriate. Additionally, please be so kind as to provide us with any relevant information regarding other taxa of conservation concern in the area, State or Federal-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas.

This correspondence is intended to comply with and address the 1977 Federal Endangered Species Act requirement for documented consultation with regulatory agencies. If you have any questions or require additional information, please do not hesitate to contact me at (401) 274-5685, Ext. 17, or plockwood@ensr.aecom.com. Thank you.

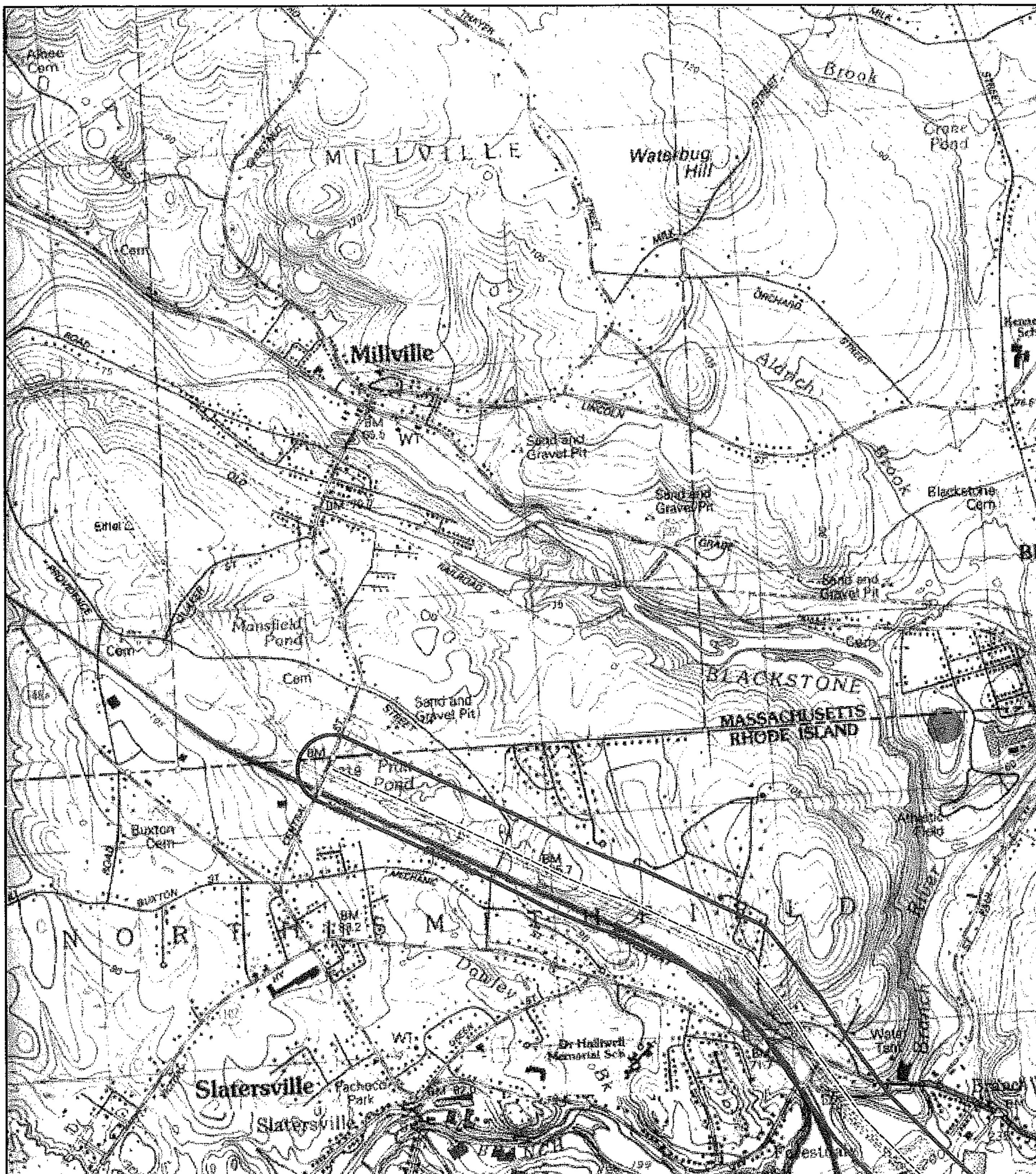
Sincere regards,

Peter Lockwood

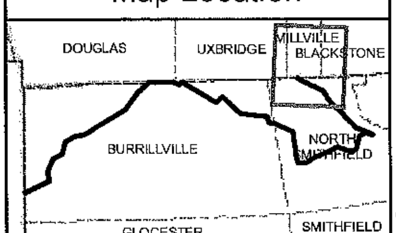
Peter Lockwood
Senior Project Specialist

Attachments: Figure 1 through 7 – Project Location & RI Rare Species Habitats

Cc: J. Durand, ENSR
D. McIntyre, National Grid
D. Beron, National Grid



Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

Substations
500ft Transmission Line Study Area
Transmission ROW Centerline
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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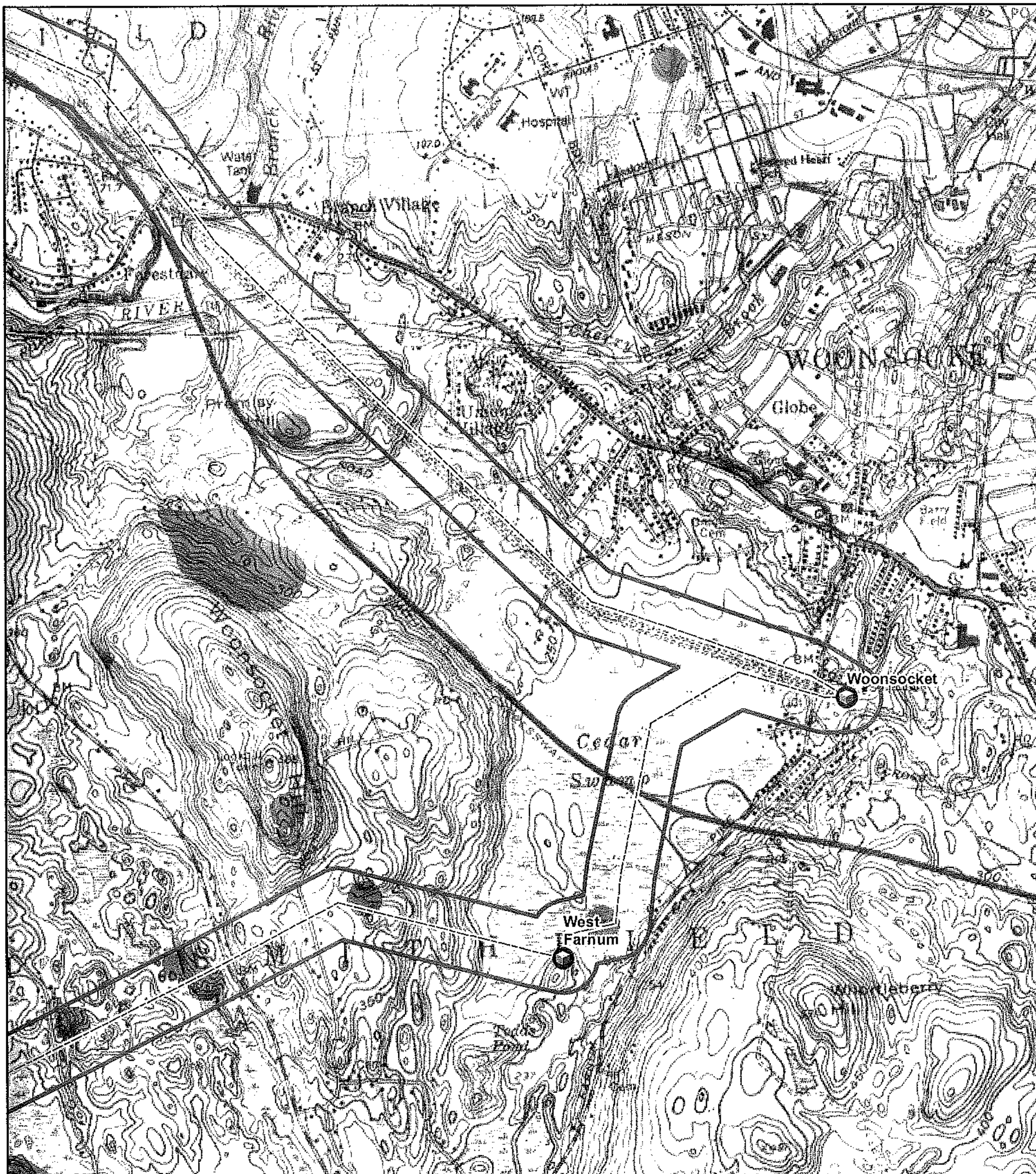
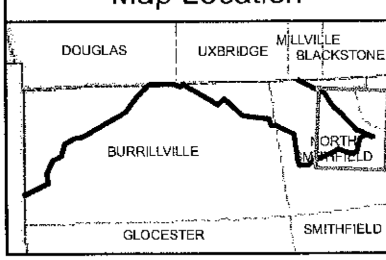
Figure 1
Date: August 2007



Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

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Substations
--- Transmission ROW Centerline
500ft Transmission Line Study Area
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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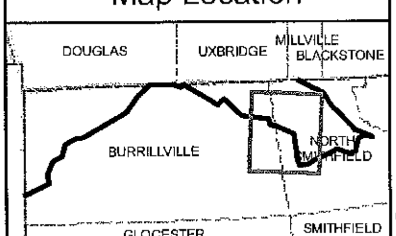
Figure 2
Date: August 2007

Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

N W E S

Substations
Transmission ROW Centerline
500ft Transmission Line Study Area
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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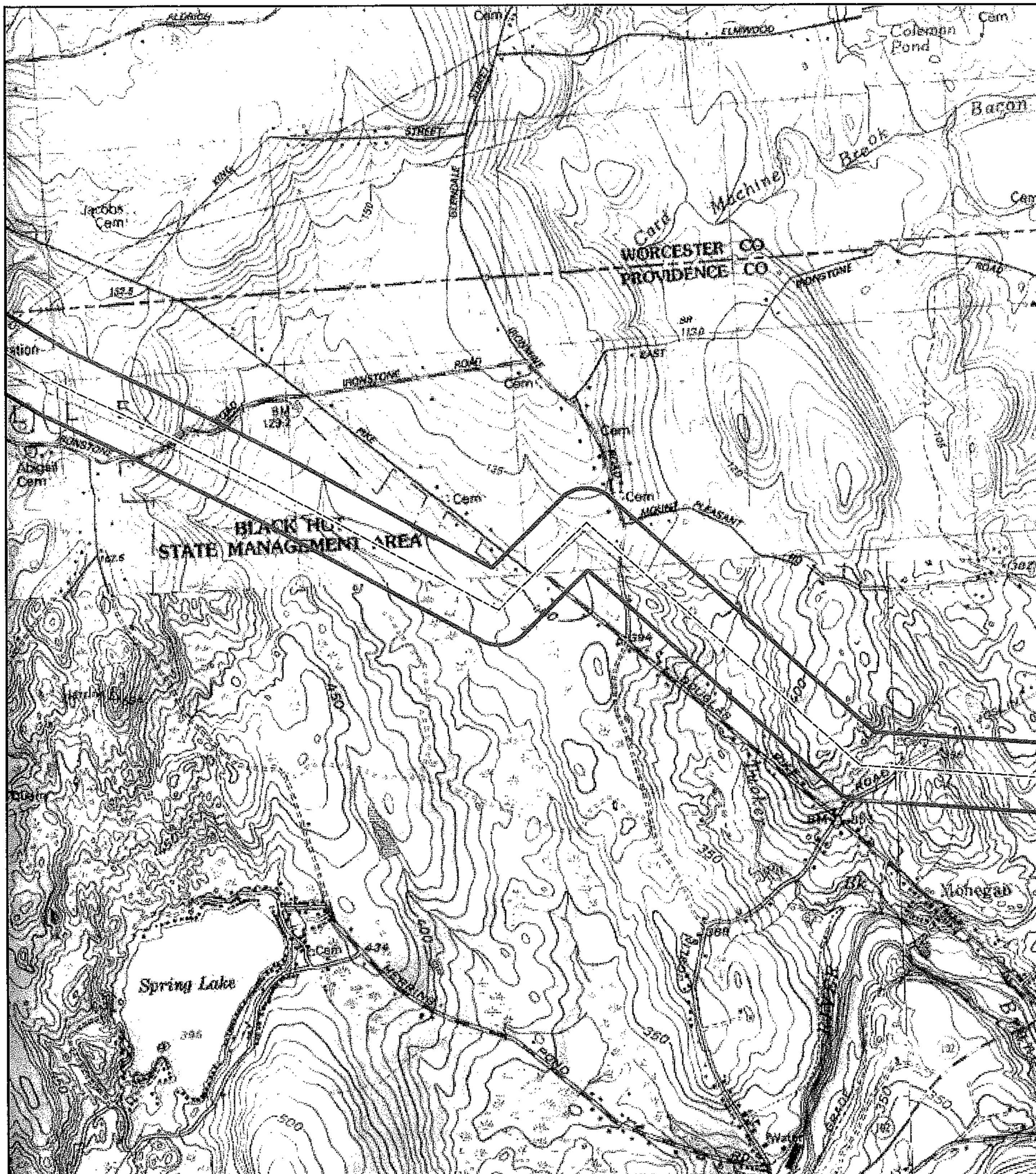
Figure 3
Date: August 2007



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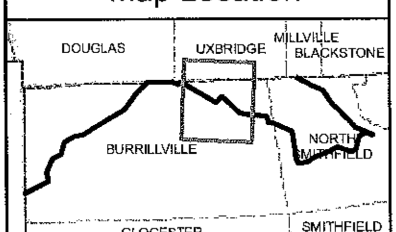

NEEWS Project
Project Location and RI Rare Species Habitats

Substations
500ft Transmission Line Study Area
Transmission ROW Centerline
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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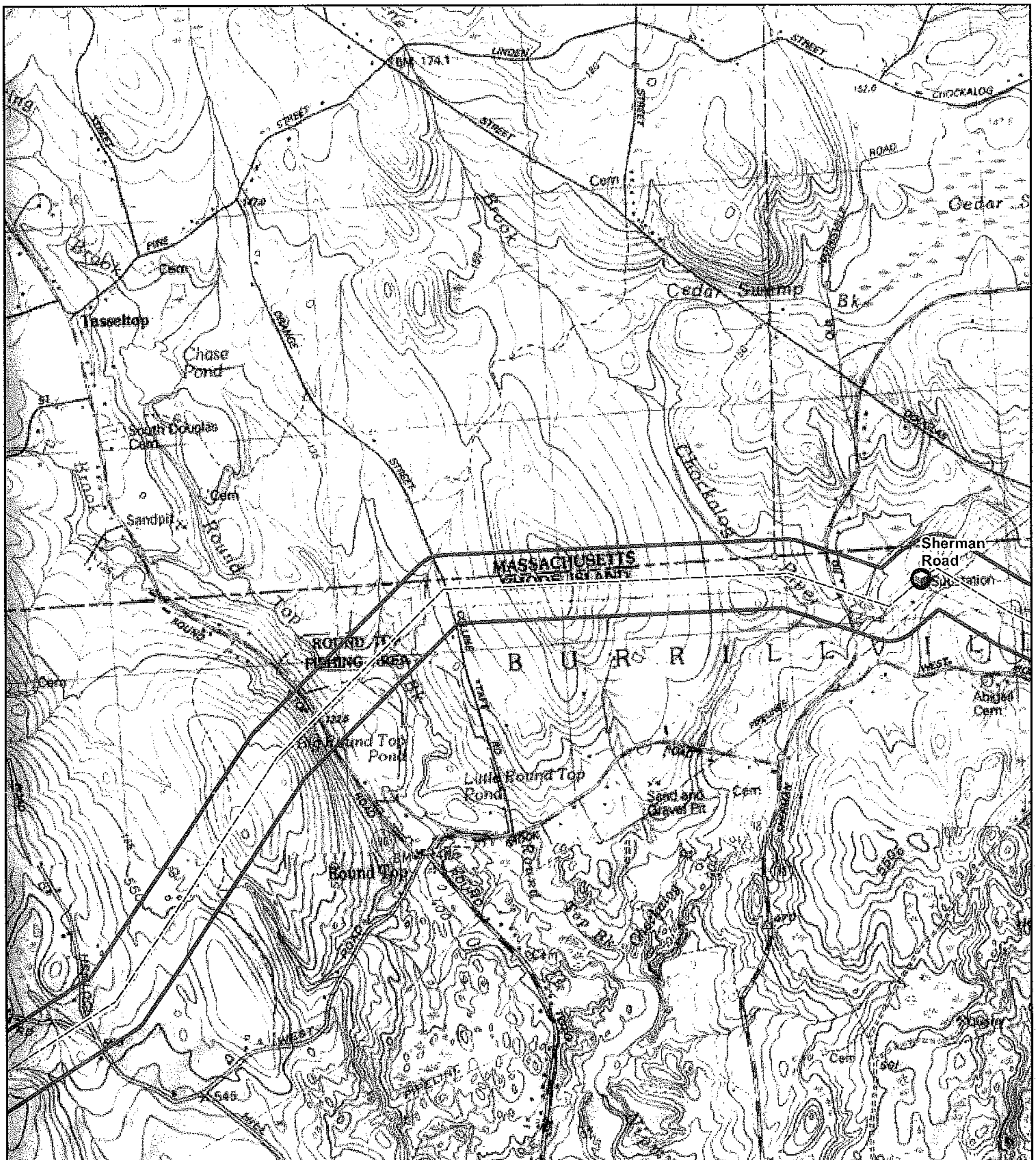
Figure 4
Date: August 2007



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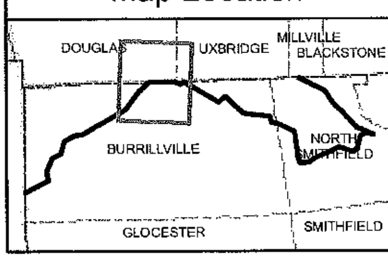

NEEWS Project
Project Location and RI Rare Species Habitats

Substations

--- Transmission ROW Centerline

500ft Transmission Line Study Area

RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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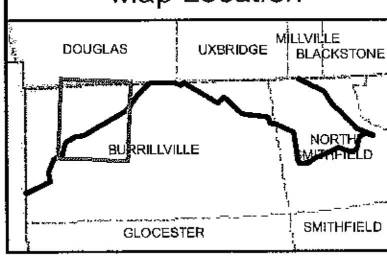
Figure 5
Date: August 2007

Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

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Substations
Transmission ROW Centerline
500ft Transmission Line Study Area
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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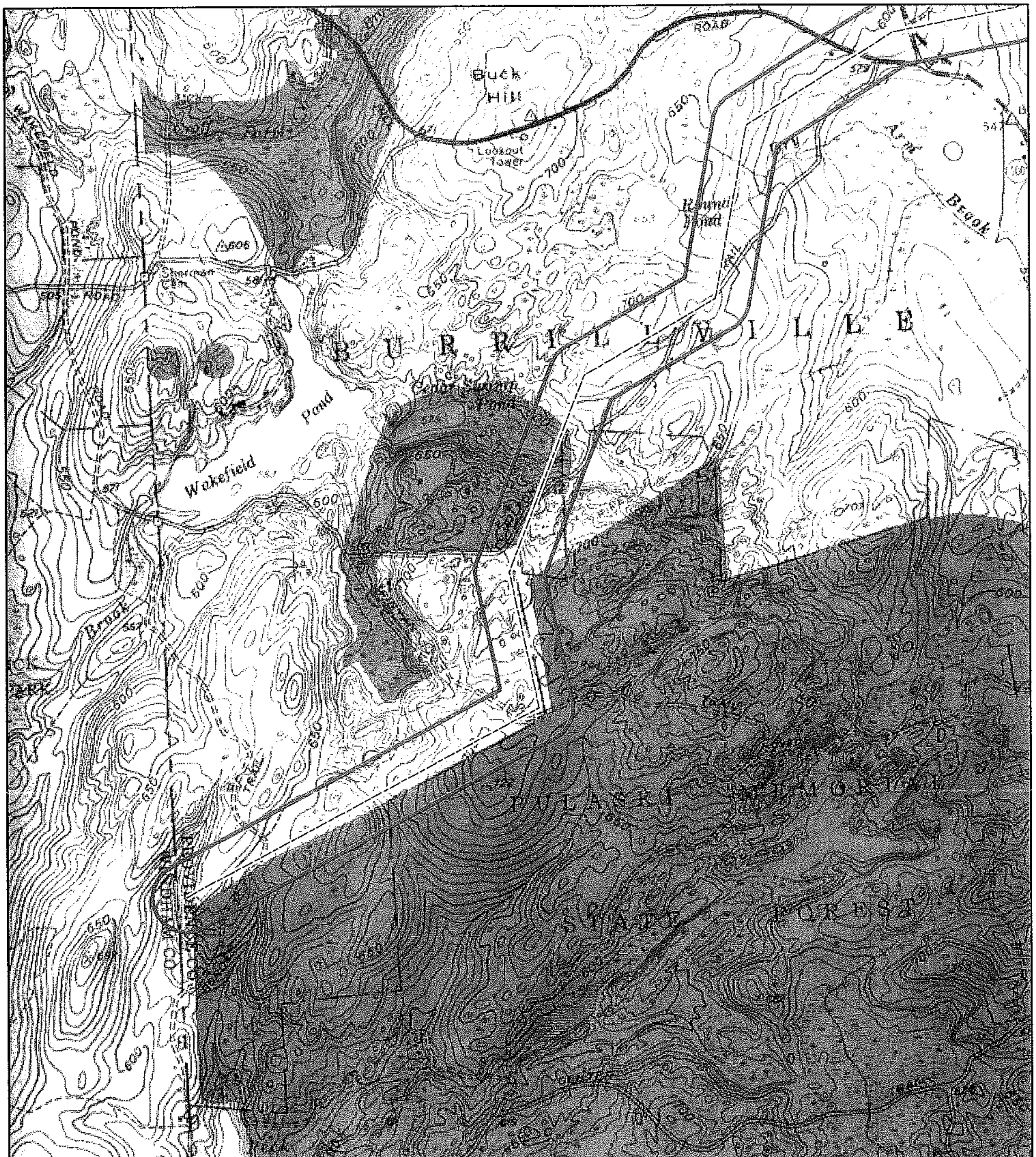
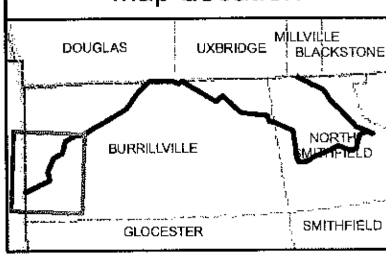
Figure 6
Date: August 2007



Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

Substations
Transmission ROW Centerline
500ft Transmission Line Study Area
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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Figure 7
Date: August 2007

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ENSR
10 Orms Street, Providence, Rhode Island, 02904
T 401.274.5685 F 401.521.2730 www.ensr.aecom.com

July 30, 2007

Mr. Richard Enser
Rhode Island Department of Environmental Management
Rhode Island Natural Heritage Program
Division of Planning and Development
235 Promenade Street
Providence, Rhode Island 02908-5767

Subject: **National Grid USA**
West Farnum Substation, North Smithfield, RI

Dear Mr. Enser:

National Grid USA ("National Grid") is proposing work within and around the existing West Farnum 345/115-kV Substation located in North Smithfield, RI. The attached map shows the location of the existing Substation facility on a 7.5 minute series USGS quadrangle map.

ENSR has reviewed the current Rhode Island Geographic Information System ("RIGIS") Rare Species mapping for the Substation area and found no mapped occurrences of rare species within a 500-foot radius of the center of the site. However, there is a documented Element Occurrence illustrated to the northeast of the Substation in the vicinity of the transmission line leading to Woonsocket (Figure 1).

This letter is a request for additional information about the subject Element Occurrence such that we can perform an area reconnaissance for the taxon as appropriate. Additionally, please be so kind as to provide us with any relevant information regarding other State or Federal-listed Threatened or Endangered species in the area, RI Species of Special Concern, exemplary or critical natural habitat areas, and designated Natural Heritage Areas.

This correspondence is intended to comply with and address the 1977 Federal Endangered Species Act requirement for documented consultation with regulatory agencies. If you have any questions or require additional information, please do not hesitate to contact me at (401) 274-5685, Ext. 17, or plockwood@ensr.aecom.com. Thank you.

Sincere regards,

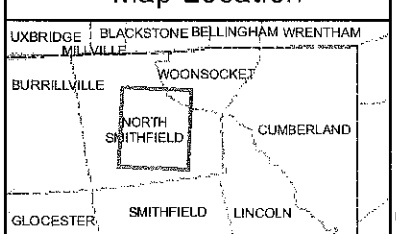
Peter Lockwood

Peter Lockwood
Senior Project Specialist

Attachments: Figure 1 – Project Area Location & RI Rare Species Habitats

Copy To: J. Durand, ENSR
D. McIntyre, National Grid
D. Beron, National Grid

Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

Substations
West Farnum Substation 500ft Study Area
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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Figure 1
Date: August 2007

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July 30, 2007

Mr. Richard Enser
Rhode Island Department of Environmental Management
Rhode Island Natural Heritage Program
Division of Planning and Development
235 Promenade Street
Providence, Rhode Island 02908-5767

Subject: **National Grid USA**
345-kV Transmission Line Reconductoring
Sherman Road Substation to the RI/CT State Boundary

Dear Mr. Enser:

National Grid USA ("National Grid") is proposing to install new conductors along the existing 345-kV transmission line (# 347) for a distance of approximately 8.7 miles from the Sherman Road Substation in Burrillville, RI to the RI/CT state boundary in Burrillville, RI. The transmission line reconductoring will take place entirely within the existing transmission line easement.

The attached maps show the location of the transmission line corridor on USGS 7.5 minute series topographic mapping (Figures 1 - 3).

ENSR has reviewed the current Rhode Island Geographic Information System ("RIGIS") Rare Species mapping for the project area traversed by the transmission line corridor. The available RIGIS mapping indicates the presence of a mapped Natural Heritage Areas at the Clear River (Figure 2), Cedar Swamp Pond (Figure 3), and Pulaski Memorial State Forest (Figure 3).

This letter is a request for additional information about the subject Element Occurrences and Natural Heritage Areas such that we can perform reconnaissance for the taxa or communities as appropriate. Additionally, please be so kind as to provide us with any relevant information regarding other taxa of conservation concern in the area, State or Federal-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas.

This correspondence is intended to comply with and address the 1977 Federal Endangered Species Act requirement for documented consultation with regulatory agencies. If you have any questions or require additional information, please do not hesitate to contact me at (401) 274-5685, Ext. 17, or plockwood@ensr.aecom.com. Thank you.

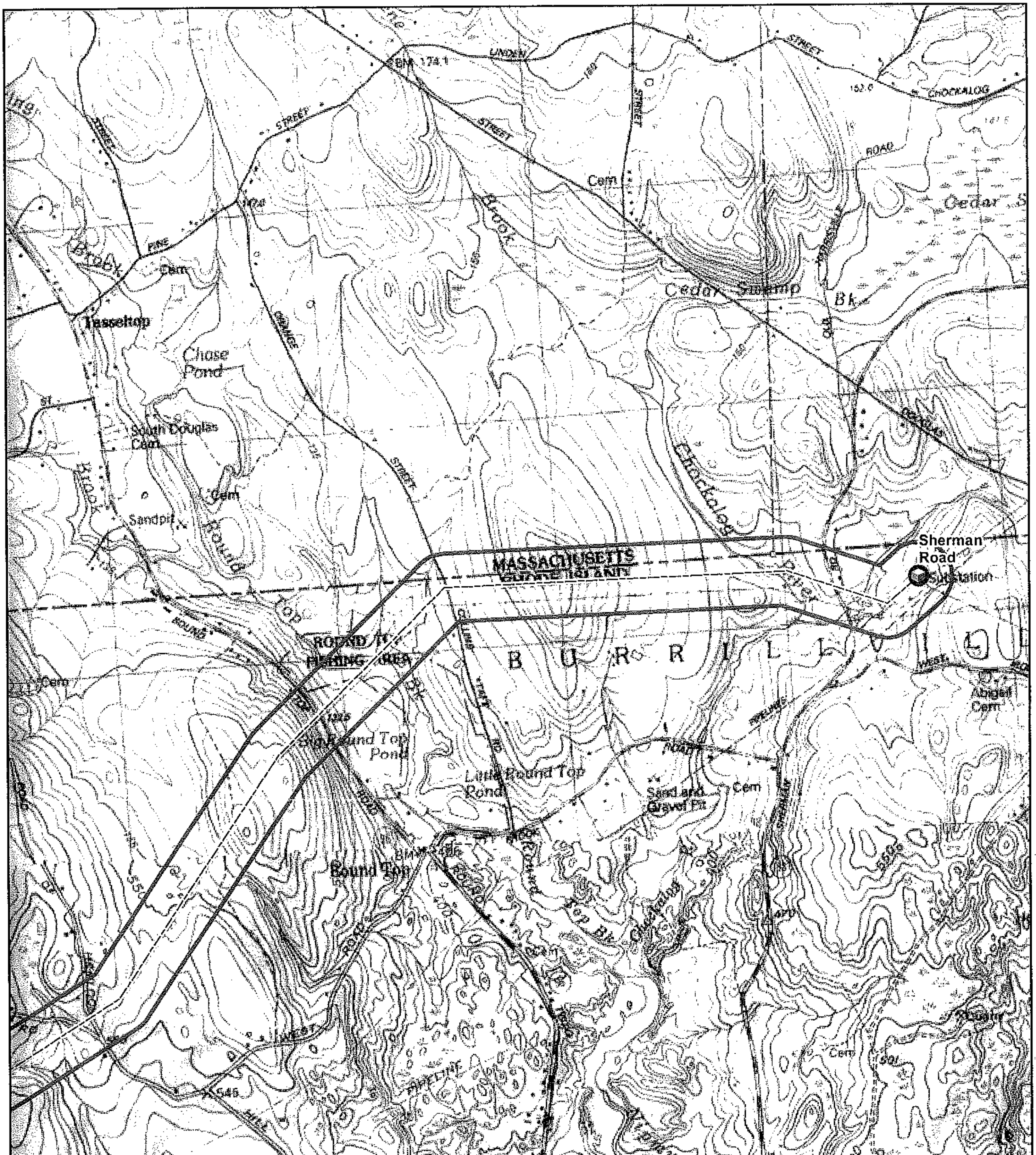
Sincere regards,

Peter Lockwood

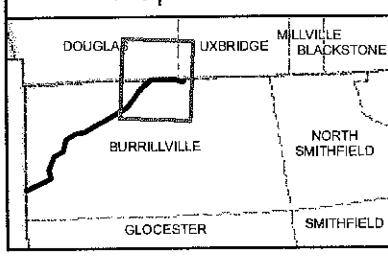
Peter Lockwood
Senior Project Specialist

Attachments Figure 1 through 3 – Project Location & RI Rare Species Habitats

Copy To: J. Durand, ENSR
D. McIntyre, National Grid
D. Beron, National Grid



Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

Substations

Transmission ROW Centerline

500ft Transmission Line Study Area

RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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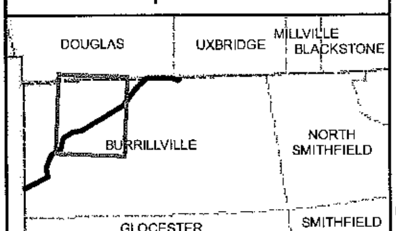
Figure 1
Date: August 2007

Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

N S W E

Substations
Transmission ROW Centerline
500ft Transmission Line Study Area
RI Rare Species Habitats

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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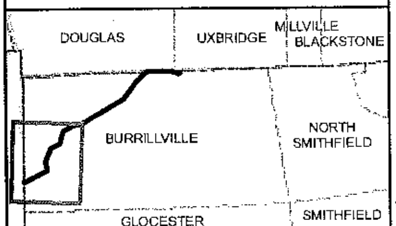
Figure 2
Date: August 2007

Map Location



NEEWS Project
Project Location and RI Rare Species Habitats

N S E W

Substations

500ft Transmission Line Study Area

RI Rare Species Habitats

Transmission ROW Centerline

Source: RIGIS, 2007; USGS 7.5 minute quadrangle Topographic Maps

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Figure 3
Date: August 2007

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AECOM
10 Orms Street, Suite 405
Providence, Rhode Island 02904

401.274.5685 tel
401.521.2730 fax

March 6, 2012

Mr. Paul Jordan
Rhode Island Department of Environmental Management
Division of Planning and Development
235 Promenade Street
Providence, RI 02908-5767

Subject: The Narragansett Electric Company dba National Grid
Interstate Reliability Project
RI/MA State Line to RI/CT State Line via the West Farnum Substation and Sherman Farm Road Switching Station

Dear Mr. Jordan,

The Narragansett Electric Company (TNEC) dba National Grid is proposing to construct a new 345 kV transmission line within existing rights-of-way (ROW) beginning at the RI/MA state boundary in North Smithfield, RI and extending approximately 23 miles via the West Farnum Substation (North Smithfield) and Sherman Farm Road Switching Station (Burrillville), ending at the RI/CT state boundary in Burrillville, RI. The attached maps and shapefile show the location of the transmission line corridor in United States Geological Survey (USGS) 7.5 minute series topographic mapping (Figures 1-7).

We are sending this information with the understanding that all information regarding the Project (i.e., electronic ROW shapefile data) will remain confidential and will not be distributed.

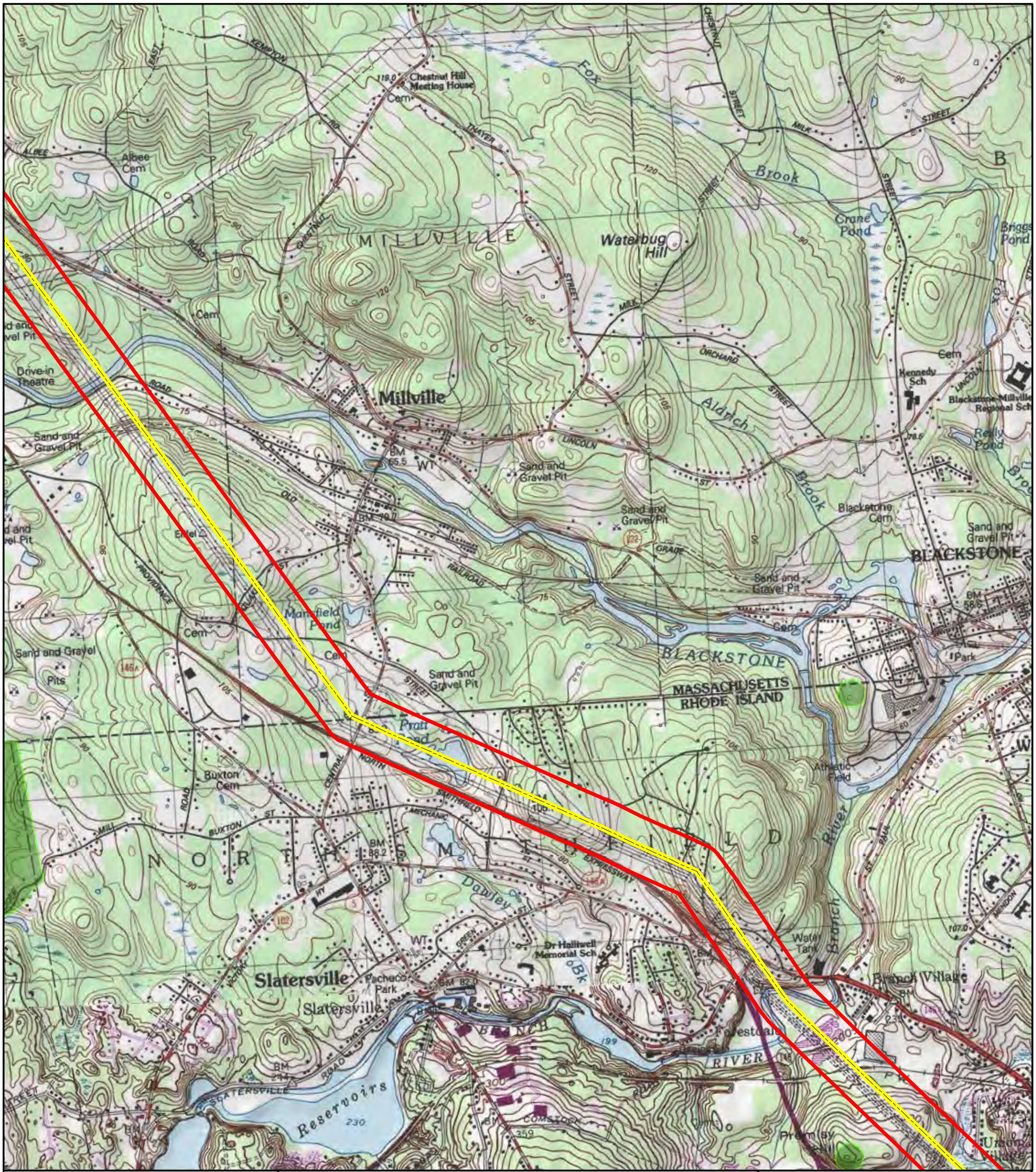
This Project was reviewed by Rhode Island Natural History Survey (RINHS) in June 2007 and again in March 2011 (correspondence attached). In continuing consultation with RINHS, Executive Director David Gregg informed AECOM that RINHS, RIDEM, University of Rhode Island, and The Nature Conservancy have joined a four-group collaborative and have combined their data concerning taxa of conservation concern in the area, State or Federally-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas. Dr. Gregg also indicated that you were the correct person to contact concerning this new data. We are requesting an updated review of the Project area to ensure we have the most current data available regarding subject Element Occurrences and Natural Heritage Areas so that we can perform reconnaissance surveys for the taxa or communities as appropriate. AECOM has reviewed the current United States Fish and Wildlife Endangered Species (USFWS) Consultation (http://www.fws.gov/newengland/EndangeredSpec-Consultation.htm). Based on a review of the USFWS there are no Federally-listed species documented in the Towns of North Smithfield and Burrillville. We request correspondence from your office regarding taxa of conservation concern in the area, State or Federally-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas.

This request specifically addresses the requirement for documented consultation with regard to compliance with the Endangered Species Act ("ESA") of 1973 and Rhode Island Endangered Species Statutes (R.I. Gen. Law §§ 20-37-1-5 (1977)). If you have any questions or require additional information, please do not hesitate to contact me at (401) 274-5685 X14, or James.durand@aecom.com. Thank you.

Yours sincerely,

James (Jamie) Durand
Program Manager

Attachments



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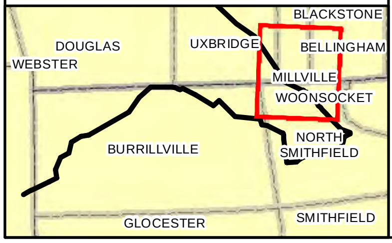

Interstate Reliability Project
Project Location and RI Rare Species Habitats

- Proposed 345-kV
- 500ft Transmission Line Study Area
- Substation
- RI Rare Species Habitats
- Switching Station

Source: RIGIS Rare Species 1990;
USGS 7.5 minute quadrangle Topographic Maps

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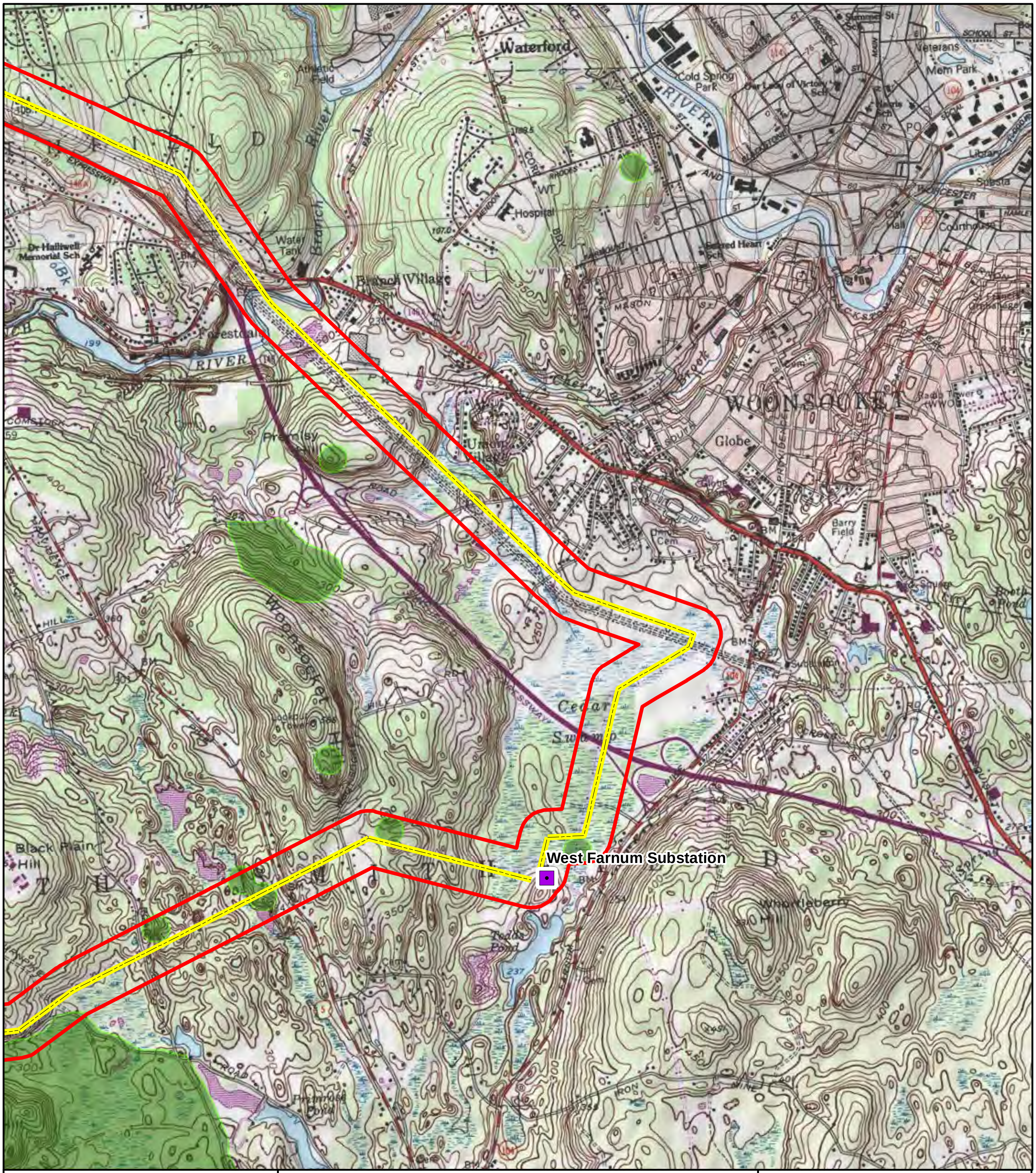
Figure 1
Date: February 2012



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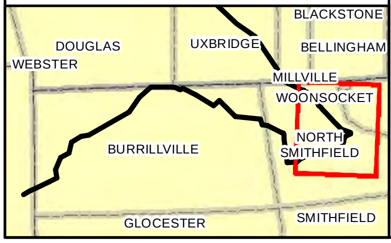

Interstate Reliability Project
Project Location and RI Rare Species Habitats

N W E S

- Proposed 345-kV
- 500ft Transmission Line Study Area
- Substation
- RI Rare Species Habitats
- Switching Station

Source: RIGIS Rare Species 1990;
USGS 7.5 minute quadrangle Topographic Maps

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Figure 2

Date: February 2012

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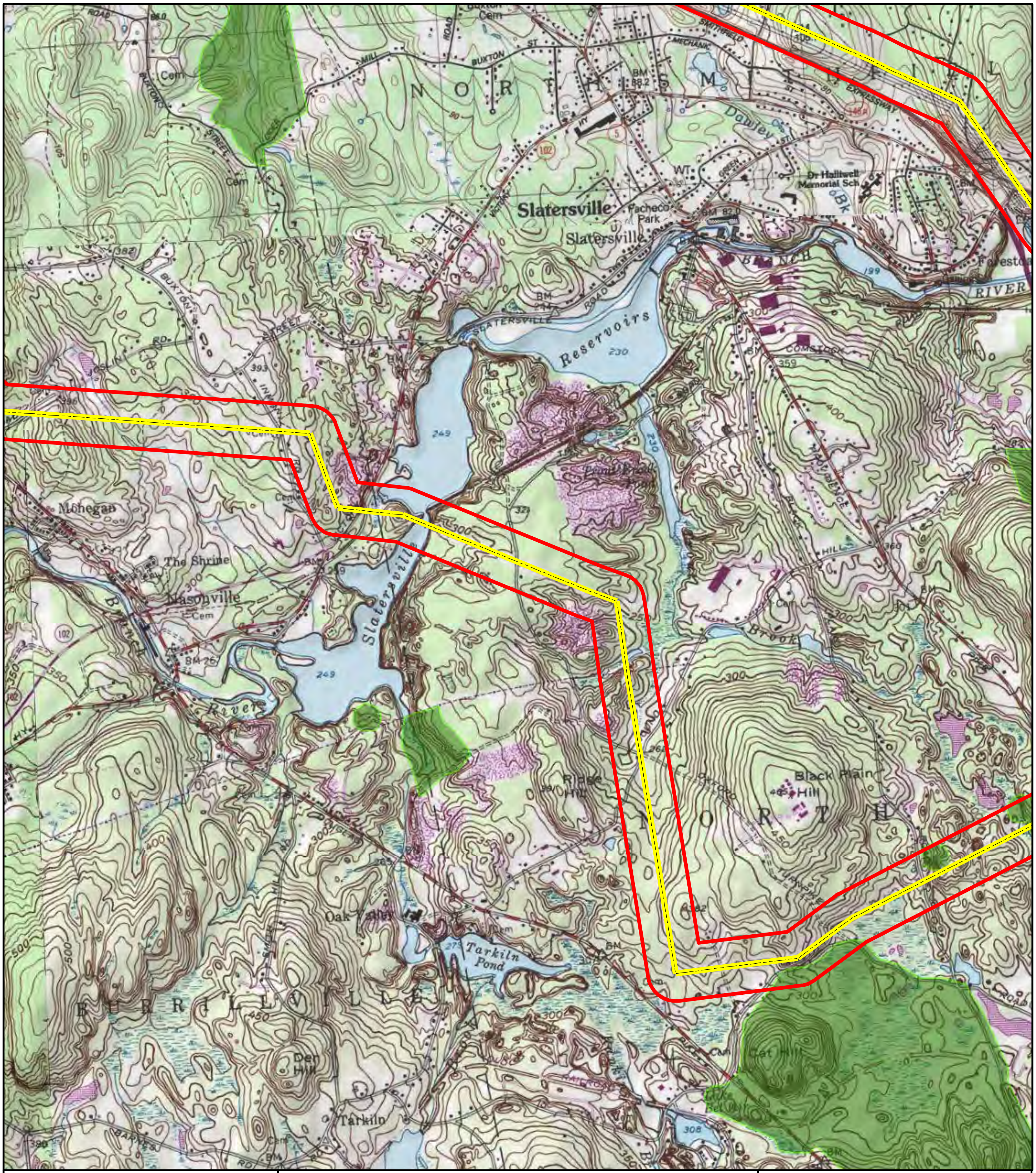
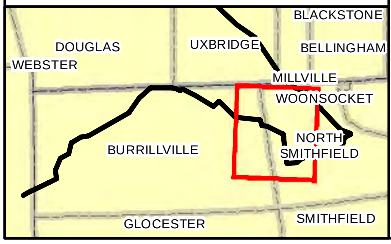


Map Location



Interstate Reliability Project
Project Location and RI Rare Species Habitats

- Proposed 345-kV
- 500ft Transmission Line Study Area
- Substation
- RI Rare Species Habitats
- Switching Station

Source: RIGIS Rare Species 1990;
USGS 7.5 minute quadrangle Topographic Maps

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Figure 3
Date: February 2012

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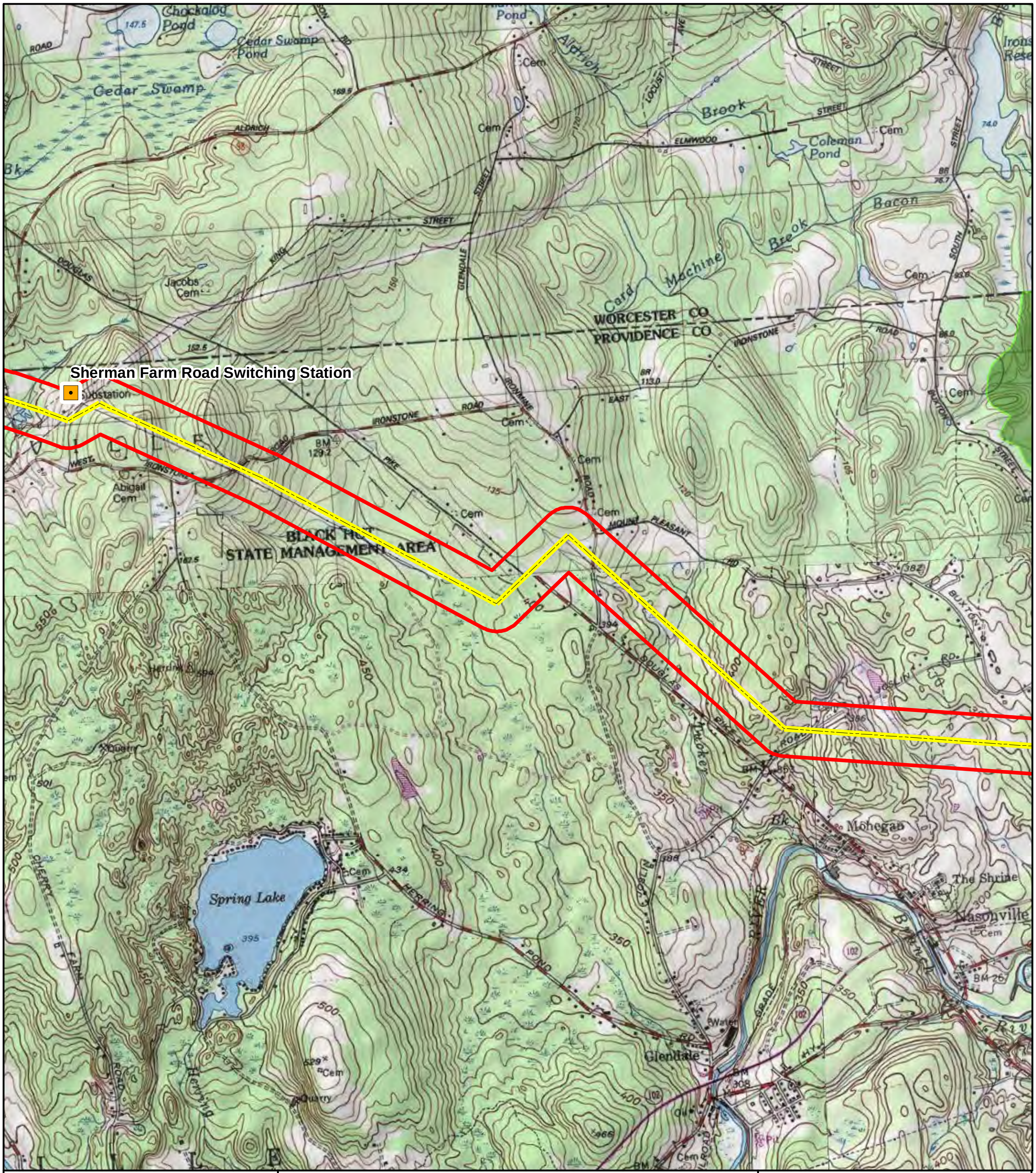

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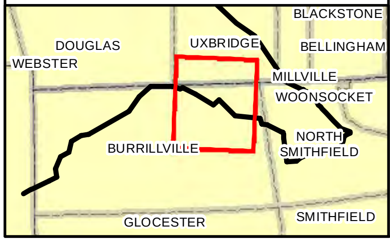

Interstate Reliability Project
Project Location and RI Rare Species Habitats

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- Proposed 345-kV
- 500ft Transmission Line Study Area
- Substation
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- Switching Station

Source: RIGIS Rare Species 1990;
USGS 7.5 minute quadrangle Topographic Maps

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Figure 4

Date: February 2012

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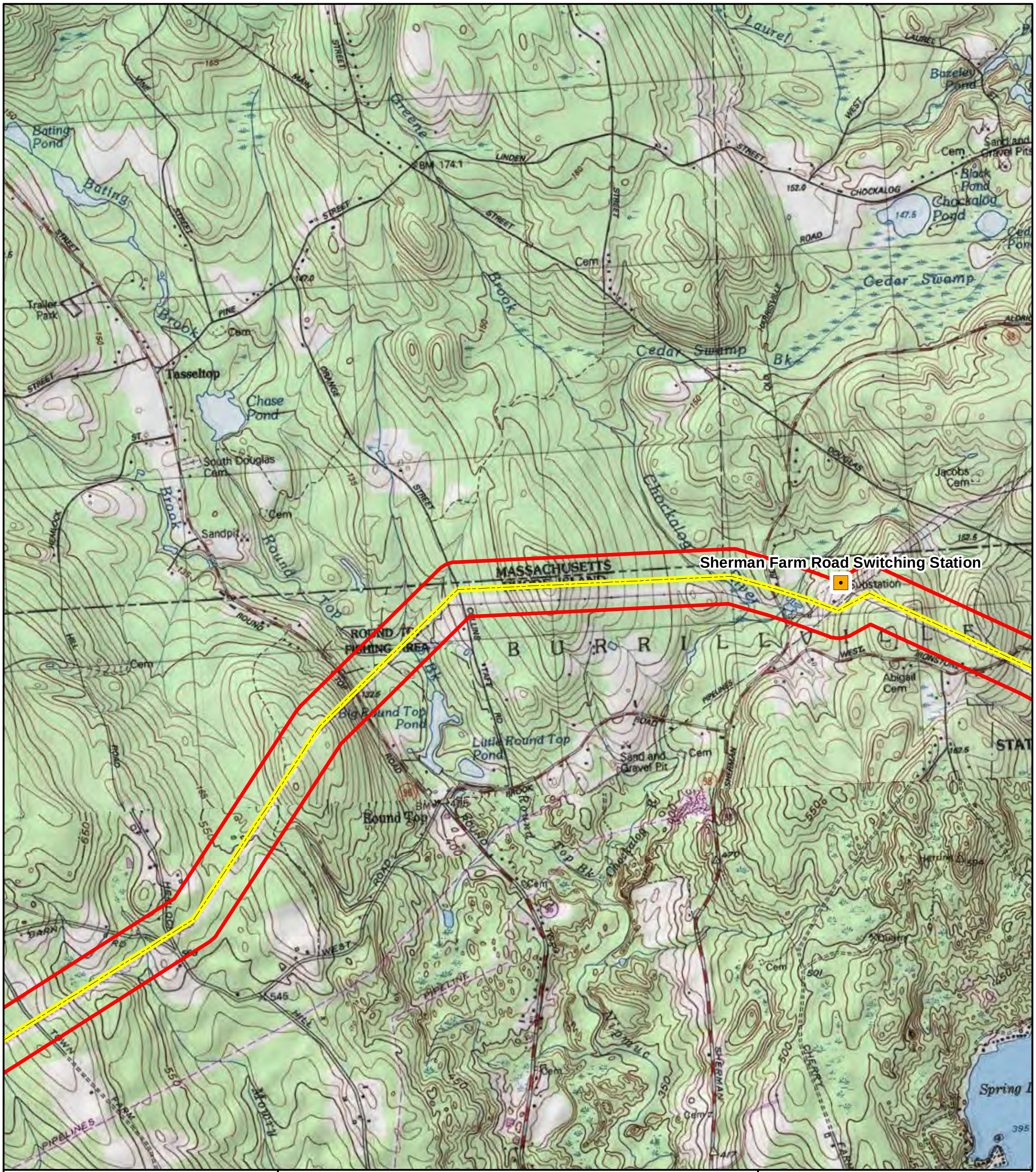
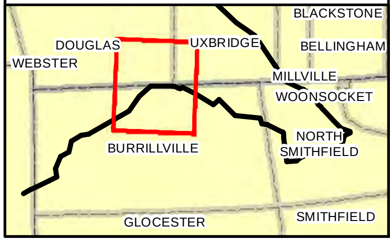


Map Location



Interstate Reliability Project
Project Location and RI Rare Species Habitats

- Proposed 345-kV
- 500ft Transmission Line Study Area
- Substation
- RI Rare Species Habitats
- Switching Station

N E S W

Source: RIGIS Rare Species 1990;
USGS 7.5 minute quadrangle Topographic Maps

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Figure 5
Date: February 2012

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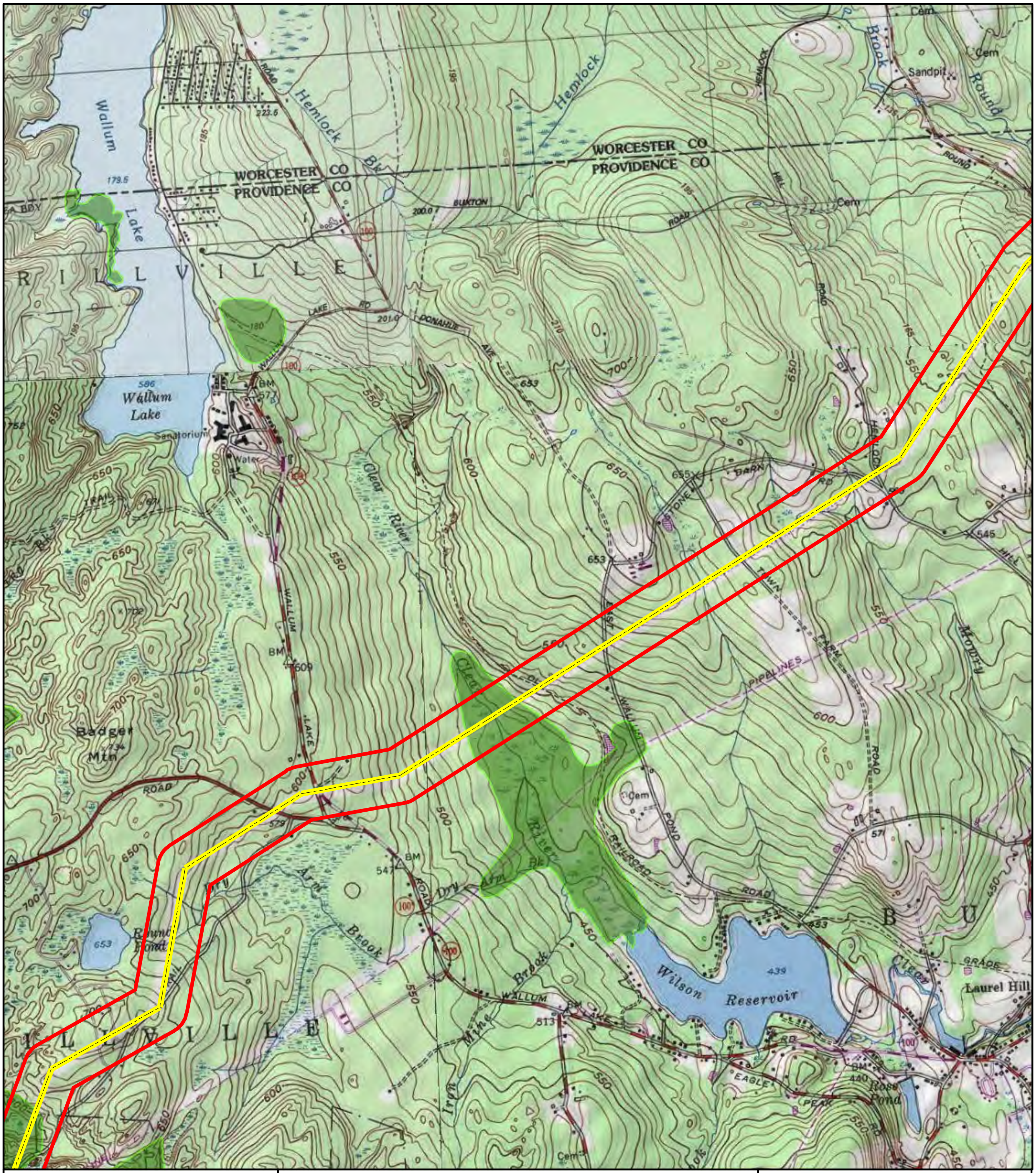
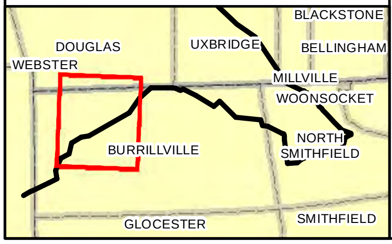


Map Location



Interstate Reliability Project
Project Location and RI Rare Species Habitats

- Proposed 345-kV
- 500ft Transmission Line Study Area
- Substation
- RI Rare Species Habitats
- Switching Station

N W E S

Source: RIGIS Rare Species 1990;
USGS 7.5 minute quadrangle Topographic Maps

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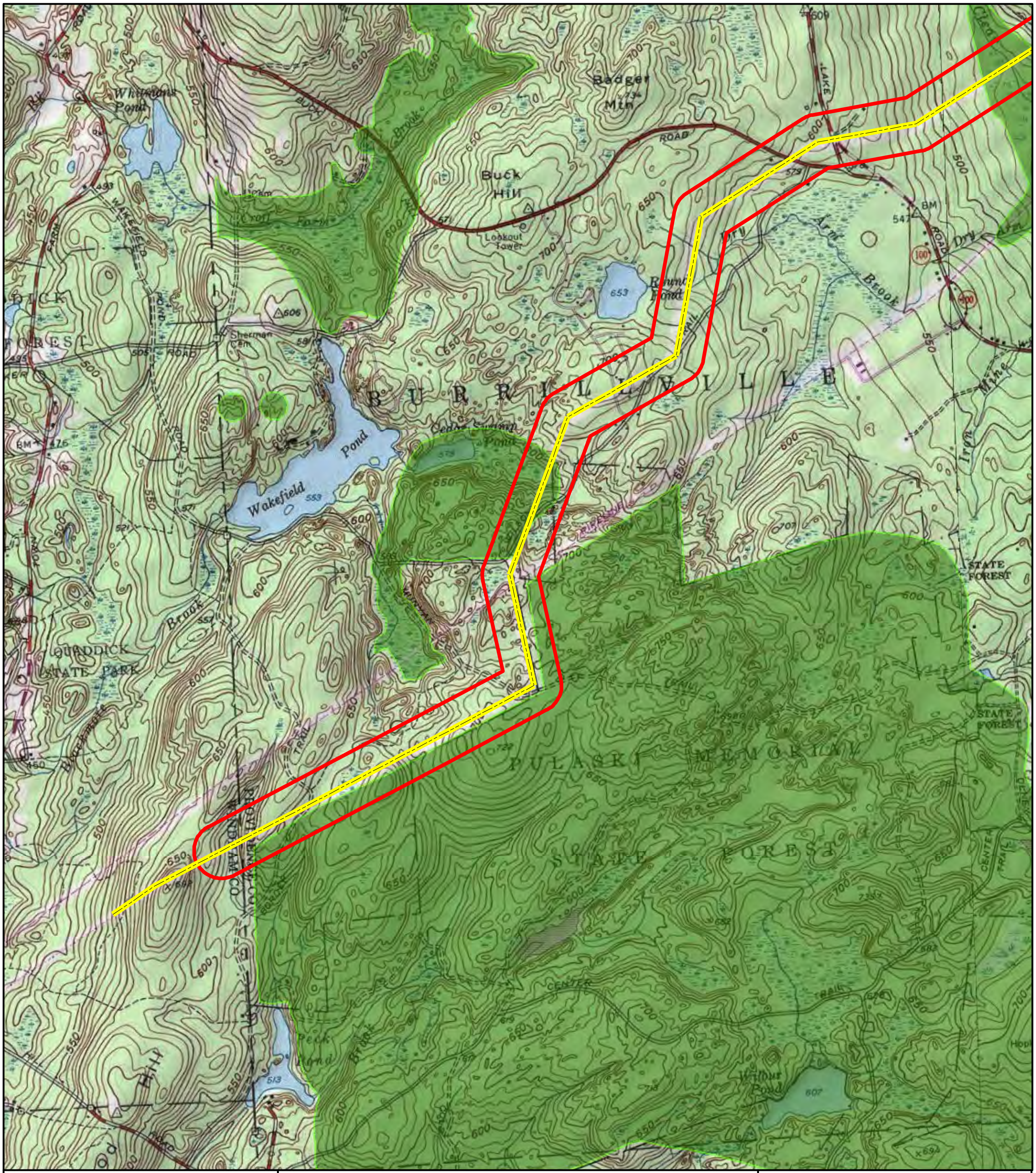
AECOM

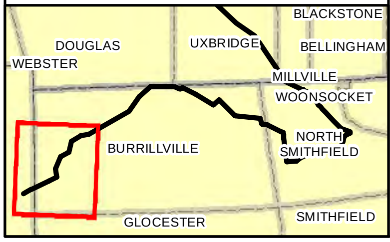
Figure 6

Date: February 2012

Path: Y:\Projects\NatGrid\IRP_NEW\MXD\Rare_Species\2012_02_24\Rare_Species_Alison_Milliman_mapping_8p5x11.mxd



Map Location



Interstate Reliability Project

Project Location and RI Rare Species Habitats

Proposed 345-kV

500ft Transmission Line Study Area

Substation

RI Rare Species Habitats

Switching Station

Source: RIGIS Rare Species 1990;
USGS 7.5 minute quadrangle Topographic Maps

0 1,000 2,000 3,000 4,000 Feet

1:29,900

nationalgrid

AECOM

Figure 7

Date: February 2012

Path: Y:\Projects\NatGrid\IRP_NEW\MXD\Rare_Species\2012_02_24\Rare_Species_Alison_Milliman_mapping_8p5x11.mxd

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From: Paul Jordan [Paul.jordan@DEM.RI.GOV]
Sent: Monday, March 12, 2012 11:31 AM
To: Milliman, Alison
Subject: RE: AECOM SendFiles Notification: Alison Milliman has sent you files
Attachments: AECOM_HeritageReview.zip

Hello Alison,

Attached are a map of your project area with 11 Heritage species sites identified with the ROW and a shapefile from the Heritage database documenting locations and attribute information for same. At this time, I don't yet have proper documentation for the field names so please call if you have any questions. And please note that these data are provided only for the current project and may not be shared with third parties not specifically involved in it.

Paul

Paul Jordan
Supervising GIS Specialist
RI Dept of Environmental Management
235 Promenade Street
Providence, RI 02908
(401) 222-2776 x4315

From: alison.milliman@aecom.com [mailto:alison.milliman@aecom.com]
Sent: Tuesday, March 06, 2012 12:27 PM
To: Paul Jordan
Subject: AECOM SendFiles Notification: Alison Milliman has sent you files

Alison Milliman has sent you 6 files using AECOM's File Transfer System.

Alison Milliman says:

Dear Mr. Jordan,
The Narragansett Electric Company (TNEC) dba National Grid is proposing to construct a new 345 kV transmission line within existing rights-of-way (ROW) beginning at the RI/MA state boundary in North Smithfield, RI and extending approximately 23 miles via the West Farnum Substation (North Smithfield) and Sherman Farm Road Switching Station (Burrillville), ending at the RI/CT state boundary in Burrillville, RI. The attached maps and shapefile show the location of the transmission line corridor in United States Geological Survey (USGS) 7.5 minute series topographic mapping (Figures 1-7).

We are sending this information with the understanding that all information regarding the Project (i.e., electronic ROW shapefile data) will remain confidential and will not be distributed.

This Project was reviewed by Rhode Island Natural History Survey (RINHS) in June 2007 and again in March 2011 (correspondence attached). In continuing consultation with RINHS, Executive Director David Gregg informed AECOM that RINHS, RIDEM, University of Rhode Island, and The Nature Conservancy have joined a four-group collaborative and have combined their data concerning taxa of conservation concern in the area, State or Federally-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas. Dr. Gregg also indicated that you were the correct person to contact concerning this new data. We are requesting an updated review of the Project area to ensure we have the most current data available regarding subject Element Occurrences and Natural Heritage Areas so that we can perform reconnaissance surveys for the taxa or communities as appropriate. AECOM has reviewed the current United States Fish and Wildlife Endangered Species (USFWS) Consultation (http://www.fws.gov/newengland/EndangeredSpec-Consultation.htm). Based on a review of the USFWS there are no Federally-listed species documented in the Towns of North Smithfield and Burrillville.

We request correspondence from your office regarding taxa of conservation concern in the area, State or Federally-listed Threatened or Endangered species, RI Species of Special Concern, and exemplary or critical natural habitat areas.
This request specifically addresses the requirement for documented consultation with regard to compliance with the Endangered Species Act ("ESA") of 1973 and Rhode Island Endangered Species Statutes (R.I. Gen. Law §§ 20-37-1-5 (1977)). If you have any questions or require additional information, please do not hesitate to contact me at (401) 274-5685

X14, or James.durand@aecom.com. Thank you.

These files will be available for download until 3/13/2012

File	Description	Size
IRP_RINHS_2011.pdf		35KB
RI IRP NHS.pdf		960KB
Powerline_AECOM_20110325.pdf		804KB
Data.zip		41KB
Rare_Species_cover letter_030612.pdf		13KB
Rare_Species_IRP_2012.pdf		4,429KB

If you are having trouble accessing the links in this email, you can view this message as a web page by copying the following link and pasting it into your browser:

http://sendfiles.aecom.com/message.aspx?msgId=71d3a957-f1c9-4c20-ba62-619cdc8b1cfd&u=paul.jordan%40dem.ri.gov

If you have any questions, please contact your project manager.

Cultural Resources

Gray & Pape, Inc.

Agency Correspondence

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Invenergy nationalgrid

January 23, 2017

Via Federal Express

Blackstone Valley Heritage Corridor, Inc.
670 Linwood Ave.
Whitinsville, Massachusetts 01588
Attn: Megan T. DiPrete, Deputy Director

Re: The Clear River Energy Center Project and The Burrillville Interconnection Project

Dear Ms. DiPrete:

On behalf of Invenergy Thermal Development LLC (Invenergy) and The Narragansett Electric Company d/b/a National Grid (TNEC), we extend this invitation to the Blackstone Valley Heritage Corridor, Inc. to meet directly to discuss the Invenergy proposal to construct the Clear River Energy Center (CREC Project) and the TNEC and Invenergy proposal to construct the Burrillville Interconnection Project (the new 3052 line). These respective projects consist of development of the CREC generating plant site and an approximately 6.8 mile 345 kV electric transmission line in the Town of Burrillville, RI, to interconnect the proposed generation plant to the existing electric transmission system.

The CREC Project is a proposed combined-cycle electric generating facility, with an initial power output at base load of approximately 1,000 megawatts, to be located at the Spectra Energy Algonquin Compressor Station site on Wallum Lake Road (State Route 100) in Burrillville, RI. The Burrillville Interconnection Project is a proposed transmission line that would begin at the CREC Project site and interconnect at a point of interconnection approximately 0.8 miles to the northeast of the CREC Project at TNEC's existing right of way (ROW). The transmission line will continue traveling east approximately 6 miles within existing TNEC ROW to TNEC's existing Sherman Road Switching Station in Burrillville, RI.

Invenergy and TNEC would be happy to discuss the project in more detail. Please let us know and we will arrange for a convenient time and place.

Sincerely,

John Niland	Erin Whoriskey
Director Business Development	Lead Environmental Scientist
Invenergy	National Grid

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STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
HISTORICAL PRESERVATION & HERITAGE COMMISSION
Old State House • 150 Benefit Street • Providence, R.I. 02903-1209
TEL (401) 222-2678 FAX (401) 222-2968
TTY (401) 222-3700 Website www.preservation.ri.gov

20 December, 2016

Christopher Donta
Gray & Pape
60 Valley Street, Suite 103
Providence RI 02909

Re: Permit 16-22, CREC/Grid Proposed 3052 Line, Burrillville, RI

Dear Mr. Donta,

The RIHPHC has reviewed the archaeology permit application you submitted for Phase I archaeological testing in portions of the Clear River Energy Center (Invenergy)/National Grid 3052 transmission line in accordance with US Army Corps of Engineers permitting requirements. Previous archaeological survey work conducted for the 341 and 347 lines which run parallel to the proposed 3052 line located Native American and Historical archaeological sites within the existing ROW, and as a result the RIHPHC considers the proposed c. four mile transmission corridor for the 3052 line to be sensitive for Native American and Historical archaeological sites. The 3052 line will be constructed on 56 steel structures, 48 of which will be located on the south side of the existing ROW.

The Phase 1 testing strategy you have proposed is flawed because the scope of work calls for the examination of only 22 structure locations, instead of evaluating the potential impacts of the project as a whole. Based on an assessment of these 22 structure locations, Gray and Pape has recommended conducting testing at 18 proposed structure locations. The fragmented survey you propose will not provide sufficient information to identify historic properties and evaluate adverse effects that may be associated with construction of the remaining 34 structures. This type of segmentation does not meet the federal requirements for review under Section 106 of the National Historic Preservation Act.

RIHPHC would require a sensitivity and disturbance assessment of the entire length of the power line. We agree with the proposed Phase 1 archaeological testing you have proposed for the Army Corps permitted areas. Additional Phase 1 testing also may be required based on further archaeological sensitivity assessment and predictive modeling for other portions of the transmission corridor.

These comments are provided in accordance with Section 106 of the National Historic Preservation Act. If you have any questions, please contact Charlotte Taylor or Timothy Ives, archaeologists at this office.

Very truly yours,

Edward F. Sanderson
Executive Director
State Historic Preservation Officer

Cc: John Brown, NTHPO
Mike Feinblatt, ESS Group Inc.
Kate Atwood, USACOE

161220.02

I, **Christopher Donta** [archaeologist], certify that the information contained in this application is correct, and that I will comply with applicable federal and state legislation, regulations and standards, and any special conditions appended to this application (see below). I understand that any change to the specifications of this permit, the research design, or project scope of work, without the approval of the RIHPHC, may result in the revocation of this permit and the cessation of archaeological investigations. I also understand that should I fail to satisfy the conditions of this permit (items 7,8,9,10,11,) the RIHPHC may decide not to issue me, or my employer, permits for future projects until the deficiencies under this permit are resolved.

I, John Niland [landowner or project proponent], agree to comply with applicable federal and state legislation and special conditions attached to this permit. I also agree to maintain adequate security at the project area, and, if determined necessary by the RIHPHC, will take steps, as required by the RIHPHC, to prevent trespassers or other unauthorized individuals from causing harm to the archaeological site or sites under investigation.

#1513 8/5/15 - 6/30/16

Permit effective date

Signature of Applicant

Approved
Rhode Island Historical Preservation
and Heritage Commission

Property owner or project proponent

Reviewed by: Charles Tyn, RIHP&HC staff archaeologist

See below for any attached Special Conditions that may apply to this permit:

1. Native American special condition yes ___ no ___

2. Other special condition yes ___ no ___

The RIHP&HC reserves the right to amend the terms and conditions of this permit based on new information received in the course of the project.

Form revised 12/10

APPENDIX C

Visual Impact Assessment: Clear River Energy Center Transmission Line Project (February 2017)

Visual Impact Assessment

Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Prepared For:

ESS group

100 Fifth Avenue, 5th Floor
Waltham, MA 02451

Prepared by:

edr

Environmental Design & Research,
Landscape Architecture, Engineering,
& Environmental Services, D.P.C.
217 Montgomery Street, Suite 1000
Syracuse, New York 13202
P: 315.471.0688
F: 315.471.1061
www.edrdpc.com

This document has been reviewed for Critical Energy Infrastructure Information (CEII). [February 2017]

February 2017

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FIGURES, TABLES, & APPENDICES

FIGURES

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1.0 INTRODUCTION

Environmental Design and Research, Landscape Architecture, Engineering, & Environmental Services, D.P.C. (EDR) was retained by ESS Group, Inc. to prepare a Visual Impact Assessment (VIA) for the proposed Burrillville Interconnection Project (Project) located in the Town of Burrillville, Providence County, Rhode Island. The purpose of this VIA is to:

- Describe and illustrate the appearance of the visible components of the proposed Project;
- Define and describe the visual character of the Project study area;
- Inventory and evaluate existing visual resources and viewer groups within the study area;
- Evaluate potential Project visibility within the study area;
- Identify key views for visual assessment; and
- Assess the visual impacts associated with the proposed Project.

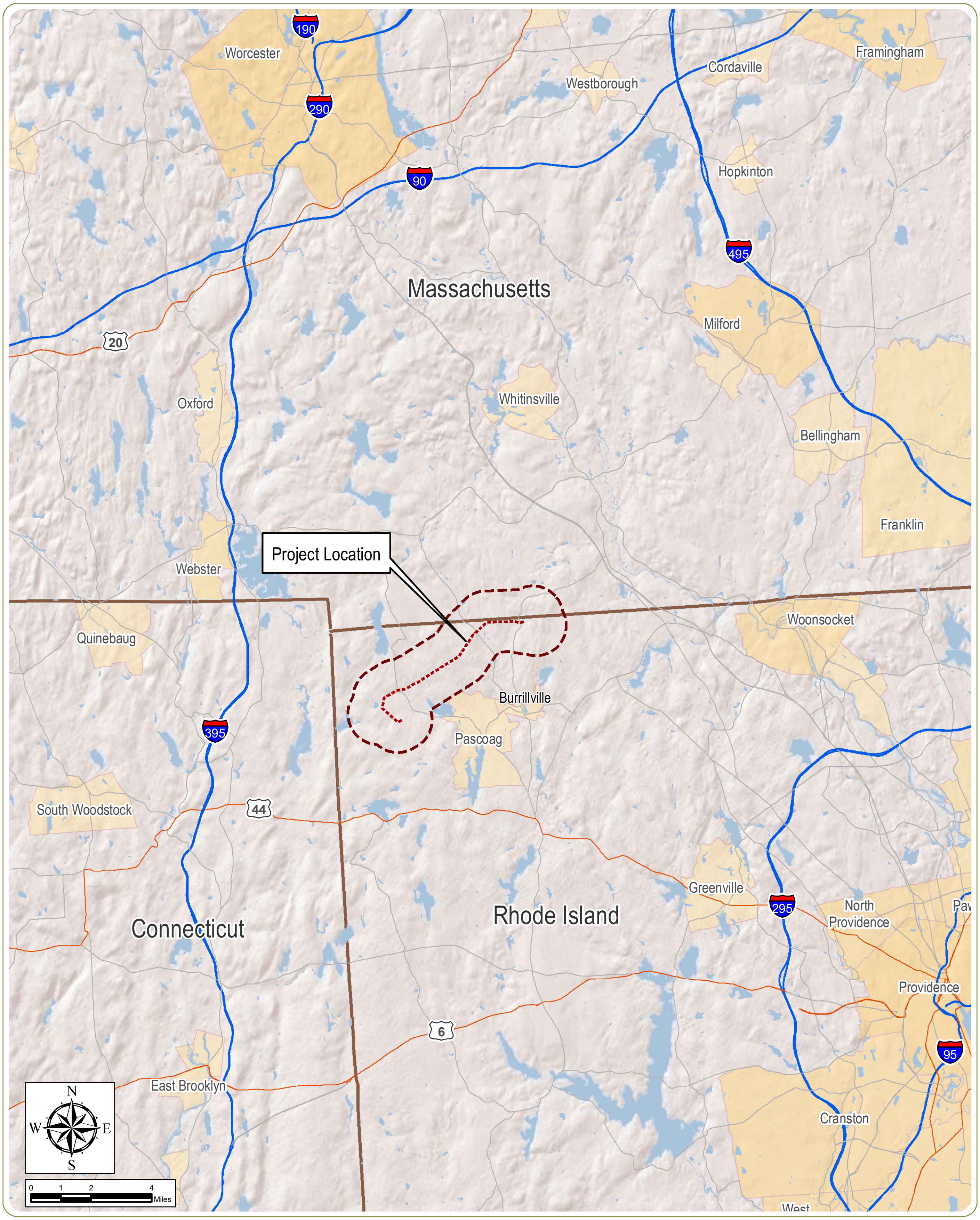
This VIA was prepared under the direct guidance of a registered landscape architect experienced in the preparation of visual impact assessments. It is also consistent with the policies, procedures, and guidelines contained in established visual impact assessment methodologies (see Literature Cited/References section).

2.0 PROJECT DESCRIPTION

2.1 Project Site

In support of Invenergy's Clear River Energy Center (CREC) project, Narragansett Electric Company (d/b/a National Grid) (TNEC) is proposing to install a 345-kilovolt (kV) transmission line from the proposed CREC to TNEC's existing Sherman Road Switching Station in the Town of Burrillville, Rhode Island (Figure 1). The proposed transmission line would begin at the CREC site which is proposed to be located off Wallum Lake Road in Burrillville. From the CREC site, the line extends approximately 0.8 miles in new right-of-way (ROW) in a northwesterly direction, to the existing TNEC ROW. The line then extends approximately 6.0 miles within an existing TNEC right-of-way (ROW) in a generally northeasterly direction to TNEC's existing Sherman Road Switching Station (Figure 2).

The existing TNEC ROW contains two single circuit 345 kV transmission lines supported on wood and self-weathering steel H-Frame structures ranging in height from 65 to 130 feet. The existing cleared ROW averages approximately 250 feet wide and is dominated by shrubs and successional old field vegetation. Areas adjacent to the existing ROW are dominated by mixed deciduous forest and widely scattered rural residences. The 0.8 mile of newly proposed ROW is currently characterized by dense forest vegetation, and runs adjacent to an existing compressor station along the Algonquin gas transmission line. Topography along the route is gently rolling, and higher density commercial or residential development is lacking. The Project route crosses the Clear River and several town roads and state highways.



Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 1: Regional Project Location

January 2017

Transmission Centerline

1 Mile Visual Study Area

Notes: 1. Basemap: ESRI ArcGIS Online "Shaded Relief" Map Service and ESRI StreetMap North America, 2008
2. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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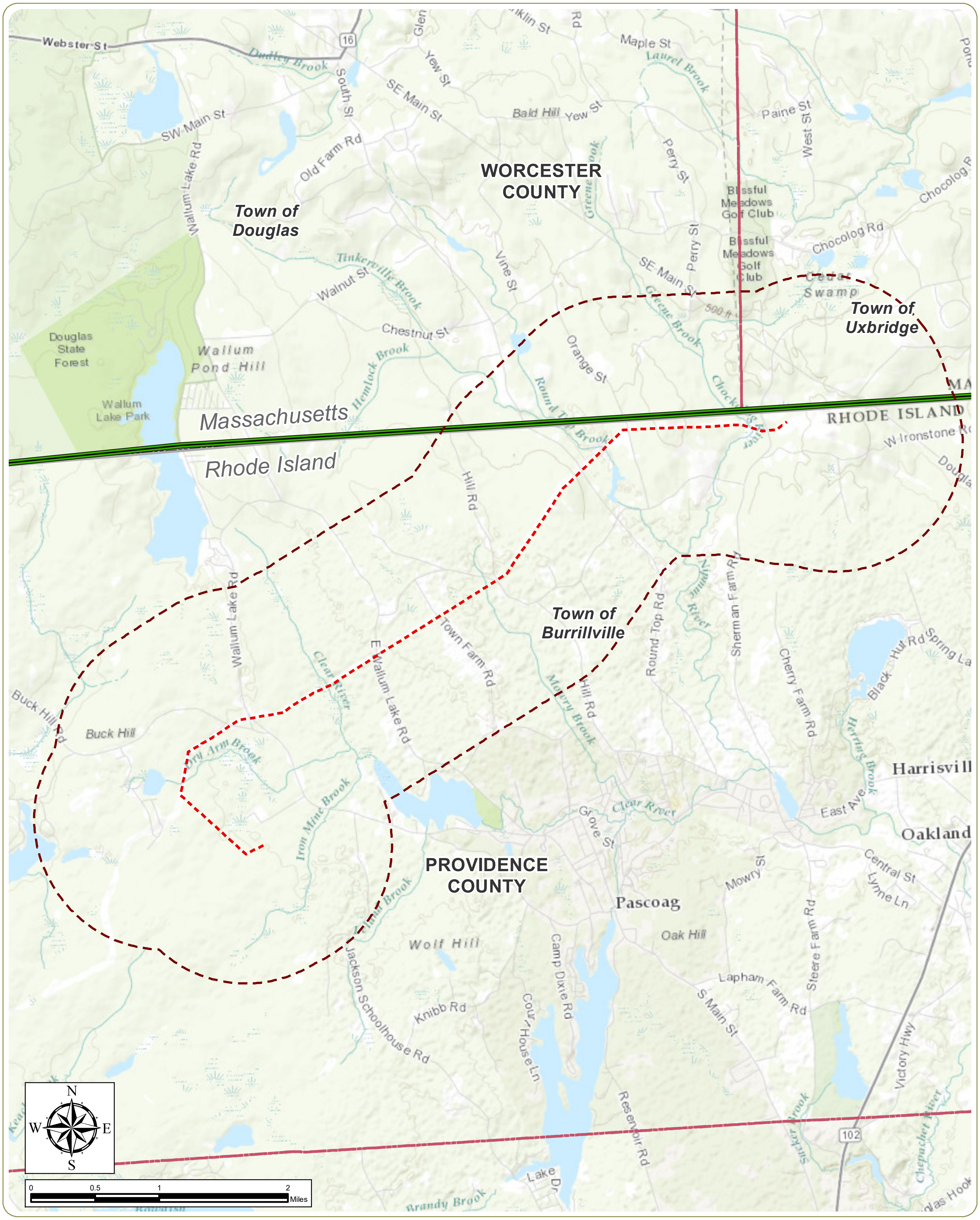

Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 2: Proposed Project Site

January 2017

Transmission Centerline

1 Mile Visual Study Area

State Boundary

County Boundary

Town Boundary

Notes: 1. Basemap: ESRI ArcGIS Online "World Topography" Map Service.
2. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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2.2 Proposed Project

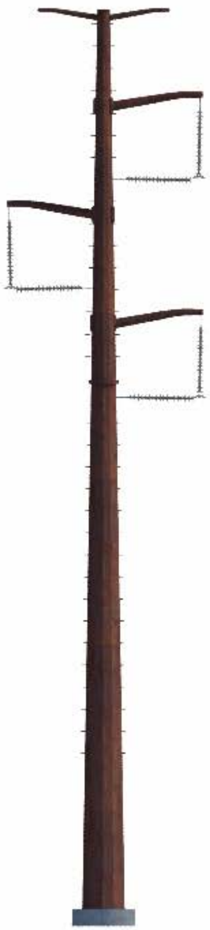
The proposed Project consists of the construction, operation and maintenance of a new 345 kV transmission line (3052 Line), approximately 6.8 miles in length, in the Town of Burrillville, Rhode Island, that will serve to interconnect the proposed CREC to the existing electric transmission grid. The proposed transmission line would begin at the CREC and extend in new ROW approximately 0.8 miles to the existing TNEC ROW. The line will then run approximately 6.0 miles within the existing TNEC ROW to TNEC's existing Sherman Road Switching Station in Burrillville. Construction of the Project will involve tree clearing and vegetation removal including the following:

- Segment 1 - Approximately 150 feet of tree/vegetation clearing along the new ROW for approximately 0.8 mile, from the existing TNEC ROW to the CREC.
- Segment 2 - Approximately 55 feet of tree/vegetation clearing along the north side of the existing ROW for approximately 1.6 miles, from just west of the Clear River to the junction with the 0.8 mile of new ROW; and
- Segment 3 - Approximately 85 feet of tree/vegetation clearing along the southern side of the existing ROW for approximately 4.4 miles, from the Sherman Road Switching Station to just west of the Clear River;

Following clearing of the ROW, new structures will be installed to support the new 345 kV transmission line. These structures will be a mix of self-weathering steel H-frame structures 68 to 113 feet in height, and single circuit steel structures ranging from 68 to 125 feet in height. The new 0.8-mile ROW from the Clear River Energy Center to the TNEC ROW will contain the proposed steel H-Frame structures with a typical height of 86 feet to support the proposed 3052 Line.

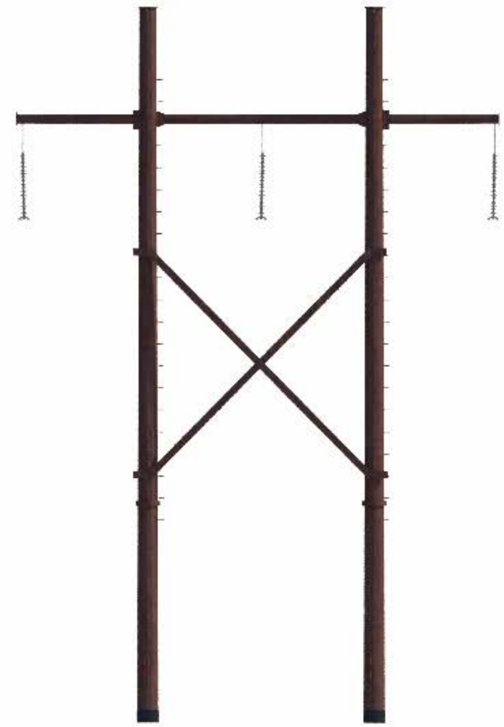
There are currently two existing transmission lines on a mix of steel and wood structures in the TNEC ROW. These include the 347 Line to the north side of the TNEC ROW and the 341 Line to the south side. Once in the TNEC ROW, the existing wood H-frame structures (that previously carried the 347 Line) will be replaced with steel H-frame structures to accommodate the proposed 3052 Line. The 347 Line will then take the place of the 341 Line and several structures will be replaced to accommodate clearances and maintain reliability. Finally, the 341 Line will be placed on all new steel structures on the north side of the TNEC ROW.

Computer models of the proposed transmission structures to be utilized on this Project are presented in Figure 3.



Proposed Self-Weathering Steel
Single Circuit Davit Arm Structure
68-125 Feet Tall

Proposed Self-Weathering Steel
Single Circuit Three Pole Deadend Structure
68-125 Feet Tall



Proposed Self-Weathering Steel
Single Circuit H-Frame Structure
68-113 Feet Tall

Burrillville Interconnection Project
Town of Burrillville, Providence County, Rhode Island
Figure 3: Computer Model of Proposed Project Structures

January 2017

3.0 EXISTING VISUAL CHARACTER

Based on established visual assessment methodology, and site-specific topographic and land use conditions, the study area for the Project was defined as the area within a 1 mile radius of the centerline of the transmission corridor. This area covers approximately 20.13 square miles, and includes portions of the Town of Burrillville, Rhode Island, and the Towns of Uxbridge, and Douglas in Massachusetts.

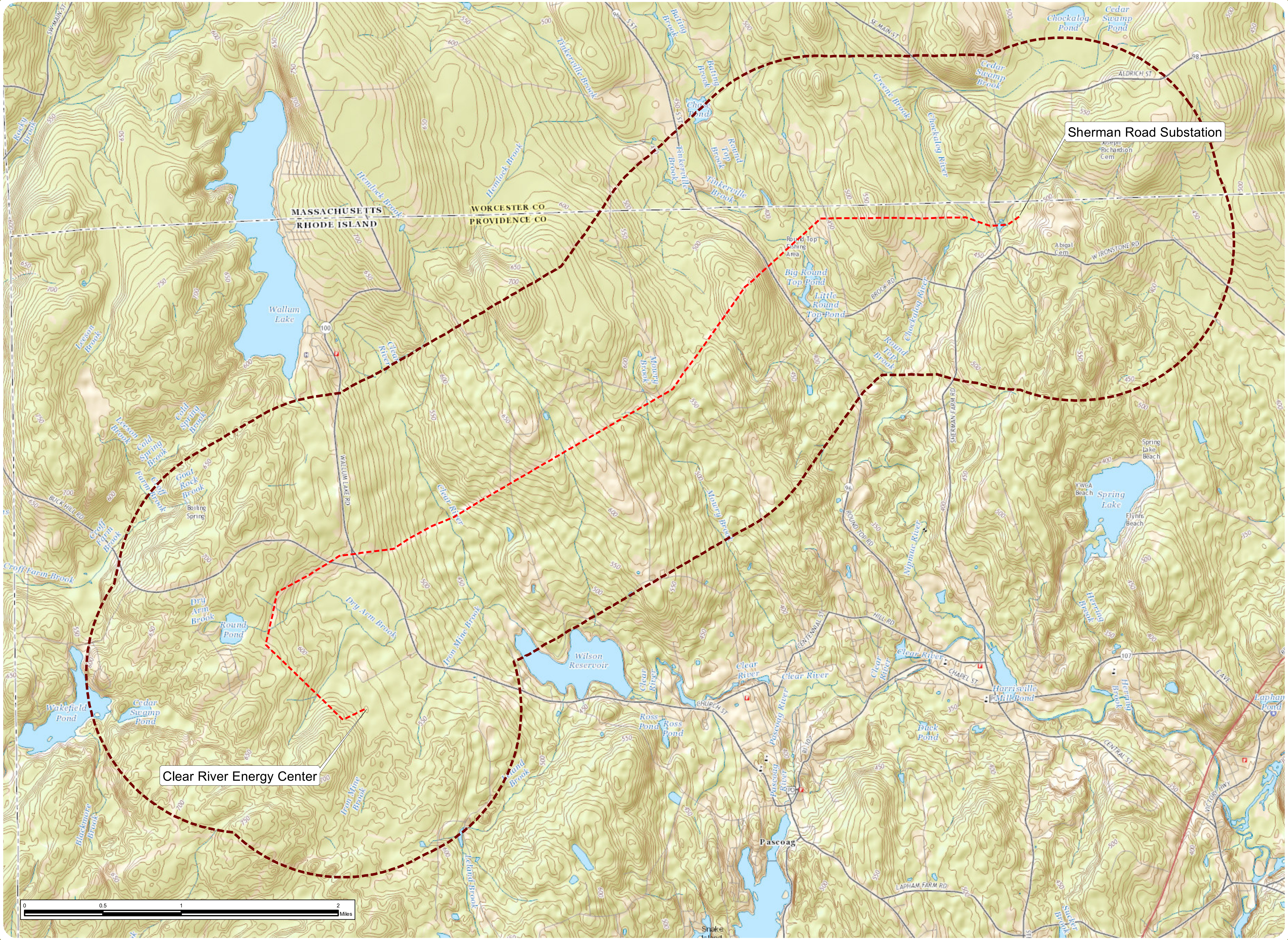
3.1 Physiographic/Visual Setting

Visual character within the study area is defined by the existing pattern of landform (topography), land use, vegetation, water features, and man-made elements in the landscape. The visual study area is located within the Southern New England physiographic region, which covers parts of New Jersey, New York, Connecticut, Massachusetts, New Hampshire, Maine, and all of Rhode Island. The Town of Burrillville is in northern Rhode Island, just south of Massachusetts and east of the Connecticut border in a primarily forested area. Elevations within the study area range from 357 to 776 feet above mean sea level, and the topography is gently rolling. Forest vegetation is primarily an oak-hickory community, intermixed with beech-maple-red oak forest and white pine/oak forest. Mature forest vegetation typically occurs in large intact blocks that provide a strong sense of enclosure and screening along roadways and around residential areas. There are several lakes, ponds, rivers, and small streams within the study area, including Round Pond, Wakefield Pond, Wilson Reservoir, Chockalog River, and Clear River. Wilson Reservoir and the Round Top Ponds are notable recreation resources with public access for fishing and hiking. Wilson Reservoir and Wakefield Pond, the largest water resources in the study area, include residential properties along the heavily wooded shorelines. Both waterbodies have a public boat launch and are regularly used for fishing, swimming, and watercraft use.

The visual study area includes widely scattered residences along the road frontage and in rural subdivisions. High density residential neighborhoods and commercial development are lacking. Industrial land use is limited to utility infrastructure. Within the study area, the proposed Project crosses several local and state roads including, Buck Hill Road, Wallum Lake Road (State Route 100), East Wallum Lake Road, Town Farm Road, Stone Barn Road, Hill Road, Round Top Road (State Route 96), Collins Taft Road, and Sherman Farm Road. Generally, homes within the study area are concentrated along these roads, particularly along Town Farm Road and Wallum Lake Road.

Additionally, there are a few small farms and agricultural fields scattered throughout the study area. These farms are generally small working agricultural and recreation operations, including horse farms (commercial recreation operations), hayfields, and small dairy farms. Fields are generally small (5-10 acres) and are bordered by dense forest, hedgerows or roads.

Several State Wildlife Management Areas (WMAs) are also present within the study area. These include the George Washington, Buck Hill, Round Top, Chockalog Swamp, and Black Hill Management Areas. These facilities are largely forested, and offer public recreation opportunities such as fishing, hiking, and hunting (see additional discussion in Section 3.4).



Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 4: Visual Study Area

January 2017

Transmission Centerline

1 Mile Visual Study Area

Notes:
1. Basemap: ESRI ArcGIS Online "USA Topo Maps" Map Service.
2. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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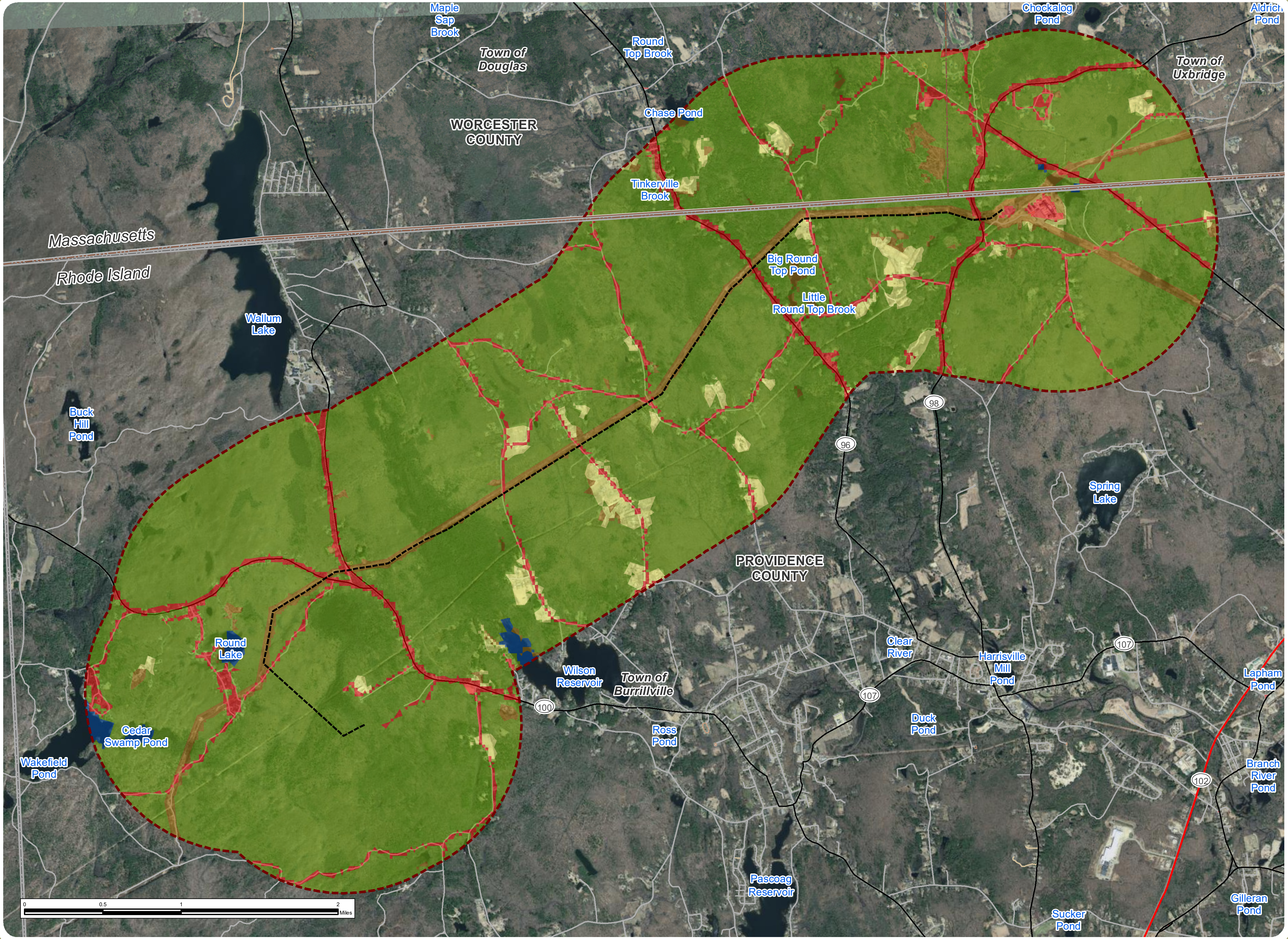
3.2 Landscape Similarity Zones

Defining discrete landscape types within a given study area provides a useful framework for the analysis of a project's potential visual effects. These landscape types, referred to in this report as Landscape Similarity Zones (LSZs), are defined based on the similarity of various landscape characteristics including landform, vegetation, water, and/or land use patterns, in accordance with established visual assessment methodologies (Smardon et al., 1987; USDA Forest Service, 1995; USDOT Federal Highway Administration, 1981; USDI Bureau of Land Management, 1980). Within the visual study area for the Project, EDR defined five primary LSZs: forested, rural residential, agricultural, open water and industrial. The USGS National Land Cover Dataset (NLCD) that was used to help define the location of these zones is illustrated in Figure 5. The cover types demonstrated in Figure 5 are left in their original classifications (as defined by the NLCD) and therefore, do not match the LSZ names. The general landscape character, land use, and availability of outward views within each of the defined LSZs are described below.



Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 5: Landcover Type

January 2017

- Transmission Centerline
- County Boundary
- Town Boundary
- 1 Mile Visual Study Area
- State Boundary

Land Cover

- Agricultural
- Developed
- Forestland
- Grassland/Shrubland
- Open Water

Notes:
Basemap: ESRI ArcGIS Online "World Imagery" Map Service.
2. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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3.2.1 Zone 1: Forested Zone

This zone is characterized by gently rolling topography and the dominance of mature forest vegetation. It is the dominant LSZ, covering approximately 87% of the visual study area, and bordering the existing and proposed transmission line corridor along its entire length (Photo Insets 1 and 2). Views within the forested zone are generally restricted to forest edges or areas where yards, small clearings, road cuts and utility corridors provide breaks in the tree canopy. Where longer distance views are occasionally available, they are typically tightly framed by surrounding trees and therefore of short duration (e.g. roads passing through the cleared ROW). Land use in this zone includes low-density residential development and outdoor recreational use. These forested areas are a mix of private and public lands and include the previously mentioned State WMAs.

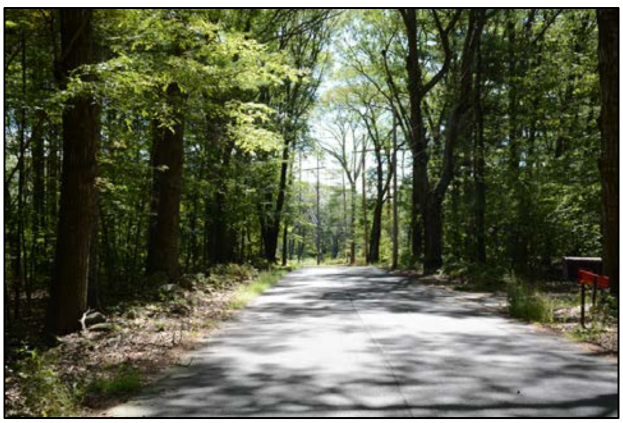



Photo Inset 1. Forest Zone: Hill Road (above, left)
Photo Inset 2. Forest Zone: Buck Hill Road (above, right)

3.2.2 Zone 2. Rural Residential Zone

This LSZ occurs primarily along the frontage of rural roads and within rural residential subdivisions that occur throughout the study area. The rural residential zone is characterized by low density residential development in a largely forested setting (Photo Insets 3 and 4). Frontage development along the roads typically includes single family homes that vary widely in age and architectural style (from modern modular homes to historic structures). The homes are closely surrounded by mature trees that generally screen or tightly frame outward views.

Photo Inset 3. Rural Residential Zone: Buck Hill Road (above, left)
Photo Inset 4. Forest Zone: Wallum Lake Road (above, right)

3.2.3 Zone 3: Agricultural Zone

The Agricultural LSZ occurs primarily in the central portion of the visual study area along Town Farm, Stone Barn, and Hill Roads. This landscape type is characterized by a mix of active crop fields, pastures, hedgerows, farm structures, rural residences, and small woodlots (Photo Insets 5 and 6). The presence of small open fields offers more open views. However, these views are still rather limited due to the small size of the fields and the presence of mature forest vegetation surrounding them. Views in the Agricultural LSZ typically include an open field in the foreground, with a tree line defining a woodlot or hedgerow in the mid-ground. Views also include livestock, farm equipment, homes, and farm buildings.

Photo Inset 5. Rural Agricultural Zone: Intersection of East Wallum Lake Road and Stone Barn Road (above, left)
Photo Inset 6. Rural Agricultural Zone: Collins Taft Road (above, right)

3.2.4 Zone 4: Open Water Zone

This LSZ occurs in limited portions of the study area, including small ponds and reservoirs such as Round Pond, Wilson Reservoir, and Big Round Top and Little Round Top Ponds. These waterbodies are characterized by an open, flat water surface which is enclosed by a vegetated shoreline (Photo Insets 7 and 8). The shorelines are typically dominated by deciduous trees but are occasionally interrupted by man-made features such as homes, docks and boat launches. Human activity on the lakes and along the shoreline includes recreational activities, such as boating and fishing. Shoreline trees and low forested hills define the visible background in most views from the Open Water LSZ. Outward views from most water bodies are largely screened by shoreline vegetation. The Open Water LSZ often overlaps with state-designated Scenic Areas, suggesting generally higher scenic quality than other LSZs within the study area.


Photo Inset 7. Open Water Zone: Round Pond (above, left)
Photo Inset 8. Open Water Zone: Wilson Reservoir (above, right)

3.2.5 Zone 5: Industrial Zone

The Industrial LSZ is defined by the presence of large electricity generation and transmission facilities (Photo Insets 9 and 10). This zone is confined to three discrete facilities within the visual study area. These include the Sherman Road Switching Station, the Ocean State Power Facility, and the Algonquin Gas Compressor Station. Additionally, the existing transmission corridor could also be considered a part of the Industrial zone. In general, views of the Industrial LSZ are limited to nearby road crossings that provide breaks in the dense forest vegetation that surrounds these facilities. The Algonquin Compressor Station is only visible from the Project site itself and public views are generally not available.

Photo Inset 9. Industrial Zone: Sherman Farm Road (above, left)
Photo Inset 10. Industrial Zone: Sherman Farm Road (above, right)

3.3 Viewer/User Groups

Three categories of viewer/user groups were identified within the visual study area. These include the following:

3.3.1 Local Residents

Local residents include those who live, work, and travel for their daily business within the visual study area. They generally view the landscape from their yards, homes, local roads and places of employment. Residents are concentrated in the rural residential areas located off Town Farm Road and Wallum Lake Road, but occur throughout the study area. Except when involved in local travel, residents are likely to be stationary, and have frequent or prolonged views of the landscape. Residents' sensitivity to visual quality is variable, and may be tempered by the aesthetic character/setting of their neighborhood and local roads. However, it is assumed that most residents will be sensitive to changes in the landscape that can be viewed from their homes and neighborhoods.

3.3.2 Through Travelers

Travelers passing through the area view the landscape from motor vehicles on their way to other destinations. Through travelers are typically moving, have a relatively narrow field of view oriented along the axis of the roadway, and are destination-oriented. Drivers on the more heavily traveled roads in the area (e.g., Wallum Lake Road and Sherman Farm Road) will generally be focused on the road and traffic conditions, but do have the opportunity to observe roadside scenery. Passengers in moving vehicles will have greater opportunities for prolonged off-road views than will drivers, and therefore may be more aware of the quality of surrounding scenery. However, through travelers who are not residents of the area are unlikely to be particularly sensitive to visual change along the route of their travel.

3.3.3 Recreational Users

This group includes local residents and tourists involved in outdoor recreational activities at local parks, recreational facilities, and natural areas. This group includes bicyclists, boaters, hunters, fishermen, and those involved in more passive recreational activities (picnicking, walking, nature observation, etc.). Scenery and visual quality may or may not be an important part of the recreational experience for these viewers, although in general, recreational enjoyment is almost always enhanced in a setting that has not been visually degraded. For some recreational users, scenery may be a very important part of their recreational experience, and their activities may afford continuous views of landscape features over relatively long periods of time. Such viewers are likely to have a high appreciation for visual quality and high sensitivity to visual change. However, it is worth noting that the presence of the existing utility infrastructure within the study area may temper the expectations of visual quality and sensitivity to visual change in some locations.

3.4 Visually Sensitive Resources

To identify visually sensitive resources within the visual study area, EDR consulted a variety of data sources, including: digital geospatial data (shapefiles) obtained primarily through the Rhode Island Geographic Information System (RIGIS, 2016) or the Environmental Systems Research Institute (ESRI); numerous national, state, county and local agency/program websites, as well as websites specific to identified resources; USGS 7.5-minute topographic maps; and web mapping services such as Google Maps. All inventoried sensitive aesthetic resources, including their distance relative to the Project Site, are listed in Table A, included in Appendix A. The locations of the mapped visually sensitive resources within the visual study area are illustrated in Figure 6 and the large-scale viewshed map included in Appendix A.

Visually sensitive resources generally fall into two categories: 1) aesthetic resources that have been formally recognized, such as buildings and landscapes listed on the National or State Register of Historic Places, designated scenic areas, or publicly-owned properties such as conservation areas and parks; or 2) places of concentrated activity such as schools, villages centers and heavily used roadways, or landscapes of high aesthetic merit that may be considered important by local residents. Visually sensitive resources include resources of national, state and local significance.

The visual study area is located entirely within the John H. Chafee Blackstone River Valley National Heritage Corridor. The Blackstone River Valley runs from Worcester, Massachusetts to Providence, Rhode Island, covering over 500 square miles. It has historic significance as an important center of early industry, as well as ecological and recreational importance today (NPS, 2016b). No other scenic or recreational resources of national significance are present within the study area. The area includes no national scenic byways (America's Byways, 2016) or national recreation trails (NRT, 2016). None of the water bodies in the study area are included on the national list of wild, scenic or recreational rivers (NWSRS, 2016), and there are no national wildlife refuges (USFWS, 2016), national seashores, national forests (USDA, 2016), national parks (NPS, 2011), or national natural landmarks (NPS, 2016e) located within or adjacent to the visual study area.

As indicated in Table A, and shown on Figure 6, the study area includes 77 resources/sites that could be considered visually sensitive from a statewide, regional, or local perspective. Aesthetic resources within the visual study area considered to be of statewide significance include historic structures listed in the State/National Register of Historic Places (NRHP), state forest land, state WMAs, state-designated scenic areas, and state bike routes and trails. Regionally and locally significant resources include local parks and recreational facilities (including trails, bike paths, golf courses and water resources), designated open space (e.g., land trust properties and conservation lands), cemeteries, and areas of intensive land use (e.g., villages and major transportation corridors). Specific visually sensitive resources of these types that occur within the visual study area are described below.

3.4.1 Historic Sites

According to databases maintained by the U.S. Department of the Interior National Park Service (NPS, 2016d and 2016f), the Rhode Island Geographic Information System (RIGIS, 2016), and the Massachusetts Cultural Resource Information System (MACRIS) (MHC, 2016), the area within 1 mile of the proposed Project includes four historic sites that are listed on the NRHP, and two local historic sites that are candidates for listing on the NRHP. The NRHP-listed sites are located in the northern portion of the visual study area, in the Town of Douglas, Massachusetts. In addition, the South Douglas Historic Area, a locally-designated historic area, occurs within the visual study area. There are no National Historic Landmark districts or National Historic Trails within the visual study area (MHC, 2016; NPS, 2016d; RIGIS, 2016).

NRHP-listed sites within the visual study area include the Smith Sherman House, Jesse Coombs House, Baker Cemetery, and South Douglas Cemetery. All of these historic sites are located in the Town of Douglas, Massachusetts (between 0.5 to 1.0 mile from the proposed Project), and are described below.

- Baker Cemetery is small (800 square-foot) cemetery located off South Street in the Town of Douglas, Massachusetts. The cemetery was first used circa 1812 through 1865, and contains approximately 25 to 30 stones, of which half of the gravestone are granite slabs and the other half are made of marble (Beldinga, 1989, MACRIS, 2016).

- Jesse Coombs House is located at 24 Makowski Drive in the Town of Douglas, Massachusetts. The house was constructed circa 1800 and is a vernacular cape style house. The house reflects late 18th to early 19th century building trends and is one of many such examples in the Town of Douglas, Massachusetts (Belding, 1989b, MACRIS, 2016).
- Smith Sherman House was constructed circa 1840 and is located at 80 Orange Street, in the Town of Douglas, Massachusetts. The house is a good example of vernacular/colonial revival architecture. It is a two-story side-gabled house with a large colonial revival picture window. (Belding, 1989c, MACRIS, 2016)
- South Douglas Cemetery is a 1.5-acre cemetery located at 288 South Street in the Town of Douglas, Massachusetts. The cemetery was first used circa 1820 and is still used today, and currently has about 200 stones. The cemetery was established shortly after the First Methodist Church was established in 1808. The land was part of the Amos Yates Farm. Yates was one of the founders of the First Methodist Church in South Douglas. The church no longer exists, as it burned down in 1896 (Belding, 1989d, MACRIS, 2016).

In addition to the NRHP-listed historic sites, there are two locally significant historic sites identified as candidates for listing on the NRHP, which include the A. Paine Farm and J. Millard House/Barksfield. Historic candidate sites are resources identified by the Rhode Island Historic Preservation Commission (RIHPHC) as historically significant and potentially NRHP-eligible, but are not yet formally listed on the NRHP (RIHPHC, 1979).

3.4.2 Scenic Areas

The visual study area includes several state and locally-designated scenic and conservation areas. State-designated scenic areas located within the visual study area are primarily associated with lakes and ponds that have been designated as noteworthy or distinctive scenic landscapes or views by the Rhode Island Department of Environmental Management (RIDEM). These include Wallum Lake, Town Farm Road/Wilson Reservoir, Wakefield Road/Croft Farm, and Round Pond.

Conservation lands are lands controlled by the State of Rhode Island, including conservation and recreation easements, and deeds to development rights for farms conserved by the Rhode Island Agricultural Land Preservation Commission (RIDEM, 2015). There are two state-designated conservation easements, Nipmuc River Flowage Land Conservation Easement and Schofield/Gillis Conservation Easement, both located at the southern edge of the visual study area (RIDEM, 2016b).

3.4.3 Parks and Recreational Areas

According to the Rhode Island Geographic Information System database (RIGIS, 2016) the visual study area includes five state WMAs and a state forest (Fayette E Bartlett Woodland) that could be considered visually sensitive due to type or level of recreational use they receive. State WMAs in the visual study area include the Chockalog Swamp WMA in the Town of Uxbridge, Massachusetts, and Black Hut, Buck Hill, George Washington, and Round Top WMAs, and forest land parcels within the George Washington WMA, all in the Town of Burrillville, Rhode Island. All of these WMAs are used for wildlife-related outdoor recreation, including hunting, bird watching, and nature appreciation. The Round Top WMA is located in the central portion of the study area, and the existing and proposed lines pass through it. The Round Top WMA includes both Big Round Top and Little Round Top Ponds, as well as the Round Top Fishing Area.

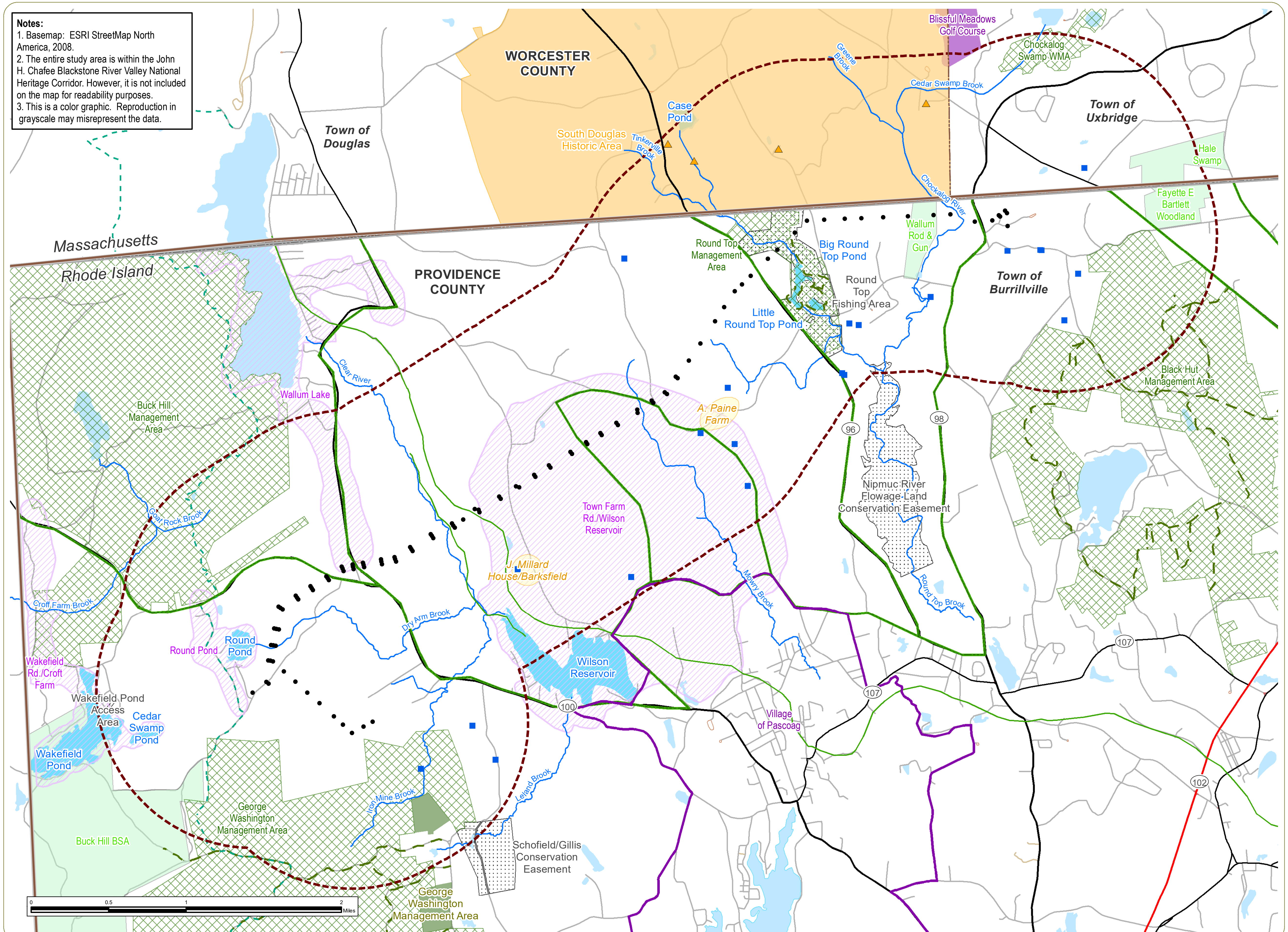
The visual study area also includes hiking trails, bike routes, local parks, a golf course, and water resources that provide recreational opportunities. These resources are included in Table A, of Appendix A and the location of these resources within the visual study area are illustrated in Figure 6.

3.4.4 Areas of Intensive Land Use

Areas of intensive land use are also considered visually sensitive sites due to the number of potential viewers that use these sites. The Village of Pascoag extends only slightly into the south-central portion of the visual study area. The major transportation corridors within the study area include State Routes 96, 98, and 100. According to the Rhode Island Department of Transportation web site (RIDOT, 2016c), data collected during the 2015 annual 48-hour average daily traffic counts for the three state routes within the visual study area are:

- State Route 96: 4,100 vehicles per day
- State Route 98: 1,147 vehicles per day
- State Route 100: No data available

All inventoried sensitive aesthetic resources are listed in Table A, included in Appendix A. The locations of the mapped visually sensitive resources within the visual study area are illustrated in Figure 6.



Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 6: Visually Sensitive Resources

January 2017

- Proposed Pole Locations
- Historic Site
- Cemetery
- State Bike Route
- State Trail
- Bike Route
- Local Trail
- Major Road
- Stream & River
- Village
- Historic Area
- Historic Candidate Site
- State Forest Land
- State Scenic Area
- State WMA
- Golf Course
- Lake & Pond
- Local Park
- RIDEM Land
- 1 Mile Visual Study Area
- Town Boundary
- County Boundary
- State Boundary

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4.0 VISUAL IMPACT ASSESSMENT METHODOLOGY

The VIA procedures used for this study are consistent with methodologies developed by various state and federal agencies, including the U.S. Department of the Interior, Bureau of Land Management (1980), U.S. Department of Agriculture, National Forest Service (1974), the U.S. Department of Transportation, Federal Highway Administration (1981), and the New York State Department of Environmental Conservation (2000). The specific techniques used to assess potential Project visibility and visual impacts are described in the following section.

4.1 Project Visibility

An analysis of Project visibility was undertaken to identify those locations within the visual study area where there is potential for the proposed transmission line to be seen from ground-level vantage points. This analysis included identifying potentially visible areas on viewshed maps and evaluating potential Project visibility in the field. The methodology employed for each of these assessment techniques is described below.

4.1.1 Viewshed Analysis

Viewshed maps define areas of potential Project visibility by identifying areas within the study area that could have an unobstructed line of sight from the viewer to any portion of one or more of the proposed transmission structures (NYSDEC, not dated). To evaluate potential Project visibility, EDR performed viewshed analyses of the existing and proposed transmission line structures. The viewshed analyses were based on data provided by TNEC, indicating the location and height of all existing and proposed structures along the transmission line corridor. Heights of existing structures evaluated in this analysis ranged from 65.5 feet to 125 feet, while heights of the proposed transmission structures ranged from 68 feet to 130 feet. Topographic viewshed maps for the Project were prepared using 2011 State of Rhode Island LIDAR data (to create a bare earth digital elevation model), the location and height of all proposed structures, an assumed viewer height of 6 feet, and ESRI ArcGIS® software with the Spatial Analyst extension. Two 1-mile radius topographic viewsheds were mapped, one to illustrate potential visibility of the proposed structures, and the other to illustrate potential visibility of the existing transmission structures already on the ROW.

The ArcGIS program defines the viewshed (using topography only) by reading every cell of the digital elevation model (DEM) data and assigning a value based upon the existence of a direct, unobstructed line of sight to transmission structure location/elevation coordinates from observation points throughout the 1-mile study area. The resulting topographic viewshed maps define the maximum area from which any portion of any structure in the completed Project could potentially be seen within the study area based on the existence of a direct line of sight, and ignoring the screening effects of existing vegetation and structures. Its accuracy is directly related to the accuracy of the DEM data used in the analysis. The resulting viewshed map for the existing transmission line structures and the viewshed map for the new transmission line structures were then overlaid and compared to show the areas of potential increased or decreased visibility resulting from construction of the proposed Project.

Because the screening provided by vegetation and structures is not considered in this specific analysis, the topographic viewshed represents a "worst case" assessment of potential Project visibility. Topographic viewshed maps assume that no trees exist, and therefore are very accurate in predicting where visibility will not occur due to topographic interference. However, they are less accurate in identifying areas from which the Project would actually be visible. Trees and buildings can limit or eliminate visibility in areas indicated as having potential Project visibility in the topographic viewshed analysis.

To supplement the topographic viewshed analysis, a vegetation viewshed was also prepared to illustrate the potential screening provided by forest vegetation. A base vegetation layer was created using the USGS 2011 National Land Cover Dataset (NLCD) to identify the mapped location of forest land (including the Deciduous Forest, Evergreen Forest, Mixed Forest, and Woody Wetland NLCD classifications). This vegetation layer was then modified to reflect the existing extent of clearing within the transmission line ROW (which was not reflected in the 2011 NLCD data) for use in the viewshed analysis of the existing structures. A second version of this vegetation layer was then created to reflect the proposed extent of clearing for use in the viewshed analysis of the proposed structures. Based on standard visual assessment practice, the mapped locations of the forest land were assigned a conservative assumed height of 40 feet and added to the DEM. The viewshed analysis was then re-run, as described above. As with the topographic viewshed analysis, the potential visibility of both the existing and proposed structures was evaluated. Once the viewshed analysis was completed, the areas covered by the forest vegetation layer were designated as “not visible” on the resulting data layer. Although there are certainly areas of mapped forest that have natural or man-made clearings that provide open outward views, these openings are typically narrow/enclosed and would include little of the proposed Project. In most forested areas, outward views will be well screened by tree trunks, branches and/or the overhead tree canopy. During the growing season the forest canopy will generally fully block views of the proposed structures, and such views will typically be almost completely obscured, or at least significantly screened, even under “leaf-off” conditions.

Because it accounts for the screening provided by mapped forest stands, the vegetation viewshed is a much more accurate representation of potential Project visibility. However, it is important to note that screening provided by buildings and street/yard trees, as well as characteristics of the proposed transmission structures that influence visibility (color, narrow profile, distance from viewer, etc.), are not taken consideration in the viewshed analyses. These factors can limit or eliminate Project visibility. Consequently, being within the vegetation viewshed does not necessarily equate to actual Project visibility.

4.1.2 Field Verification

Visibility of the proposed Project was also evaluated in the field on September 17, 2016. Clear, sunny skies with high stratus clouds and low humidity resulted in excellent visibility throughout the day. During the field verification, an EDR field crew drove public roads and visited public vantage points within the 1-mile radius study area to document locations from which the transmission line would likely be visible, partially screened, or fully screened. Photos were taken from 32 representative viewpoints within the study area (see Figure 8). All photos were obtained using a digital SLR camera with focal length set between 28 and 35 mm (equivalent to between 45 and 55 mm on a standard 35 mm film camera). This focal length is the standard used in visual impact assessment because it most closely approximates normal human perception of spatial relationships and scale in the landscape. Photo resolution was a minimum of 16 megapixels. Viewpoint locations were determined using a hand-held global positioning system (GPS) unit and high resolution aerial photographs. The time and location of each photo was documented on all field data sheets (see Appendix B). Viewpoints photographed during field review generally represented the most open, unobstructed available views toward the Project site.

4.2 Project Visual Impact

Beyond evaluating potential visibility of the transmission lines, the VIA also examined the visual impact of the proposed Project on the aesthetic resources and viewers within the visual study area. This assessment involved creating computer models of the proposed Project structures, selecting representative viewpoints within the study area, and preparing computer-assisted visual simulations of the proposed Project. These simulations were then used to characterize the type and degree of visual impact resulting from Project construction. Details of the visual impact assessment procedures are described below.

4.2.1 Viewpoint Selection

From the photo documentation conducted during field verification, EDR selected a total of eight viewpoints for development of visual simulations. These viewpoints were selected based upon the following criteria:

1. They provide open views of the Project (as determined through field evaluation).
2. They illustrate typical views from landscape similarity zones and sensitive resources from which views of the Project will be available.

3. They illustrate typical views of the proposed Project that will be available to representative viewer/user groups within the visual study area.
4. They illustrate views of different amounts of clearing and types and arrangements of proposed transmission structures, to illustrate the range of Project appearance following construction.

Specific reasons for selection of each of the eight viewpoints are summarized below:

Viewpoint # 1 - Buck Hill Road

This viewpoint is located on Buck Hill Road, a designated Rhode Island Bike Route that has a relatively high number of residences scattered along both sides of the road near the ROW. This viewpoint location also represents the first road crossing (and therefore, open view) of the proposed transmission line after it enters the ROW from the CREC. Dense forest vegetation and the lack of significant topographic features (scenic vistas) will restrict open views of the Project to the road crossing. This crossing offers views of the ROW that will include two lines of H-Frame structures and one line of davit arm structures.

Viewpoint # 8 - Wallum Lake Road

This view was chosen because it falls within the Wallum Lake State Scenic Area and is along one of the primary travel routes to access Wallum Lake and the Buck Hill Management Area. It will also provide a unique view of proposed three pole dead-end structure upgrades.

Viewpoint # 11 - Town Farm Road

This view was chosen because it is located within the Town Farm Road Scenic Area. Because of dense forest vegetation and lack of topography, the Project will only be visible at the road crossing. The layout of the corridor through this section starts out with three lines of H-Frame structures in the foreground changing to two lines of H-frame structures and one line of davit arm structures in the background. This view will also show clearing on both sides of the ROW; on the left-hand side in the foreground, and on the right-hand side in the background.

Viewpoint # 17 - Town Farm Road

This view was chosen to represent a typical view from within the Town Farm Road/Wilson Reservoir State Scenic Area in a location other than directly under the crossing of the transmission line. The view as you approach the line is more representative of what viewers will experience throughout the majority of the designated Scenic Area.

Viewpoint # 18 - Town Farm Road

This view was chosen as another representation of what will be experienced from the Town Farm Road/Wilson Reservoir State Scenic Area. Again because of vegetation and rolling topography the Project will only be visible at the road crossing. The layout of the transmission lines through this area will include three parallel H-Frame structures running the length of the ROW. This view will also show clearing on a single (left) side of the ROW.

Viewpoint # 21 - Hill Road

This view is located in the Town Farm Road/Wilson Reservoir State Scenic Area and will illustrate the appearance of upgraded dead-end structures on the existing lines, and the addition of a new set of dead-end structures.

Viewpoint # 26 - Round Top Road

This view from Round Top Road (a state designated bike route) will show the full width of the upgraded ROW, including new H-Frame and davit arm structures and the associated clearing. This is also a brief view visitors traveling to the Round Top Management Area will experience (i.e., visibility limited to the road crossing).

Viewpoint #30 - Sherman Farm Road

This view was chosen to show proposed upgrades at the point of interconnection with the Sherman Road Switching Station from this state designated bike route. Project-related clearing will also allow additional existing infrastructure to be visible.

It is worth noting that all of the selected viewpoints fall within or adjacent to the Forested and Rural Residential LSZs. They are also all less than 0.5 mile from the proposed Project, and thus all fall within the foreground viewing distance. In this regard, these viewpoints present the potential “worst case” visibility and visual impact of the Project. Locational details regarding the viewpoints selected for simulation are summarized in Table 1.

Table 1. Viewpoints Selected for Simulation and Evaluation

VP #	Viewpoint Location	Sensitive Resource	LSZ Represented	Viewer Group Represented	Viewing Distance`	View Orientation[2]
1	Buck Hill Road	Rhode Island Bike Route	Forested	Residents	45 feet	SW
8	Wallum Lake Road	Wallum Lake State Scenic Area	Forested/Rural Residential	Residents, Visitors	65 feet	SW
11	E. Wallum Lake Road	Town Farm Rd./Wilson Reservoir State Scenic Area	Forested	Residents, Visitors	1,300 feet	SW

VP #	Viewpoint Location	Sensitive Resource	LSZ Represented	Viewer Group Represented	Viewing Distance`	View Orientation[2]
17	Town Farm Road	Town Farm Rd./Wilson Reservoir State Scenic Area	Forested/Rural Residential	Residents, Visitors	420 feet	SE
18	Town Farm Road	Town Farm Rd./Wilson Reservoir State Scenic Area	Forested	Residents, Visitors	485 feet	SW
21	Hill Road	Town Farm Rd./Wilson Reservoir State Scenic Area	Forested	Residents, Visitors	455 feet	NE
26	Round Top Road	Rhode Island Bike Route	Forested	Residents	535 feet	NE
30	Sherman Farm Road	Rhode Island Bike Route	Industrial	Residents	685 feet	E

[1]Distance measured in miles from viewpoint to nearest proposed Project structure that would be visible from this viewpoint in the direction indicated
[2]N = North, S = South, E = East, W = West

4.2.2 Visual Simulations

To show anticipated visual changes associated with the proposed Project, high-resolution computer-enhanced image processing was used to create realistic photographic simulations of the transmission lines and substation from each of the eight selected viewpoints. The photographic simulations were developed by using Autodesk 3ds Max® software to create a simulated perspective (camera view) to match the location, bearing, and focal length of the existing conditions photograph. Existing elements in the view (e.g., buildings, existing transmission structures, roads) were modeled based on aerial photographs and DEM data in AutoCAD Civil 3D®. A three dimensional (“3-D”) topographic mesh of the landform (based on DEM data) was then brought into the 3-D model space. At this point, minor adjustments were made to camera and target location, focal length, and camera roll to align all modeled elements with the corresponding elements in the photograph. This assures that any elements introduced to the model space (i.e., the proposed transmission structures) will be shown in proportion, perspective, and proper relation to the existing landscape elements in the view. Consequently, the alignment, elevations, dimensions, and locations of the proposed Project structures will be accurate and true in their relationship to other landscape elements in the photograph.

Three-dimensional (3D) computer models of the proposed transmission structures were prepared based on specifications and data provided by ESS (see representations of 3-D models in Figure 3). Using the camera view as guidance, the visible portions of these modeled Project components were imported to the landscape model space described above, and set at the proper coordinates. Coordinates for proposed transmission structures were provided to EDR by ESS. For the purposes of this visual impact assessment, all new transmission structures were assumed to be self-weathering steel poles with brown insulators.

Once the proposed Project was accurately aligned within the camera view, a lighting system was created based on the actual time, date, and location of the photograph. Using the Mental Ray Rendering System® with Final Gather and Mental Ray Daylight System® within the Autodesk 3ds MAX® software, light reflection, highlights, color casting, and shadows were accurately rendered on the modeled Project based on actual environmental conditions represented in the photograph.

The rendered Project was then superimposed over the photograph in Adobe Photoshop® and portions of the Project that fall behind vegetation, structures or topography were masked out. Photoshop software was also used to take out any existing structures or vegetation proposed to be removed as part of the Project. Once the new Project components were added to the photo, any shadows cast on the ground by the proposed structures were also included by rendering a separate "shadow pass" over the DEM model in Autodesk 3ds Max® and then overlaying the shadows on the simulated view with the proper fall-off and transparency using Adobe Photoshop®.

4.2.3 Visual Impact Evaluation

To evaluate anticipated visual changes associated with the proposed Project, the photographic simulations of the completed Project (as described above) were compared to photos of existing conditions. These "before" and "after" photographs, identical in every respect, except for the Project components shown in the simulated views, were printed in 11 x 17 inch format for each selected viewpoint. A rating panel of two landscape architects and one visual assessment expert (two in-house and one independent) was then asked to determine the effect of the proposed Project on visual conditions, in terms of its contrast with existing components of the landscape (land form, vegetation, land use, water and sky). The methodology utilized in this evaluation is a simplified version of the U.S. Department of the Interior, Bureau of Land Management (BLM) contrast rating methodology (USDI BLM, 1980). The rating form was developed by EDR, and has been used for visual impact evaluation on numerous energy generation and transmission projects in New York and New England. Along with having proven to be accurate in predicting public reaction to such projects, this methodology 1) documents the basis for conclusions regarding visual impact, 2) allows for independent review and replication of the evaluation, and 3) allows a large number of viewpoints to be evaluated in a reasonable amount of time without "burn-out" of the evaluator.

Visual impact rating form instructions were provided to the landscape architects to clarify terms and understanding of what information was requested in the rating forms. The instructions provided: background concerning the LSZs, viewer types, and visually sensitive resources in the study area; guidance regarding how best to describe landscape components depicted in each viewpoint (e.g., in terms of landscape composition, form, line, color, texture, focal point, order, atmospheric conditions, lighting direction, and visual clutter); guidance regarding evaluation of viewpoint sensitivity (in terms of both scenic quality and viewer exposure); and guidance regarding terms and concepts used in contrast rating. The visual impact rating form instructions included the following guidance to ensure consistency and reliability in the landscape architect's understanding of what should be considered for each of the factors under consideration:

Landform: *Please consider the effect of the project relative to the appearance of the landform or topography, including the strength and range of color, the density of relief, the space as defined by the landform, and the extent of its scale.*

Because this is a new line on an existing transmission ROW, key considerations relative to landform may include the vertical scale relationship and spatial presence/prominence of the proposed structures relative to existing topography and other landscape elements, including existing utility structures. Relevant considerations include the form, size, and spacing of the proposed structures relative to landscape elements in the view.

Vegetation: *Please consider the effect of the project relative to the appearance of the form(s) and variety of vegetation, including the extent of clearing, the range of color, the density of texture, space as defined by the vegetation, and its hierarchy/diversity of scale.*

Key considerations for a new transmission line relative to vegetation include change in vertical scale of the proposed structures relative to vegetation in the view, proposed vegetation clearing associated with right-of-way expansion of the existing ROW, and the color of the proposed transmission structures. The introduction of transmission structures into an otherwise "natural" setting that does not include visible utility infrastructure is likely to be perceived as generally less compatible (or greater contrast). In areas with existing electrical infrastructure, the replacement, alteration, or addition of transmission structures is generally less likely to attract attention or be perceived as incompatible with the existing setting. Structures that are consistent in color or tone with their back-drop, such as brown structures against a forested backdrop, are less likely to attract viewer attention.

Land Use: *Please consider the effect of the project relative to the appearance of identifiable land use(s) in the view, and evaluate the degree to which the project is compatible/consistent with the appearance of existing land use(s) in the view.*

The key considerations for a new transmission line relative to land use are the natural and man-made features of the landscape that define its dominant character. The type and extent of existing development and the compatibility of the proposed changes to the utility infrastructure with their setting – including whether similar structures are present in the existing view – should be considered. In instances where similar infrastructure or other man-made features are not apparent in the existing view, the proposed project is more likely to attract viewer attention and may be perceived as less compatible with existing land use. In areas with existing electrical infrastructure, the replacement, alteration, or addition of transmission structures is generally less likely to attract attention or be perceived as incompatible with the existing setting.

Water: *Please consider the effect of the project relative to the appearance of water features in terms of the form of the water body(ies), its (their) shorelines, color, and texture (which refers here to movement) reflection, degree of enclosure, and the scale or extent of the presence of water in the view.*

Waterbodies typically attract viewer attention, provide a focal point in the view, and are generally associated with higher scenic quality. Key considerations for a new transmission line relative to waterbodies is the degree to which the changes to the view resulting from the project obstruct, compete with, or distract from the viewer's attention to, and/or enjoyment of, the waterbody as a focal point or scenic element in the view. This effect is often a function of the project's proximity to the water and/or the viewer's distance from the project.

Sky: *Please consider the effect of the project relative to the appearance of the sky in terms of form (including the appearance of clouds), the edges of its lines (perhaps in terms of the horizon), clarity of color, texture (which here could refer to cloudiness or other atmospheric conditions), the degree of openness or enclosure, and the scale or extent of the sky in the view.*

Key considerations for a new transmission line relative to sky include potential changes in height of the proposed structures relative to existing structures and the effect of color. Visual contrast is generally increased if the proposed structures appear significantly taller and/or appear significantly more prominent relative to existing structures and the horizon in the view. Structures that are "skylined" or silhouetted on the horizon typically result in greater visual contrast. The color of the proposed structures can also affect the degree of contrast, with lighter poles often appearing less prominent against the back-drop of the sky.

Viewer Activity: *Please consider the effect of the project on the viewer's perception of the scenic quality and potential viewer enjoyment of the view, taking into account the viewpoint location and context, viewer type, and duration of the view.*

The key consideration for a new transmission line relative to viewer activity is the degree to which the proposed project would compete for viewer attention and/or decrease the viewer's enjoyment of whatever activity in which they are engaged. Viewers engaged in activities such as outdoor recreation and sightseeing would generally be more sensitive to visual impact than those commuting or participating in athletic events. In instances where similar or comparable infrastructure is not apparent in the existing view, the proposed project is more likely to attract viewer attention and may be perceived as less compatible with existing viewer activities. In areas with existing electrical infrastructure, the replacement, alteration, or addition of transmission structures is generally less likely to attract attention or be perceived as incompatible with the viewer activities.

The rating panel then evaluated the before and after views from each viewpoint, and assigned each view showing the proposed Project quantitative contrast ratings on a scale of 0 (insignificant) to 4 (strong). The ratings were based on consideration of five landscape components (landform, vegetation, land use, water, and sky), as well as viewer activity. The average contrast score of the five landscape components was calculated for each panel member. The composite average of all the panel members' scores for each viewpoint was then calculated to provide the cumulative score for that viewpoint. Comments were also solicited from each panel member on the observed degree of contrast, variables that might alter perceived contrast, and the Project’s overall effect on scenic quality. The contrast ratings and comments provided by the landscape architects were reviewed to generate narrative descriptions of the existing setting and the overall visual impact of the Project on the landscape, aesthetic resources, and viewers represented by each of the selected viewpoints.

5.0 VISUAL IMPACT ASSESSMENT RESULTS

5.1 Project Visibility

5.1.1 Viewshed Analysis

Potential Project visibility, as indicated by the viewshed analyses, is illustrated in Figure 7 and summarized in Table 2. Topographic viewshed analysis revealed that approximately 87.2% of the visual study area could have potential views of the proposed structures, an increase of approximately 0.5%[1] as compared to visibility of the existing transmission line. This number reflects the fact that, based on topography alone, a large portion of the study area already has potential views of the existing structures. The topographic viewshed of the existing lines covers 86.9% of the study area, disregarding screening provided by existing vegetation and man-made structures (see Table 2).

As indicated by the topographic viewshed analysis, areas of increased potential visibility generally occur as small expansions along the edges of areas already exhibiting potential visibility of the existing transmission structures (Figure 7, Sheet 1). These areas are primarily located at the northeastern and southwestern ends of the study area, as the existing structures are indicated as already being visible (if there were no screening provided by trees) from almost all areas in the central portion of the study area. Larger areas of increased potential visibility are found along Mine Brook and Richardson Trail, south of the CREC, as well as an area along the Algonquin gas transmission line south of the Stagehead Drive/Wilson Trail intersection. Some increase in potential visibility could be experienced from certain visually sensitive resources, as indicated in Appendix A. However, most of these sites are already in the viewshed of the existing lines. According to the topographic viewshed analysis, only one of the inventoried visually sensitive resources (Croft Farm Brook) is fully screened from view of the existing transmission line by intervening topography. The analysis indicates that the proposed transmission structures are also fully screened from view from this resource. The analysis indicates that the 76 remaining visually sensitive resources could have some extent of potential visibility of both the existing and the proposed transmission structures, and that 36 of those resources could potentially receive some level of expanded transmission line visibility as a result of the proposed Project. These resources include the NRHP-listed South Douglas Historic Area; the John H Chafee Blackstone River Valley National Heritage Corridor; all five of the identified Management Areas, all four of the identified State Scenic Areas; State Route 98; all of the identified bike routes, trails, and local parks; nine of the identified water resources; RIDEM lands including Round Top Fishing Area, Schofield/Gillis Conservation Easement, and Wakefield Pond Access Area; and the Rufus Aldrich and White Lot

[1] Differences between the existing and proposed viewsheds include areas where the existing structures are visible but the proposed structures are screened from view as well as the opposite: areas where the proposed structures are visible but the existing structures are screened from view. Since the existing structures will remain visible following construction of the proposed project, only the areas of expanded visibility (i.e. “newly visible areas”) are relevant. However, due to the relationship described in this note; the ”newly visible area” is not equal to the proposed viewshed minus the existing viewshed.

Cemeteries. In most cases, the extent of increased potential visibility is extremely minor. For example, approximately 1,125 acres of the South Douglas Historic Area occurs within the visual study area, the existing transmission lines are indicated as being visible from 1,102 acres and construction of the proposed Project could increase that area by approximately 1.2 acres.

Although it does not account for all potential sources of visual screening (e.g., man-made structures and small groups of trees) factoring mapped forest vegetation into the viewshed analysis significantly reduces the area where direct lines of sight toward the Project could potentially be available, and is a more accurate reflection of what the actual extent of Project visibility is likely to be (Figure 7, Sheet 2). Within a 1-mile radius, the vegetation viewshed analysis indicates that only approximately 5.4% of the area could have potential views of some portion of the Project based on the availability of an unobstructed line of sight. This is a significant reduction in visibility when compared to the analysis factoring in topography only, which indicated potential visibility from 87.2% of the study area, and reflects the abundance of forest vegetation throughout the study area. As indicated in Table 2, when considering the screening effect of both topography and vegetation, areas of proposed structure visibility within the visual study area increase by 0.8% when compared to the vegetation/topographic viewshed of the existing transmission lines. These areas of expanded visibility occur primarily along the proposed/expanded ROW where tree clearing is proposed; within the southern half of Round Lake; and along portions of Buck Hill Road and Wallum Lake Road. Additional small areas of expanded visibility occur along the edges of areas already exhibiting potential visibility of the existing transmission structures. According to the viewshed analysis, the proposed transmission structures will be fully screened from view by intervening vegetation and topography from 43 of the inventoried visually sensitive resources. Two additional resources (Pine Lot Cemetery and Samuel Smith Lot Cemetery) will not experience any increase in visible area when compared with the viewshed of the existing transmission structures. The remaining 32 visually sensitive resources are indicated as potentially receiving some level of expanded transmission line visibility as a result of the proposed Project. These resources include the NRHP-listed South Douglas Historic Area and NRHP-listed J. Millard House/Barksfield; John H. Chafee Blackstone River Valley National Heritage Corridor; Round Top and Buck Hill Management Areas; Town Farm Road/Wilson Reservoir, Wallum Lake, and Round Pond State Scenic Areas; Rhode Island State Bike Route and Burrillville Bike Route; North-South Trail and Round Top Management Area Trail; State Routes 96, 98, and 100; Wallum Lake Rod & Gun Club and Buck Hill BSA; ten of the identified water resources; Round Top Fishing Area; and Young-White Lot, Abigail, Aldrich-Thayer, and Jacobs Cemeteries.

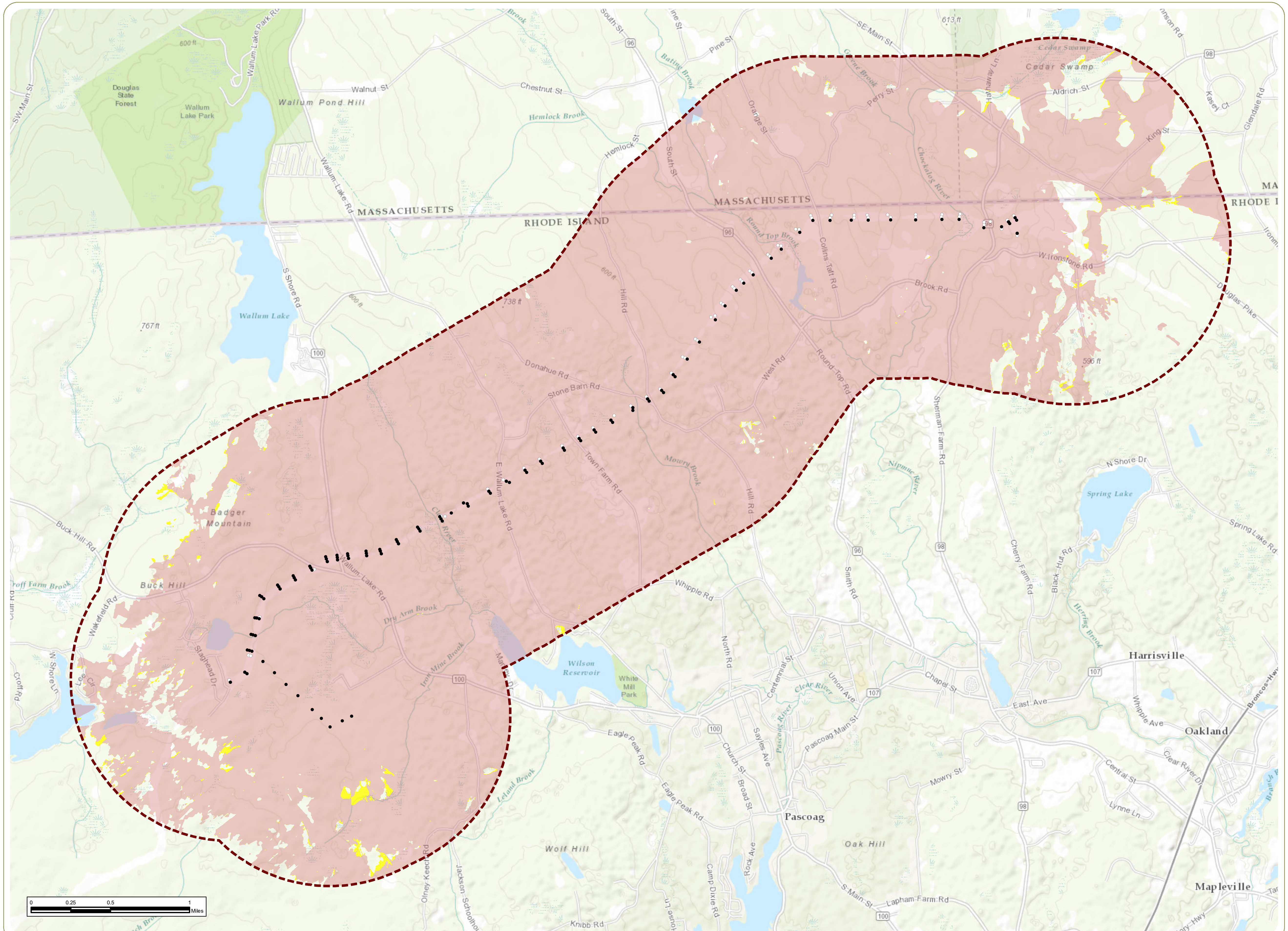
As mentioned previously, being within the Project viewshed does not equate to Project visibility, which needs to be verified in the field (see Section 5.1.2). Areas of actual visibility are anticipated to be even more limited than indicated by the vegetation viewshed analysis, due to the slender profile and natural color of the transmission structures, the effects of distance, and screening provided by yard trees, and built structures in the study area, all of which are not considered in the viewshed analysis. In addition, the analysis assumed 40 foot trees, when in fact a number of these forested areas are dominated by trees taller than this height.

Table 2. Viewshed Analysis Summary

Type of Viewshed	Potential Visibility	
	Square Miles[1]	Percent of Study Area
Existing Structures - Topography Only	15.51	86.9%
Proposed Structures - Topography Only	15.55	87.2%
Newly Visible Area – Topography Only[2]	0.09	0.5%
Existing Structures - Topography & Vegetation	0.87	4.9%
Proposed Structures - Topography & Vegetation	0.97	5.4%
Newly Visible Area - Topography & Vegetation[2]	0.14	0.8%

[1]The size of the visual study area is approximately 17.8 square miles.

[2]Differences between the existing and proposed viewsheds include areas where the existing structures are visible but the proposed structures are screened from view as well as the opposite: areas where the proposed structures are visible but the existing structures are screened from view. Since the existing structures will remain visible following construction of the proposed Project, only the areas of expanded visibility (i.e. "newly visible areas") are relevant. However, due to the relationship described in this note; the "newly visible area" is not equal to the proposed viewshed minus the existing viewshed.



Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 7: Viewshed Analysis

Sheet 1 of 2: Visibility Based on Topogrpahy Only

January 2017

- Proposed Pole Location
- Existing Pole Location
- 1-Mile Visual Study Area

Potential Visibility of Existing and Proposed Transmission Line Structures

- Existing Visibility (area that already has a view of existing transmission structures)
- Newly Visible Area (area without view of exisitng transmission structures)

Notes:

1. Basemap: ESRI ArcGIS Online "World Topographic Map" Map Service.
2. Potential Project visibility based on topography only. Screening effects of buildings, trees or other factors are not accounted for.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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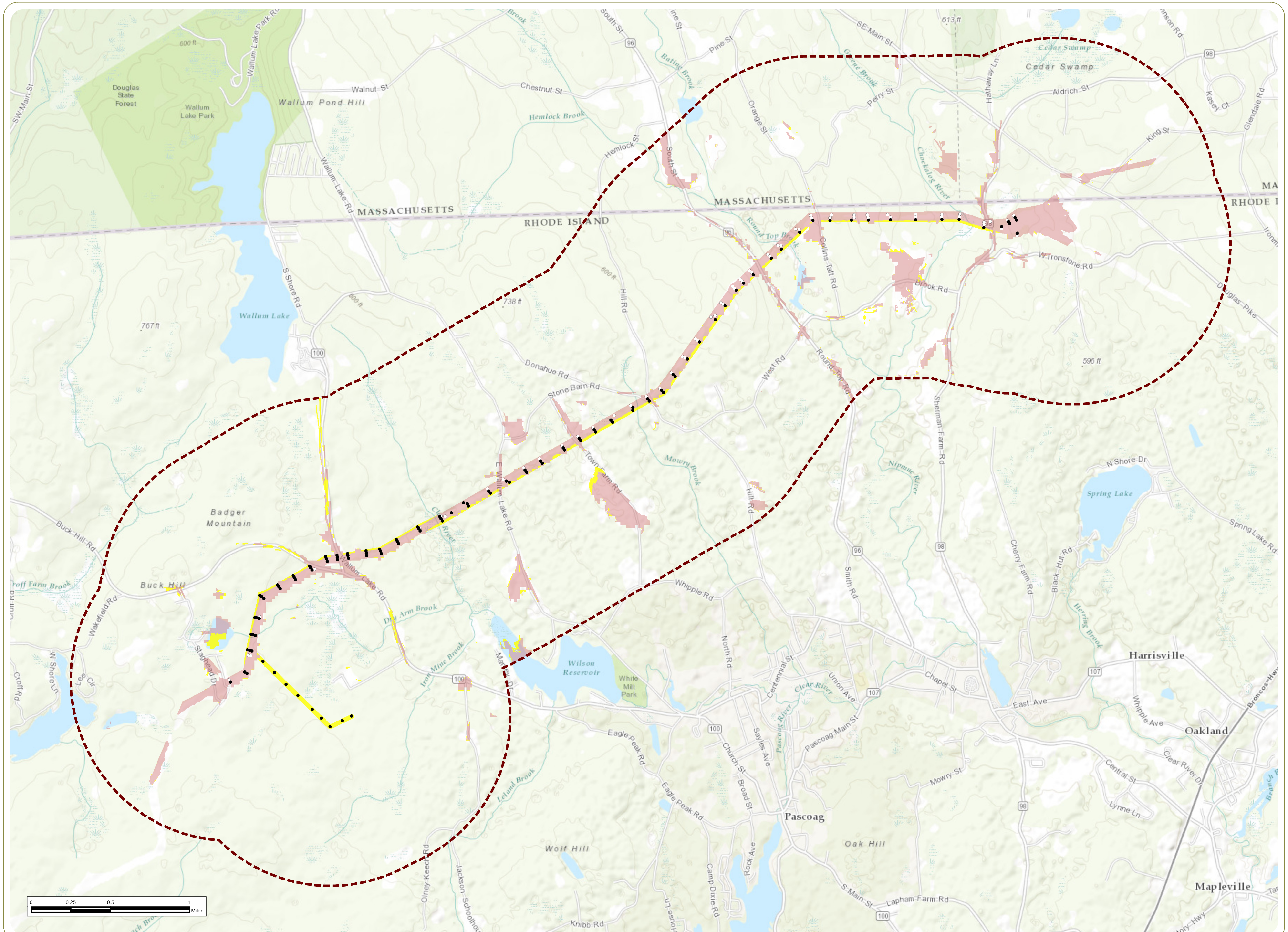

Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 7: Viewshed Analysis

Sheet 2 of 2: Visibility Based on Topogrpahy and Vegetation

January 2017

- Proposed Pole Location
- Existing Pole Location
- 1-Mile Visual Study Area

Potential Visibility of Existing and Proposed Transmission Line Structures

- Existing Visibility (area that already has a view of existing transmission structures)
- Newly Visible Area (area without view of exisitng transmission structures)

Notes:

1. Basemap: ESRI ArcGIS Online "World Topographic Map" Map Service.
2. Potential Project visibility based on topography and potential screening by mapped forest vegetation (with an assumed height of 40 feet).
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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5.1.2 Field Evaluation

Field review suggests that actual Project visibility is likely to be even more limited than suggested by viewshed mapping. The combined effect of vegetation and topography throughout the study area is to screen (or partially screen) views of the Project from many locations. The results of EDR's field review are summarized below and organized generally according to 1) visibility from roadways at transmission line crossings 2) visibility from lakes and ponds, 3) visibility in areas with forest vegetation, and 4) visibility from sensitive sites within the study area.

The roadways within the study area which intersect the proposed Project, include Buck Hill Road, Wallum Lake Route (State Route 100), East Wallum Lake Road, Town Farm Road, Stone Barn Road, Hill Road, Round Top Road (State Route 96), Collins Taft Road, Sherman Farm Road. For the most part, the visual character along these roadways is defined by heavily forested areas interspersed with widely scattered residences, and the occasional agricultural field. With the exception of the existing transmission line crossing, in most locations along these roadways, forest vegetation screens outward views from the roadway, including views toward the Project (Photo Insets 11-13).



Photo Inset 11. Viewpoint 14: View toward the Project (screened) from East Wallum Lake Road (above, left).
Photo Inset 12. Viewpoint 31: View toward the Project (screened) from Douglas Pike (above, center).
Photo Inset 13. Viewpoint 13: View toward the Project (screened) from J. Millard House on East Wallum Lake Road (above, right).

Available views from the transmission line crossings are typically of short duration for a driver, but nearby residents may have longer term views of the proposed Project. The number of structures and length of transmission line visible also varies at each road crossing. Higher elevation views (viewer superior positions) along straight portions of the ROW, will offer longer distance views and a greater number of visible structures, while lower elevations (viewer inferior) and locations where the line changes direction will have shorter views with fewer structures visible (Photo Insets 14 and 15).


Photo Inset 14. Viewpoint 23: View toward the Project from Collins Taft Road (above, left).
Photo Inset 15. Viewpoint 26: View toward the Project from Round Top Road (above, right).

Open water areas within the visual study area such as Wilson Reservoir, Round Pond, and Big and Little Round Top Ponds are noted as having small areas of visibility based on the vegetation viewshed analysis (see Figure 7, Sheet 2). However, field review revealed that these areas are heavily screened by forest vegetation and the existing transmission structures were not visible (Photo Insets 16-18).



Photo Inset 16. Viewpoint 10: View toward the Project (screened) from Wilson Reservoir (above, left).
Photo Inset 17. Viewpoint 7: View toward the Project (screened) from Round Pond (above, center).
Photo Inset 18. Viewpoint 22: View toward the Project (screened) from Round Top Pond (above, right).

Residences in the study area generally have limited to no views of the existing transmission line due to the abundance of forest vegetation that borders the ROW. Residential lots are typically interspersed along the main rural roads throughout the study area, although some higher concentrations occur in the central portion of the study area. These lots are typically defined by a small cleared yard, a one to two story dwelling set back from the road, some landscaping, and a thick natural forest buffer comprised of tall trees surrounding at least three sides of the property. In some instances, residential yards directly adjacent to the existing ROW offer partially screened views of the transmission structures (Photo Inset 19). Less frequently, open lots leading up to the road opposite the ROW, have more open prolonged views of the transmission line. More often, views of the line are completely obscured by intervening forest vegetation (Photo Inset 20).


Photo Inset 19. Viewpoint 9: Proximity and visibility of the Project relative to residence on Wallum Lake Road (above, left).
Photo Inset 20. Viewpoint 17: Typical residence on Town Farm Road approximately 250 feet from ROW (Not Visible) (above, Right).

Forested areas make up over 87 percent of the visual study area (NLCD, 2011), and field reconnaissance confirmed that forested areas define the character, and limit the availability, of outward views in the visual study area. Forest vegetation tends to screen outward views, including views of the existing transmission structures, throughout much of the study area (see Photo Insets 20-22). In fact, as suggested by the viewshed analysis, forested areas confine the majority of views of the existing transmission line to the ROW itself.

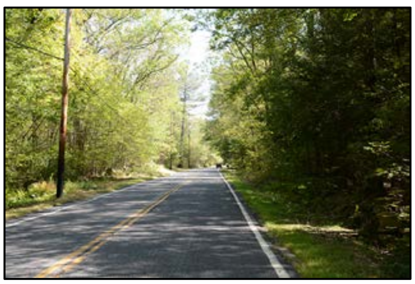


Photo Inset 20. Viewpoint 22: View toward the Project illustrating the screening effect of vegetation from Round Top Road (above, left).
Photo Inset 21. Viewpoint 31: View toward the Project illustrating the screening effect of vegetation from Douglas Turnpike (above, center).
Photo Inset 22. Viewpoint 19: View toward Project illustrating the screening effect of vegetation from Hill Road (above, right)

Visually sensitive sites are located throughout the study area (see Section 3.4, Figure 6). However, views of the Project site from sensitive sites are generally limited to the ROW crossings of public roads. The EDR field crew visited several visual resources of state and local significance and found that those sites located more than a few hundred feet from the ROW are generally fully screened by forest vegetation.

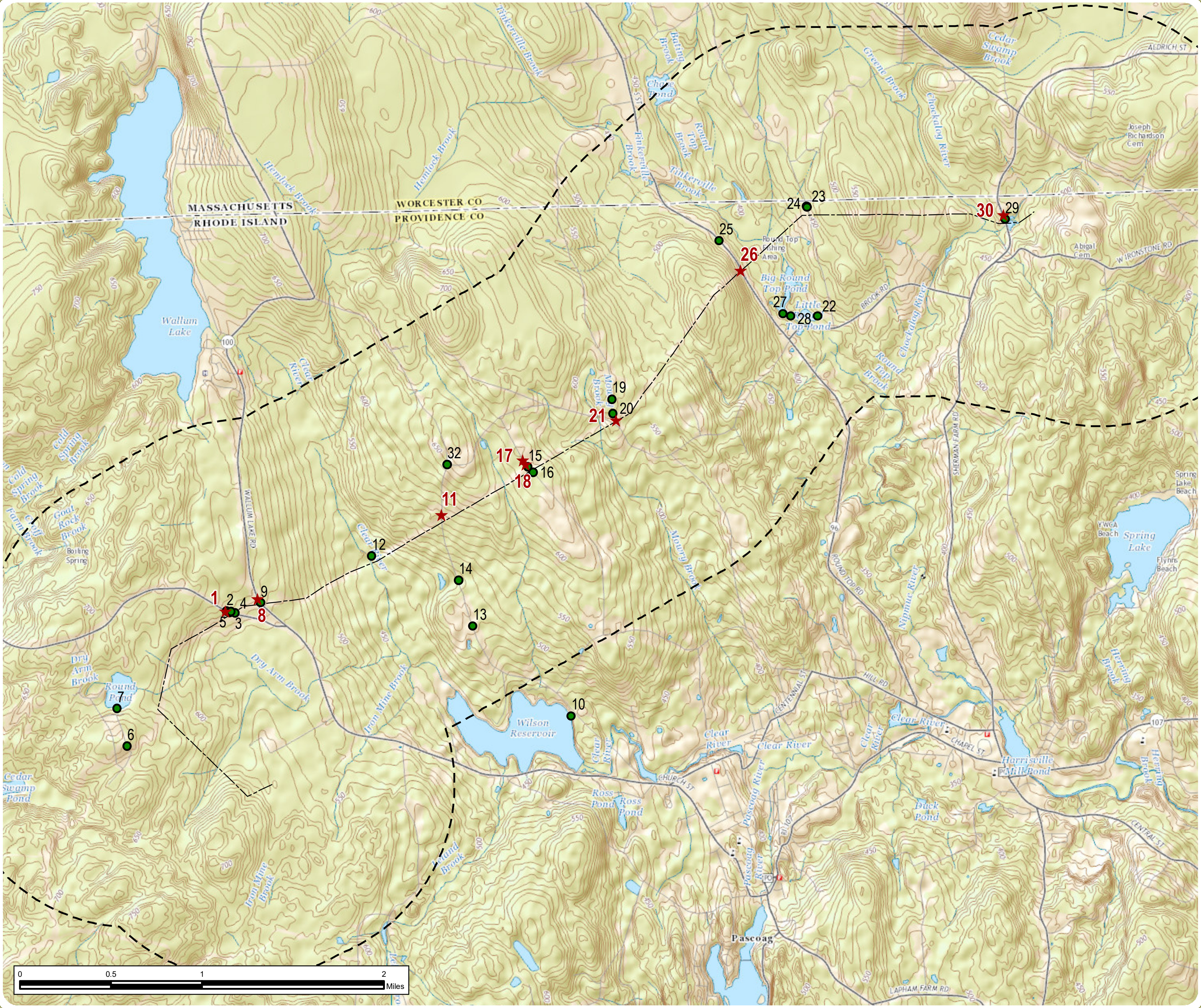
The John H. Chafee Blackstone River Valley National Heritage Corridor, and two of the State Designated Scenic Areas (Wallum Lake, Town Farm Road/Wilson Reservoir) include, or intersect, the existing transmission line and visibility is available immediately leading up to, and from within the cleared ROW. Visibility is generally confined to the road and directly adjacent residences. No visibility of the existing transmission structures was available from the Wakefield Road/Croft Farm State Scenic Area or Round Pond State Scenic Area.

The five State WMA's in the Project study area are all heavily forested, and opportunities for views toward the transmission line are limited by dense intervening vegetation. The Round Top WMA intersects the eastern portion of the transmission line, allowing for foreground views of the Project. However, during the field evaluation, no public access to the ROW within the Round Top WMA was found, and therefore no photos were obtained from this area. A portion of the George Washington Management Area is close to the proposed portion of the transmission line on the new CREC ROW, but the publicly accessible trails in this area do not offer views toward the ROW. Photos demonstrating lack of visibility from WMA's are included in the Photo Insets 23-25, below.



Photo Inset 23. Viewpoint 21: View toward the Project (screened) from Black Hut Management Area (above, left).
Photo Inset 24. Viewpoint 28: View toward the Project (screened) from Little Round Top Pond (above, center).
Photo Inset 25. Viewpoint 22: View toward the Project (screened) from Round Top Pond (above, right).

A comprehensive summary of potential Project visibility from visually sensitive resources, based on viewshed analysis as well as field review, is presented in the table included in Appendix A.



Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

Figure 8: Viewpoint Location Map

Sheet 1 of 9 - Index

January 2017

Legend

- Simulation Viewpoint
- Viewpoint
- 1 Mile Visual Study Area
- Transmission Centerline

Notes:
1. Basemap: ESRI ArcGIS Online "World Imagery" Map Service.
2. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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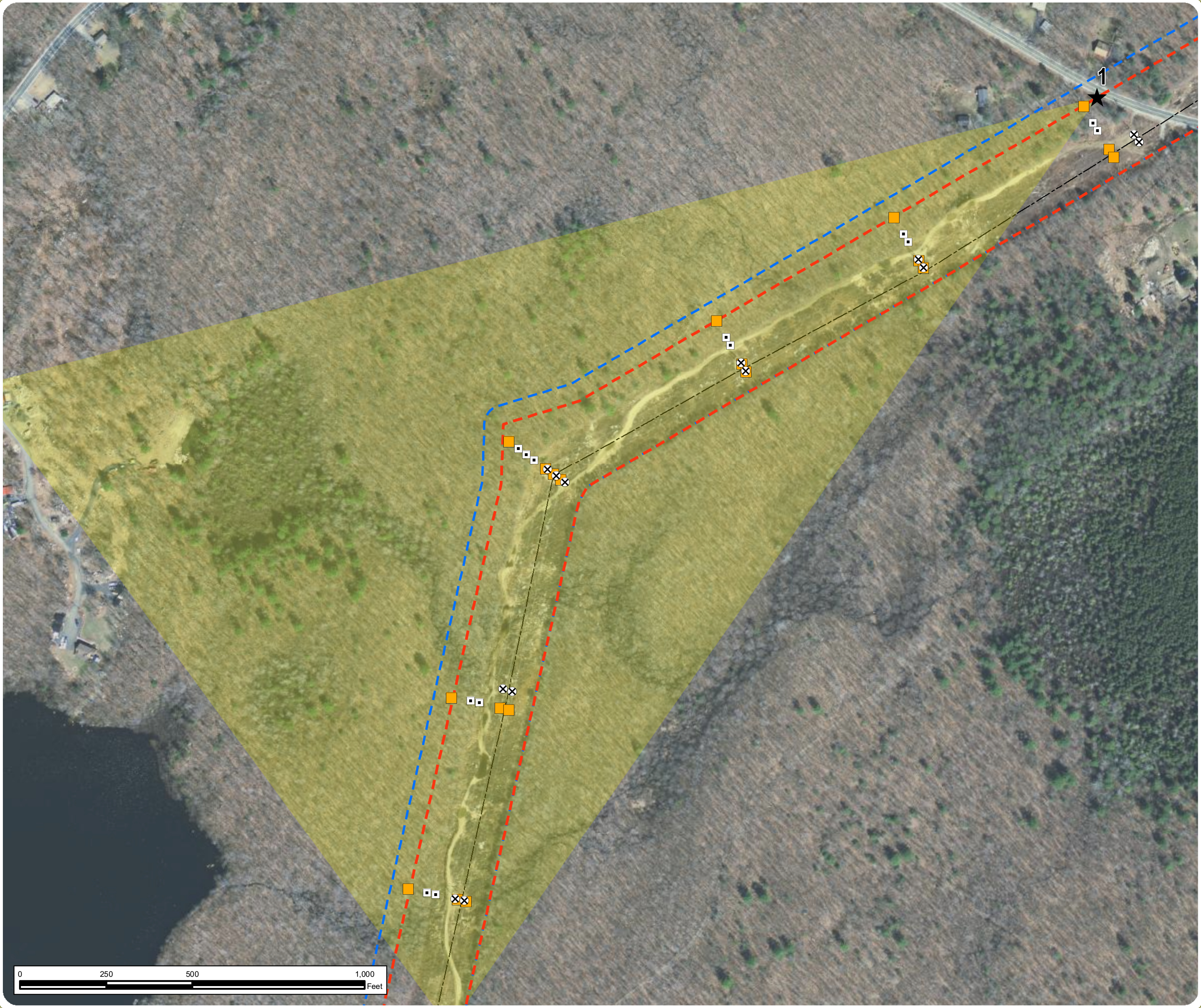


Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

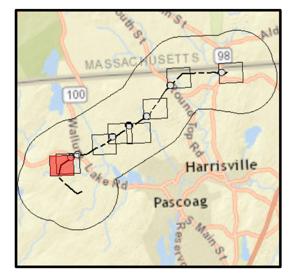
Figure 8: Viewpoint Location Map

Sheet 2 of 9
Viewpoint 1

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



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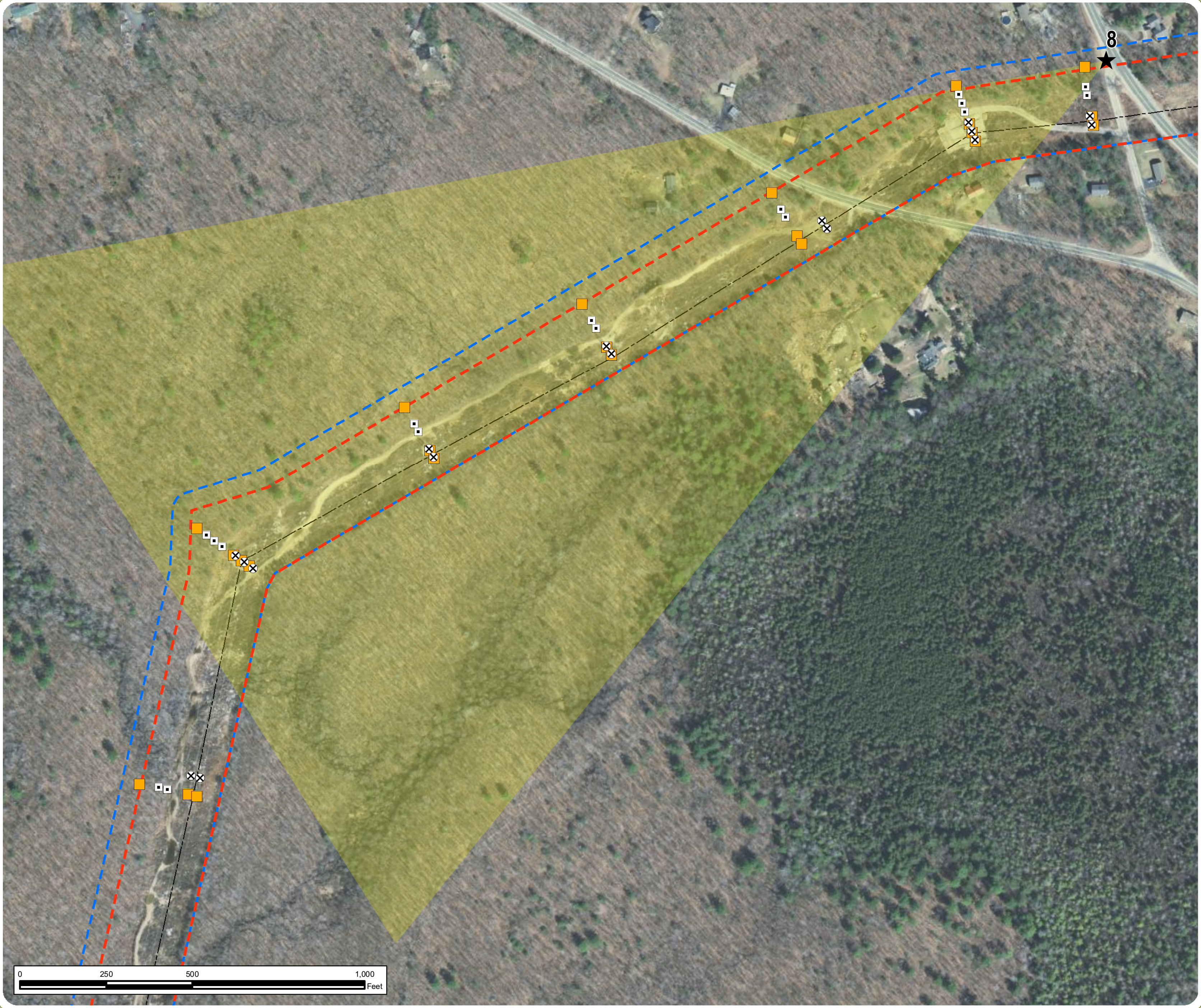


Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

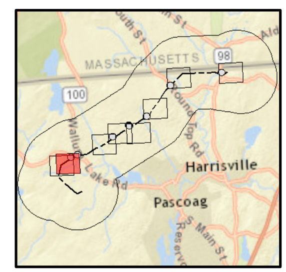
Figure 8: Viewpoint Location Map

Sheet 3 of 9
Viewpoint 8

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



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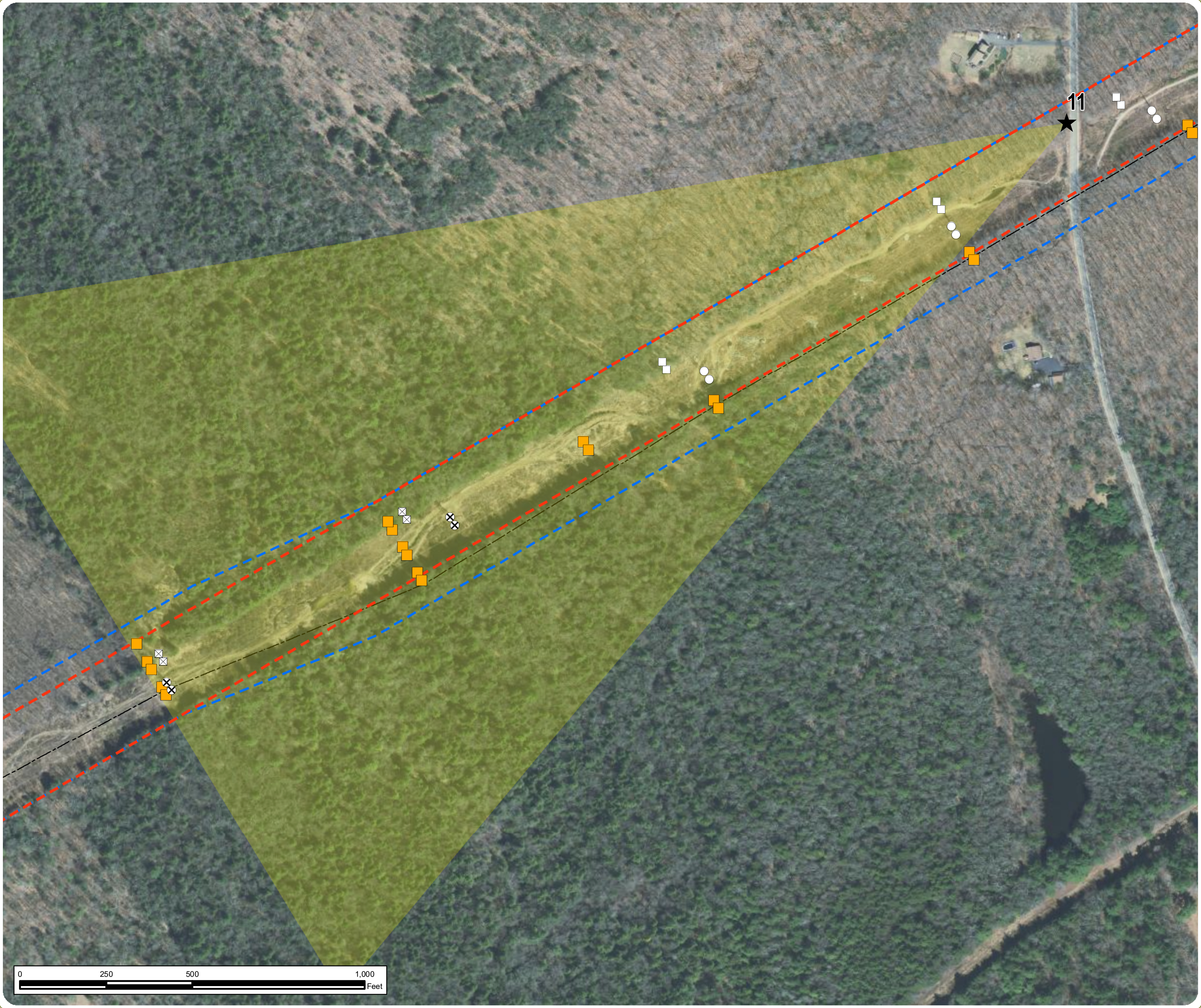


Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

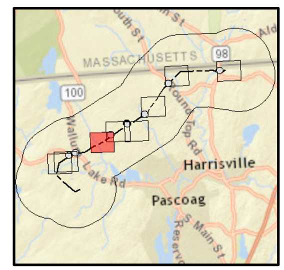
Figure 8: Viewpoint Location Map

Sheet 4 of 9
Viewpoint 11

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



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1. Basemap: ESRI ArcGIS Online "World Imagery" Map Service.
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Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

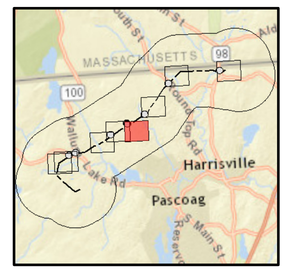
Figure 8: Viewpoint Location Map

Sheet 5 of 9
Viewpoint 17

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



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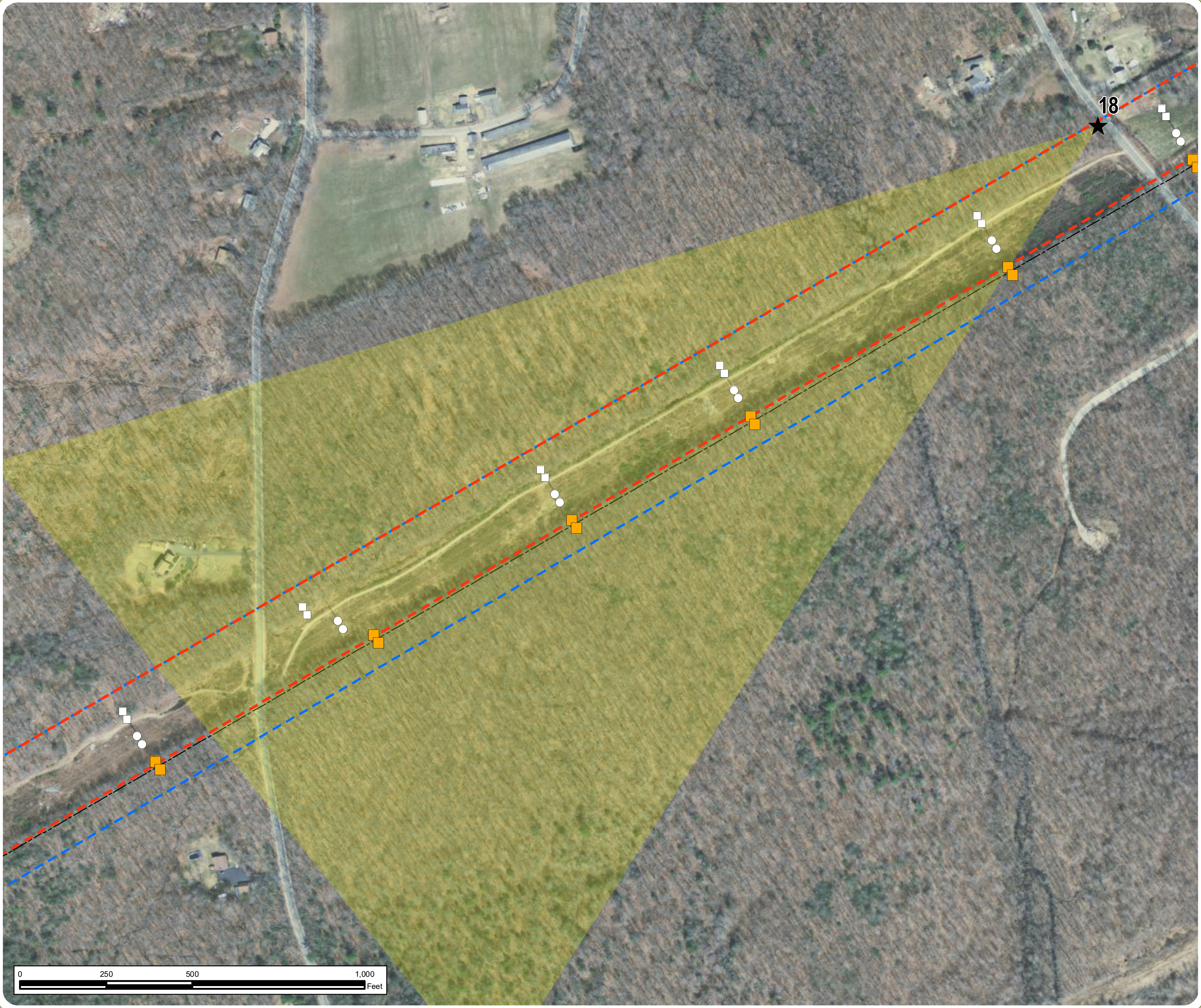


Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

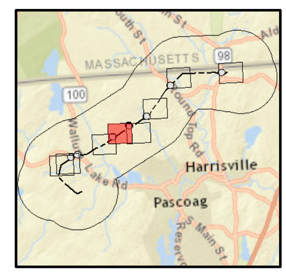
Figure 8: Viewpoint Location Map

Sheet 6 of 9
Viewpoint 18

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



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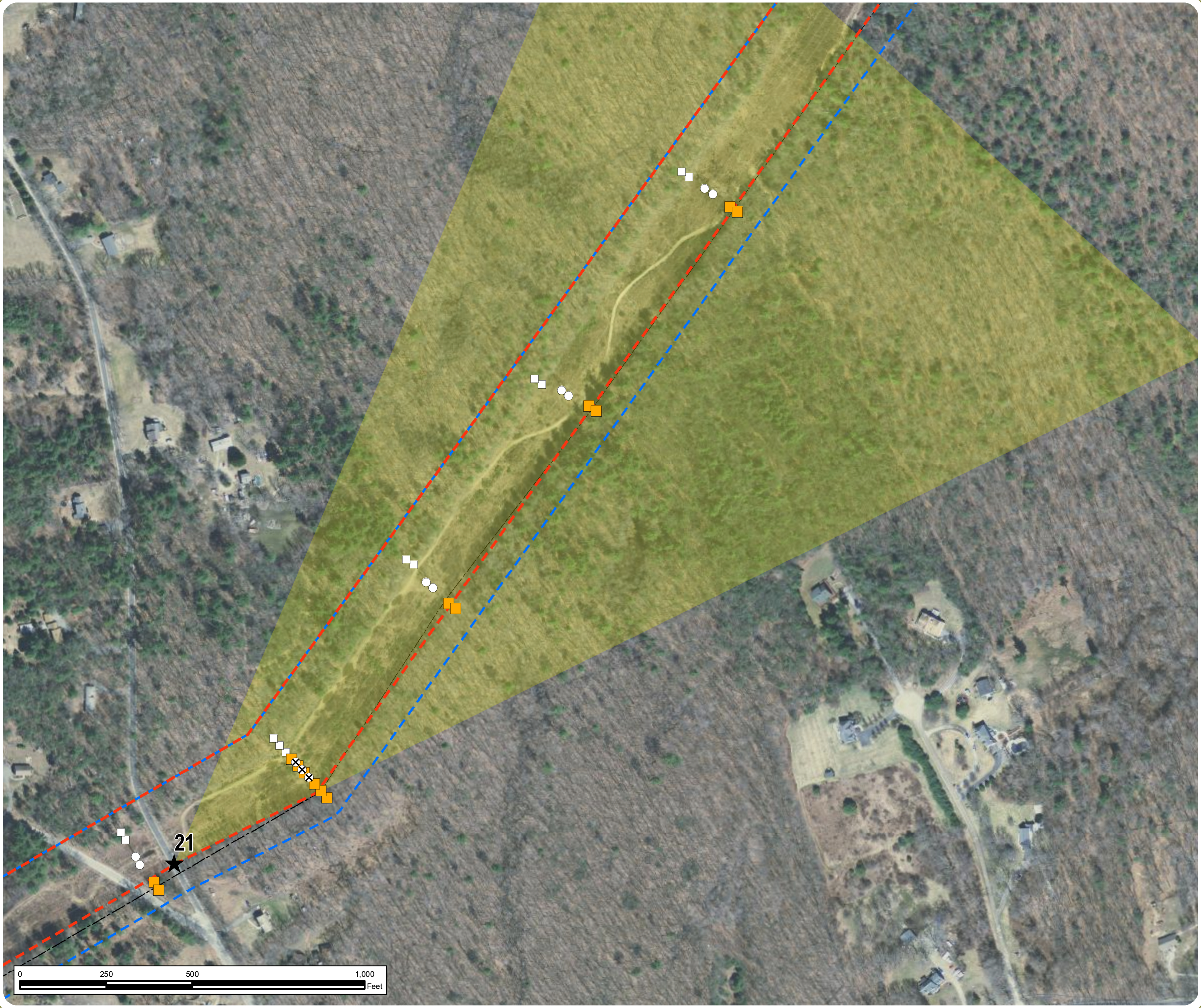


Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

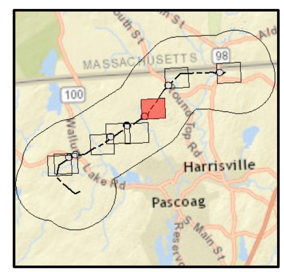
Figure 8: Viewpoint Location Map

Sheet 7 of 9
Viewpoint 21

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



Notes:
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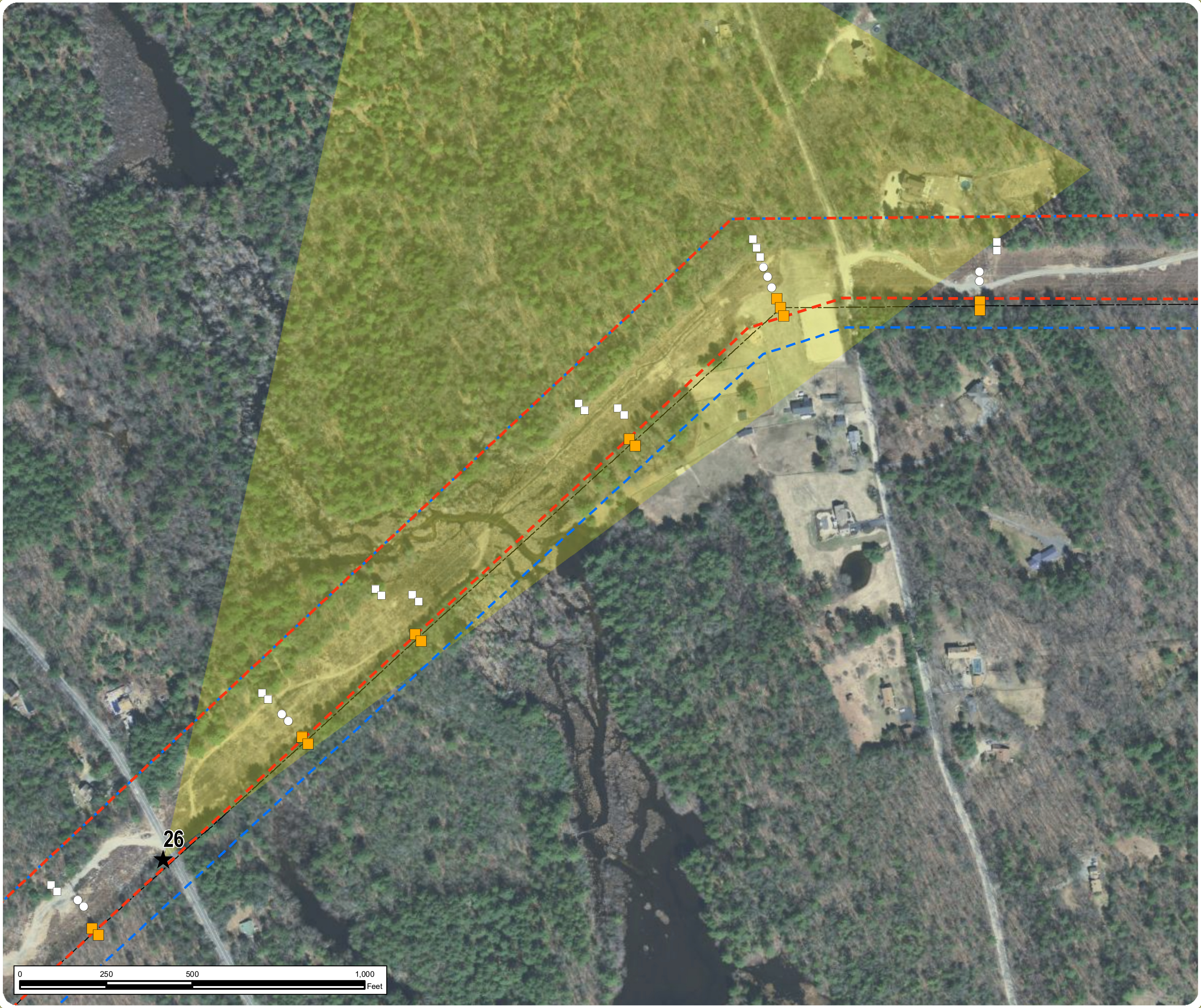


Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

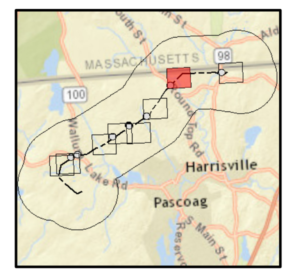
Figure 8: Viewpoint Location Map

Sheet 8 of 9
Viewpoint 26

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



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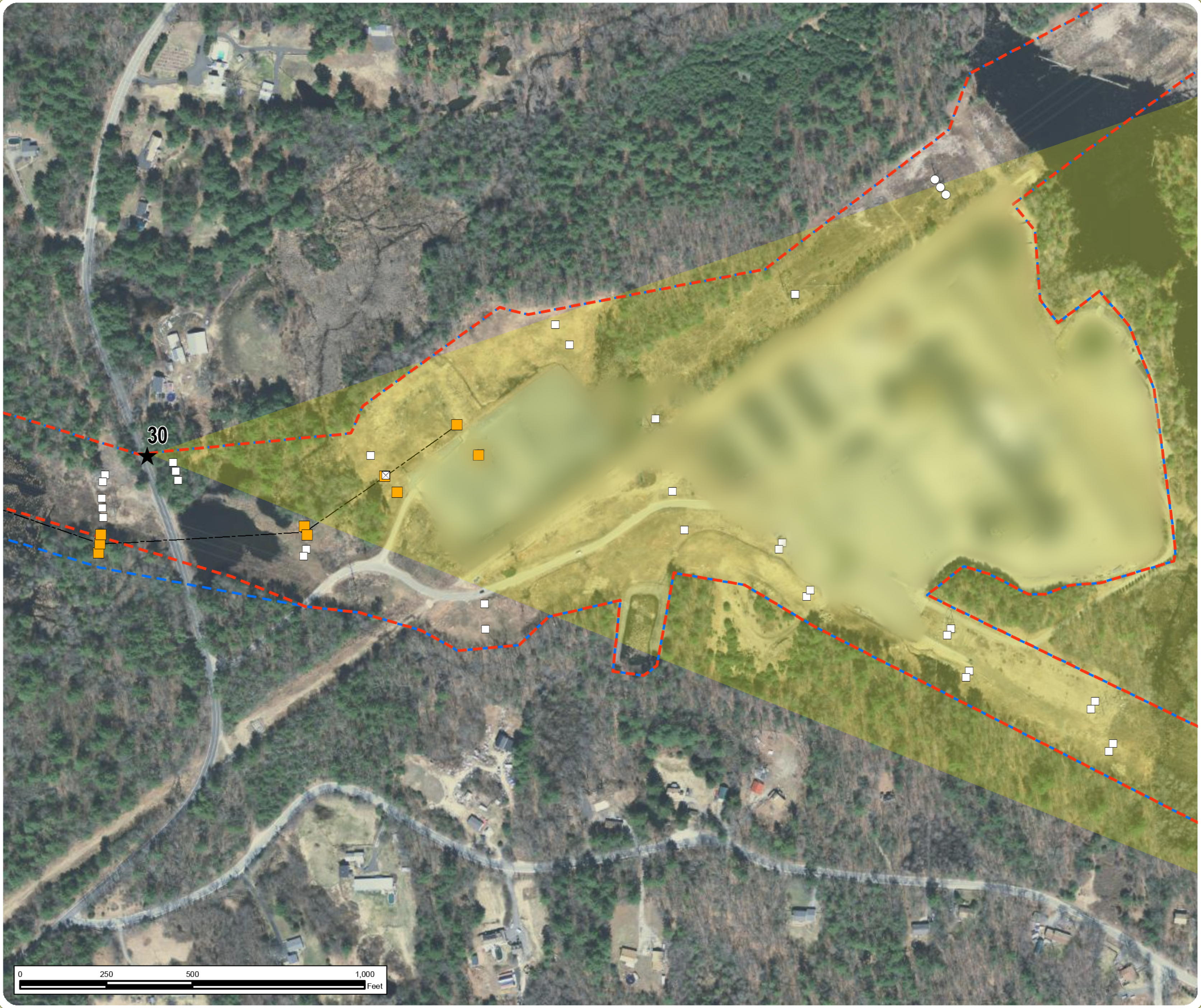


Burrillville Interconnection Project

Town of Burrillville, Providence County, Rhode Island

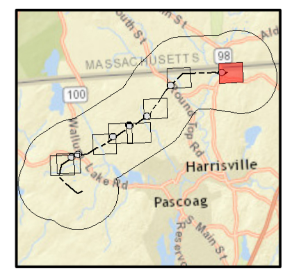
Figure 8: Viewpoint Location Map

Sheet 9 of 9
Viewpoint 30

January 2017

Legend

- Simulation Viewpoint
- Wood Pole To Be Removed
- Metal Pole To Be Removed
- Metal Pole To Be Relocated
- Metal Pole Proposed
- Metal Pole Existing
- Wood Pole Existing
- Existing Limit of Clearing
- Proposed Limit of Clearing
- Camera Cone of Vision
- Transmission Centerline



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5.2 Project Visual Impact

To illustrate anticipated visual changes associated with the proposed Project, photographic simulations of the completed Project from each of the eight simulation viewpoints indicated in Figure 8 were used to evaluate Project visibility and appearance. Review of these images, along with photos of the existing view, allowed for comparison of the aesthetic character of each view, with and without the proposed Project in place. Results of this evaluation are presented below.

5.2.1 Analysis of Existing and Proposed Views

Viewpoint 1 (Figure 9)

Existing View

Viewpoint 1 is located on Buck Hill Road in the western portion of the visual study area. The viewpoint is located on the west side of the existing cleared transmission line ROW where it crosses Buck Hill Road. It is approximately 45 feet from the nearest proposed structure that will be visible in this view. The existing view to the southwest features a cleared utility ROW dominated by low early successional vegetation. The ROW is bordered on both sides by dense deciduous forest, with the north edge of the ROW appearing to have been cut recently. The ROW includes two transmission lines carried on parallel H-frame structures. A line of forest vegetation forms a backdrop to the structures at an angle point where the line turns to the southwest. The forest vegetation that encloses the ROW on all sides blocks views of more distant landscape features. The existing transmission line structures are the focal point in this view, but are peripheral to the orientation of viewers driving down the road. The presence of the existing lines, along with the lack of variability in vegetation and landform, result in scenic quality that is relatively low.

Proposed Project

With the proposed Project in place, the ROW has been widened, and a third transmission line has been added along the north side of the ROW. The new line will be supported on steel davit arm structures that are taller and of a different design than the existing structures. The base of one of the new davit arm structures is directly in front of the viewer, and blocks views of some of the existing and proposed structures. Due to its proximity to the viewer, the large size and steel material of this structure are apparent. The existing wood pole H-frame structures that previously carried the line on the south side of the ROW have also been replaced with steel structures. However, these structures are similar to the existing structures in design, color, and scale, and at this viewing distance, the difference is subtle. The new structures match the existing structures in their color and location on the ROW, but the mix of designs and the additional height of the new structures results in moderate contrast with the sky at this viewpoint. The additional ROW clearing necessary to accommodate the new line is noticeable, but the overall character and scenic quality of the view remains relatively unchanged.

Simulation Information

Photograph Data
Date Taken: September 17, 2016
Time: 10:39 AM
Weather: Partly Cloudy

Camera Information
Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 51 MM
Camera Height: 5'

View Location
Orientation: Southwest
Location: Buck Hill Road, Town of Burrillville, Providence County

Visual Simulation Notes
1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information
Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 9: Viewpoint 1: View Southwest from Buck Hill Road, Existing Conditions

January 2017

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 10:39 AM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 51 MM
Camera Height: 5'

View Location

Orientation: Southwest
Location: Buck Hill Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 9: Viewpoint 1: View Southwest from Buck Hill Road, Simulation

January 2017

Viewpoint 8 (Figure 10)

Existing View

Viewpoint 8 is located on Wallum Lake Road in the western portion of the Project site. This viewpoint is located where the existing transmission line ROW crosses the public road, approximately 65 feet from the nearest proposed structure. It offers the only available open view of the lines in an area dominated by forest vegetation and widely scattered rural residences. The existing view to the southwest from this location features the cleared ROW in the immediate foreground, which includes an area of recently disturbed ground backed by low growing shrubs and old field vegetation. This early successional vegetation spans the full width of the ROW. The cleared ROW includes two parallel transmission lines. The nearest structures on both lines are three-pole dead-end structures made of self-weathering steel. More distant structures include wood and steel H-frames that extend away from the viewer to a second angle point in the distance. Due to the angles in the line, the cleared ROW is enclosed by mature deciduous forest, which blocks views of more distant landscape features. The terrain is gently rolling, and a lawn area and partially screened roof on the left side of the view indicate the presence of an adjacent residence. The dominant presence of the transmission line, and the lack of topographic and vegetation variability, result in relatively low scenic quality at this viewpoint.

Proposed Project

As with the previous viewpoint, with the proposed Project in place, the base of a new transmission structure appears directly in front of the viewer. At this distance, details of the pole's material, color and texture are apparent. Other poles on this new line can be seen (fully or in part) proceeding away from the viewer, parallel to the existing lines. The new poles are similar in color to the existing, but feature a davit arm, rather than an H-frame, design. They are also somewhat taller than the existing structures and the adjacent trees. The three-pole dead-end structures, and some of the more distant structures on the existing line, have also been upgraded as part of the Project, including a switch from wood poles to steel on the line to the left. The new structures appear more dominant against the sky, however, the height, color, and design of these new structures remains consistent with the existing structures. Similarly, although additional ROW width has been cleared to accommodate the new line, the clearing does not substantially change the appearance of the ROW. Addition of the new structures and overhead conductors increases the intensity of the utility land use, reduces the orderliness of the view, and adds some additional visual clutter. However, the dominant land use/visual character and overall scenic quality remain relatively unchanged following Project construction.

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 11:20 AM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Southwest
Location: Wallum Lake Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 10: Viewpoint 8: View Southwest from Wallum Lake Road, Existing Conditions

January 2017

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Simulation Information

Photograph Data
Date Taken: September 17, 2016
Time: 11:20 AM
Weather: Partly Cloudy

Camera Information
Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location
Orientation: Southwest
Location: Wallum Lake Road, Town of Burrillville, Providence County

Visual Simulation Notes
1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information
Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 10: Viewpoint 8: View Southwest from Wallum Lake Road, Simulation

January 2017

Viewpoint 11 (Figure 11)

Existing View

Viewpoint 11 is located on East Wallum Lake Road, within the designated Town Farm Road Scenic Area. The viewpoint is located where the existing transmission line ROW crosses the road and approximately 1,300 feet from the nearest proposed structure in the view. A closer proposed structure (475 feet from the viewer) exists, but is outside the image cone of view and therefore not visible in the simulation. The view to the southwest from this location features the cleared ROW, which includes low successional vegetation and a rudimentary access road. The ROW is bordered on both sides by dense deciduous forest. Because this vantage point is somewhat elevated, the rolling character of the topography is more evident, and a longer distance view to the horizon is available. In fact, distant transmission structures in the background can be seen against the sky above the forested horizon line. The focal points in this view are the existing transmission structures in the foreground. As in previous views, paired H-frame transmission structures, one made of wood poles (on the left) and one made of steel (on the right) proceed away from the viewer in parallel down the ROW. The elevated location of this viewpoint, and the longer stretch of straight ROW in the view, allows more transmission structures to be visible. However, descent of the ROW into a valley results in most of the structures not appearing substantially taller than the surrounding trees or breaking the skyline. The more noticeable variation in topography and the greater distance of the available view increases visual interest from this location. However, the presence of the existing lines and the uniformity of the adjacent forest cover results in relatively low visual quality.

Proposed Project

With the proposed Project in place, a third line of transmission structures has been added to the ROW. Because this line has been added to the far (left) side of the ROW, no new structures are seen in the immediate foreground. Although additional overhead conductors can be seen against the sky in the foreground, the presence of additional structures is only noticeable in the mid-ground and background portions of the view. One new structure can be seen breaking the skyline, but the shallow valley in the mid-ground appears to "swallow" the more distant poles. The additional clearing necessary to accommodate the new structures is difficult to perceive in the foreground, but more noticeable in the background portions of the view. Because the new structures mimic the design, color, height, and location of the existing structures, the contrast they present is minor. Although the ROW and sky above it includes somewhat more visual clutter, the overall appearance and visual quality of the view appears largely unchanged.

Simulation Information

Photograph Data
Date Taken: September 17, 2016
Time: 11:51 AM
Weather: Partly Cloudy

Camera Information
Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location
Orientation: Southwest
Location: E. Wallum Lake Road - Town Farm Road Scenic Area, Town of Burrillville, Providence County

Visual Simulation Notes
1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information
Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 11: Viewpoint 11: View Southwest from E. Wallum Lake Road - Town Farm Road Scenic Area, Existing Conditions

January 2017

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 11:51 AM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Southwest
Location: E. Wallum Lake Road - Town Farm Road Scenic Area, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 11: Viewpoint 11: View Southwest from E. Wallum Lake Road - Town Farm Road Scenic Area, Simulation

January 2017

Viewpoint 17 (Figure 12)

Existing View

This viewpoint is located on Town Farm Road, in the central portion of the Project site. It is located approximately 115 feet northwest of the edge of the existing ROW, about 420 feet from the nearest proposed structure. The existing view to the southeast from this location is oriented directly down Town Farm Road, similar to the perspective a driver or a passenger in an automobile would have. This rural two-lane road (and the view along it) is enclosed by deciduous trees on both sides. Rural residential land use is indicated only by the presence of driveways and mail boxes along the edge of the road. The only opportunity for more open views of the surrounding landscape and sky is along the existing cleared transmission line ROW, which can be seen as a perpendicular clearing and patch of sunlight immediately in front of the viewer. However, because the viewpoint is located outside the cleared ROW, views down it, including views of any existing structures, are not available from this location. Only the overhead conductors can be seen against the sky in the cleared corridor. Due to the lack of long distance views, the uniformity of the vegetation and topography, and the lack of any distinct visual focal points, the scenic quality of this view is relatively low.

Proposed Project

With the proposed Project in place, the existing view from Viewpoint 17 is largely unchanged. Some degree of tree clearing is evident along the far side of the ROW, which decreases the sense of enclosure around the road. However, from this viewpoint, the clearing does not result in a perceptively wider ROW. In addition, trees that line Town Farm Road screen views of the new structures that have been added to the ROW. Overhead conductors are now somewhat more visible against the sky, and viewers will notice the larger expanse of open area at the ROW crossing of the road. Otherwise, the visual character and quality of the view at this location appears unchanged.

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 12:40 PM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Southeast
Location: Town Farm Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 12: Viewpoint 17: View Southeast from Town Farm Road, Existing Conditions

January 2017

Simulation Information

Photograph Data
Date Taken: September 17, 2016
Time: 12:40 PM
Weather: Partly Cloudy

Camera Information
Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location
Orientation: Southeast
Location: Town Farm Road, Town of Burrillville, Providence County

Visual Simulation Notes
1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information
Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 12: Viewpoint 17: View Southeast from Town Farm Road, Simulation

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Viewpoint 18 (Figure 13)

Existing View

Viewpoint 18 is located on Town Farm Road in the central portion of the Project site. This viewpoint is located on the north side of the existing transmission line ROW, approximately 485 feet from the nearest structure that will be visible in the view to the southwest. The existing view in this direction looks directly down the ROW, which is dominated by low successional vegetation. The existing ROW includes two parallel transmission lines carried on side-by-side wood and steel H-frame structures. The cleared ROW is bordered by dense deciduous forest on both sides. The edges of the forest are abrupt, with the north edge appearing to have been cleared more recently. The topography is relatively level, but along the ROW appears to descend, before rising again to a forested horizon line in the distance. Trees on all sides of the ROW block views of more distant landscape features. Due to the lack of landscape variability, the visual interest and scenic quality of this view are relatively low.

Proposed Project

With the proposed Project in place, a third transmission line has been added to the ROW. The new line located to the south of the existing line, and is consistent with those lines in the location, scale/height, and design of its structures. Because the new line is on the far side of the ROW relative to the viewer's position, the additional clearing necessary to accommodate the new line is not striking, and has not appreciably increased the perceived width of the ROW. Similarly, although the new structures and overhead conductors extend above the tree line and add some visual clutter, new foreground structures do not present major changes in the view. Consequently, the Project does not significantly change the character or the scenic quality of the existing view.

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 12:41 PM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Southwest
Location: Town Farm Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 13: Viewpoint 18: View Southwest from Town Farm Road, Existing Conditions

January 2017

Simulation Information

Photograph Data
Date Taken: September 17, 2016
Time: 12:41 PM
Weather: Partly Cloudy

Camera Information
Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location
Orientation: Southwest
Location: Town Farm Road, Town of Burrillville, Providence County

Visual Simulation Notes
1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information
Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 13: Viewpoint 18: View Southwest from Town Farm Road, Simulation

January 2017

Viewpoint 21 (Figure 14)

Existing View

Viewpoint 21 is located at the existing ROW crossing of Hill Road, in the central portion of the Project site. The existing view to the northeast from this location includes two parallel transmission lines within a cleared ROW. The viewpoint is approximately 455 feet from an angle point in the lines characterized by three-pole dead-end structures that dominate the view. The structures on the west are steel, while those on the east are wood poles. The structures that proceed away from these angle structures are of the same materials. The cleared ROW includes a pole gate and maintained lawn area in the immediate foreground, backed by shrubby early successional vegetation. The cleared ROW is bordered by abrupt forested edges. The surrounding forest is dense and confines outward views to the cleared ROW. The rolling topography in this area can be seen along the cleared ROW, but the overall change in elevation appears minor. The lack of topographic and vegetation variability, along with the dominance of utility infrastructure, result in relatively low scenic quality in this view.

Proposed Project

With the proposed Project in place, a third transmission line has been added to the right side of the ROW. In addition, the existing wooden three-pole dead end structure has been replaced with a steel structure. The new/replacement structures have a heavier visual mass and extend farther into the sky. However, these structures are consistent with those of the existing lines in their design, location, height, and color. The newly cleared ROW area necessary to accommodate the new line is difficult to perceive from this viewpoint. Despite the addition of multiple new poles and overhead conductors, the land use character and scenic quality of this view have not significantly changed.

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 1:02 PM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Northeast
Location: Hill Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

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Figure 14: Viewpoint 21: View Northeast from Hill Road, Existing Conditions

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Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 1:02 PM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Northeast
Location: Hill Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Figure 14: Viewpoint 21: View Northeast from Hill Road, Simulation

Viewpoint 26 (Figure 15)

Existing View

Viewpoint 26 is located on Round Top Road in the eastern portion of the Project site. This somewhat elevated viewpoint is at the crossing of the existing transmission line ROW, approximately 535 feet from the nearest new structure that will be visible in this view. The existing view to the northeast looks down a cleared ROW that is bordered by dense mixed forest. The cleared ROW is dominated by early successional vegetation and includes two parallel transmission lines carried on side-by-side H-frame structures; one utilizing wood poles, the other steel. The ROW proceeds to an angle point in the mid-ground, where it turns to the southeast and thereafter is screened by forest vegetation. The ROW includes areas that have been recently restored (presumably following construction of the line on the northwest), which are characterized by a lack of vegetation and evidence of recent hydroseeding. The edge of Round Top Road and a pole gate at the entrance to a ROW access road are visible in the immediate foreground. The utilitarian land use and enclosed character of the existing view result in relatively low scenic quality and visual interest.

Proposed Project

With the proposed Project in place, a third transmission line has been added to the southeast side of the ROW, directly in front of the viewer. The new line is consistent with the existing lines in terms of the location, height, color, and design of the proposed structures. Addition of the new line increases the abundance of utility infrastructure and visual clutter present in the view. The ROW clearing necessary to accommodate the new line is also noticeable from this viewpoint. Loss of vegetation in the immediate foreground, and the resulting view down the newly cleared corridor, make the view substantially more open/broad. Although the perception of utility land use has been intensified with the Project in place, the visual character and scenic quality of the view do not substantially change as a result of the proposed Project.

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 1:56 PM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Northeast
Location: Round Top Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Figure 15: Viewpoint 26: View Northeast from Round Top Road, Existing Conditions

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 1:56 PM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: Northeast
Location: Round Top Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

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Burrillville, Providence County, Rhode Island

Figure 15: Viewpoint 26: View Northeast from Round Top Road, Simulation

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Viewpoint 30 (Figure 16)

Existing View

Viewpoint 30 is located on Sherman Farm Road near the southern end of the Project site. It is located at the existing ROW crossing, and is approximately 680 feet from the existing Sherman Road Switching Station, and 685 feet from the nearest proposed structure that will be visible in this view. The existing view to the east from this location includes the base of a steel transmission structure in a cleared ROW in the immediate foreground. Additional davit arm steel structures can be seen farther down the ROW, along with a portion of the existing switching station. The station is partially screened by trees on the north side of the ROW. Deciduous trees enclose the ROW on both sides and screen views of off-ROW features in the landscape. However, views directly down the cleared ROW reveal not only a portion of the switching station, but associated construction trailers, as well as stacks and other built components of the Ocean State Power Facility. Foreground trees and mid-ground structures enclose the view. The abundance of utility and industrial infrastructure define the character of the view and result in relatively low scenic quality.

Proposed Project

With the proposed Project in place, the cleared ROW has been substantially widened to accommodate a new transmission line on the south side of the ROW. A new davit arm structure and overhead conductors associated with the new line had been added, and are clearly visible against the sky. In addition, clearing for the new line appears substantial from this perspective, and has opened views of additional components of the switching station and an additional stack associated with the Ocean State Power Facility. The widened cleared ROW has made the view appear much more open. This, along with the greater abundance of visible utility/industrial infrastructure, have increased visual clutter and reduced scenic quality. However, the impact of these changes is limited by the utilitarian character and low scenic quality of the existing view.

Simulation Information

Photograph Data
Date Taken: September 17, 2016
Time: 2:17 PM
Weather: Partly Cloudy

Camera Information
Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location
Orientation: East
Location: Sherman Farm Road, Town of Burrillville, Providence County

Visual Simulation Notes
1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information
Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island

Figure 16: Viewpoint 30: View East from Sherman Farm Road, Existing Conditions

January 2017

Simulation Information

Photograph Data

Date Taken: September 17, 2016
Time: 2:17 PM
Weather: Partly Cloudy

Camera Information

Camera Make/Model: Nikon D7100
Sensor Dimensions: 35 mm
Lens Focal Length: 48 MM
Camera Height: 5'

View Location

Orientation: East
Location: Sherman Farm Road, Town of Burrillville, Providence County

Visual Simulation Notes

1. Visual Simulation is based on 3D model data available at the time from Power Engineers via ESS Group, Inc. Data is only as accurate as the original source and is not guaranteed by EDR.
2. This simulation depicts transmission line elements relative to the viewer position, and considers the effects of tree and vegetation clearing.

Technical Information

Software: AutoCad; 3ds Max; Adobe Photoshop CC; Digital elevation data source: RIGIS 2011 LIDAR.

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Figure 16: Figure 9: Viewpoint 30: View East from Sherman Farm Road, Simulation

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5.2.2 Impact Evaluation

Evaluation of the simulations of the proposed Project by a panel of landscape architects indicated that overall visual contrast and impact on scenic quality is likely to be somewhat variable, but generally minimal. For the eight simulations evaluated, individual viewpoint ratings ranged from 0.1 to 1.7. Composite contrast ratings ranged from 0.31 to 1.14, and averaged 0.77 on a scale of 0 (insignificant) to 4 (strong). This rating indicates an overall minimal contrast with existing conditions. This is largely due to the fact that the Project is proposed on an existing cleared ROW that already accommodates two major transmission lines, and that open views of the Project are only available where the ROW crosses public roads. Consequently, scenic quality and viewer sensitivity to visual change are low, as utility infrastructure already dominates the existing view in almost all cases. When looking at Project contrast with individual components of the landscape, the ratings indicate moderate contrast with the existing vegetation and sky due to the required clearing of the ROW and the greater height and/or visual presence of the new structures. However, the overall rating generally reflects insignificant to minor contrast in the categories of land form, land use and viewer activity due to the fact that the Project is proposed within an existing transmission corridor.

Viewpoint 30 received the highest composite contrast rating (1.08), indicating a minimal overall visual contrast with existing conditions. As in most of the viewpoints, this is largely attributable to the dominance of utility infrastructure in the existing view and the resulting low baseline scenic quality. The somewhat higher contrast rating received by this viewpoint is a result of the perception of more substantial vegetation clearing, which results in a more open view that includes additional existing and proposed utility infrastructure. Viewpoint 8 received the second highest composite contrast rating (1.07), also indicating minimal overall visual contrast. At this viewpoint, the proximity of one new structure, the heavier replacement dead-end structures, and the greater height of the new structures create additional visual clutter against the sky and increase the visual intensity of the existing utility land use. However, as with all of the other viewpoints, this impact is limited by the dominance of existing utility structures, low scenic quality, and the fleeting duration of the view. The lowest overall contrast rating was received by Viewpoint 11 (0.4), where clearing of the far side of the existing ROW and the addition of new structures similar in design to the existing results in only very minor contrast with existing visual conditions.

Table 3. Visual Impact Assessment Summary

Viewpoint	Contrast Score[1]			
	Rater 1	Rater 2	Rater 3	Average
1	1.4	0.4	0.5	0.77
8	1.6	0.3	1.3	1.07
11	0.4	0.5	0.3	.0.40
17	0.1	0.3	1.7	0.70
18	0.4	0.3	0.8	0.50
21	0.4	0.1	1.2	0.57
26	1.2	0.3	1.6	1.03
30	1.3	0.3	1.7	1.08
Average	0.85	0.31	1.14	0.77

[1]On a scale of 0 to 4, where: 0 = Insignificant, 1 = Minor, 2 = Moderate, 3 = Appreciable, and 4 = Strong.

6.0 CONCLUSIONS

The VIA for the Project allows the following conclusions to be drawn:

1. Based on topographic viewshed analysis (i.e., analysis that considers only the screening provided by landform) approximately 87.2% of the visual study area could have potential views of the proposed Project; however, this only represents a 0.5% increase in visible area when compared to the topographic viewshed of the existing transmission lines. When the screening effect of mapped forest vegetation is factored into the viewshed analysis, approximately 5.4% of the study area has potential views of the proposed Project. This represents a 0.8% increase in visible area when compared to the vegetation/topographic viewshed of the existing transmission lines.

2. Topographic viewshed analysis indicates that views of the proposed transmission line could potentially be available from the majority of the visually sensitive resources that occur within the 1-mile visual study area. However, vegetation viewshed analysis suggest that views of the Project from many of these sensitive sites will be fully or significantly screened by intervening forest vegetation.

3. Field review suggests that actual Project visibility is likely to be more limited than suggested by viewshed mapping. Mature forests throughout the study area screen (or partially screen) views of the Project from most locations. The existing 341 and 347 Transmission Lines were visible (and therefore, the Project would be visible) from within the ROW when crossed by public roads. These types of views will be temporary and fleeting for vehicular traffic. Bikers and walkers will experience slightly more exposure to the changes introduced by the Project, but the effect will still be fleeting in nature.

4. Fieldwork also confirmed that views from visually sensitive sites toward the Project are also likely to be more limited than suggested by viewshed analysis. In almost all cases, views of the Project from sensitive sites located outside the immediate Project ROW will be partially or completely screened. From all of the documented historic sites within the study area, views of the existing transmission lines are screened by intervening topography and vegetation. The existing transmission lines run through the Round Top Management Area, Town Farm Road/Wilson Reservoir State Scenic Area, Wallum Lake State Scenic Area, and the Wallum Lake Rod and Gun Club. Open, unobstructed views of the Project will be available from multiple locations within these areas. However, these resources include large areas of land and the types of activities they offer are typically focused away from the ROW and those activities will not be adversely impacted by the addition of the proposed 3052 Line. For example, public fishing access areas at the Big Top Management Area revealed no visibility of the existing transmission lines.

5. Simulations of the proposed transmission line indicate that the Project will not significantly alter the visual character and scenic quality of the existing views. Evaluation by a panel of landscape architects indicates that the proposed transmission lines' overall contrast with the visual/aesthetic character of the area will generally be minimal. Some degree of contrast with the existing vegetation and sky was noted for several viewpoints due to clearing within the ROW and the new structures' greater height, and more dominant visual presence. However, this effect was limited due to the proposed location of the Project on an existing transmission line ROW with low baseline scenic quality.

6. As indicated by the results of the analyses summarized above, visual impact of the proposed Project will generally be restricted to sites where public roads cross the ROW and offer an unobstructed view of the proposed transmission lines. In all instances, views of the landscape from these road crossings already include the existing transmission lines. Siting of the proposed line within an existing transmission corridor significantly reduces adverse visual impacts by avoiding the need for additional ROW clearing and minimizing perceived change in land use. The H-frame design of many of the new structures is consistent with the design of the existing structures, and limits the extent to which the new structures extend above the adjacent tree lines into the sky. The natural brown color of the self–weathering steel poles also generally blends well with the existing structures on the ROW and the background vegetation. As a result, mitigation of visual impacts does not appear warranted.

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Appendix A

Sensitive Site Table

Visually Sensitive Resource	Location: Town	Location: County	VP Number[1]	Distance[2]: Miles from Transmission Line	Project Visibility[3] (+ Visible - Not Visible +/- Partially Visible): Topographic Viewshed	Topographic & Vegetation Viewshed	Field Review
1. Properties listed on the National or State Register of Historic Places							
South Douglas Historic Area	Douglas, MA	Worcester, MA		0.1	+/-*	+/-*	
Sherman, Smith House	Douglas, MA	Worcester, MA		0.5	+	-	
Coombs, Jesse House	Douglas, MA	Worcester, MA		0.7	+	-	
Baker Cemetery	Douglas, MA	Worcester, MA		0.8	+	-	
South Douglas Cemetery	Douglas, MA	Worcester, MA		1.0	+	-	
Properties which are candidates for listing on the National Register of Historic Places							
A. Paine Farm	Burrillville, RI	Providence, RI		0.3	+	-	
J. Millard House/Barksfield	Burrillville, RI	Providence, RI	13	0.4	+	+/-*	
2. State Parks							
None in Study Area							
3. Heritage Areas							
John H. Chafee Blackstone River Valley National Heritage Corridor	Burrillville, RI; Douglas and Uxbridge, MA	Providence, RI; Worcester, MA	All Viewpoints	0.0	+/-*	+/-*	+
4. State Forest Land							
George Washington Management Area	Burrillville, RI	Providence, RI		0.6	+	-	-
5. National Wildlife Refuges, State Game Refuges and State Wildlife Management Areas							
Round Top Management Area	Burrillville, RI	Providence, RI	22, 25, 27, 28	0.0	+/-*	+/-*	+
George Washington Management Area	Burrillville, RI	Providence, RI		0.1	+/-*	-	-
Buck Hill Management Area	Burrillville, RI	Providence, RI		0.4	+/-*	+/-*	
Black Hut Management Area	Burrillville, RI	Providence, RI	31	0.5	+/-*	-	-
Chockalog Swamp WMA	Uxbridge, MA	Worcester, MA		0.9	+/-*	-	
6. National Natural Landmarks							
None in Study Area							

Visually Sensitive Resource	Location: Town	Location: County	VP Number[1]	Distance[2] Miles from Transmission Line	Project Visibility[3] (+ Visible - Not Visible +/- Partially Visible): Topographic Viewshed	Topographic & Vegetation Viewshed	Field Review
7. National Parks, Recreation Areas, Seashores and/or Forests							
None in Study Area							
8. National or State Designated Wild, Scenic, or Recreational Rivers							
None in Study Area							
9. Sites, Areas, Lakes, Reservoirs or Highways Designated or Eligible as Scenic							
Town Farm Rd./Wilson Reservoir State Scenic Area	Burrillville, RI	Providence, RI	10,11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 32	0.0	+/-*	+/-*	+
Wallum Lake State Scenic Area	Burrillville, RI	Providence, RI	8, 9	0.0	+/-*	+/-*	+
Round Pond State Scenic Area	Burrillville, RI	Providence, RI	7	0.0	+/-*	+/-*	+/-
Wakefield Rd./Croft Farm State Scenic Area	Burrillville, RI	Providence, RI		0.6	+/-*	-	
10. State and Federally Designated Trails							
Rhode Island State Bike Route	Burrillville, RI	Providence, RI	1, 8, 17, 18, 26, 30	0.0	+/-*	+/-*	+
North-South Trail	Burrillville, RI	Providence, RI		0.1	+/-*	+/-*	+
11. State Nature and Historic Preserve Areas							
None in Study Area							
Locally Important Resources							
Areas of Intensive Land Use (City, Village, Hamlet)							
Village of Pascoag	Burrillville, RI	Providence, RI		0.0	+	-	
Transportation Corridors							
SR 96	Burrillville, RI; Douglas, MA	Providence, RI; Worcester, MA	25, 26	0.0	+/-	+/-*	+
SR 98	Burrillville, RI; Douglas, MA	Providence, RI; Worcester, MA	29, 30	0.0	+/-*	+/-*	+

	Location			Distance[2]	Project Visibility[3] +Visible - Not Visible +/- Partially Visible		
Visually Sensitive Resource	Town	County	VP Number[1]	Miles from Transmission Line	Topographic Viewshed	Topographic & Vegetation Viewshed	Field Review
SR 100	Burrillville, RI	Providence, RI	8, 9	0.0	+	+/-*	+
Recreation Resources							
Local Parks							
Wallum Rod & Gun Club	Burrillville, RI	Providence, RI		0.0	+/-*	+/-*	+
Buck Hill BSA	Burrillville, RI	Providence, RI		0.5	+/-*	+/-*	
Fayette E Bartlett Woodland	Burrillville, RI	Providence, RI	31	0.7	+/-*	-	+
Hale Swamp	Uxbridge, MA	Worcester, MA		0.8	+/-*	-	
Bike Route							
Burrillville Bike Route	Burrillville, RI	Providence, RI	12	0.0	+/-*	+/-*	+
Trails							
Round Top Management Area Trail	Burrillville, RI	Providence, RI	22, 27, 28	0.0	+/-*	+/-*	+
George Washington Management Area Trail	Burrillville, RI	Providence, RI		0.8	+/-*	-	
Black Hut Management Area Trail	Burrillville, RI	Providence, RI		0.9	+/-*	-	
Lakes and Rivers							
Chockalog River	Burrillville, RI; Douglas, MA	Providence, RI; Worcester, MA		0.0	+	+/-*	
Clear River	Burrillville, RI	Providence, RI		0.0	+	+/-*	+
Dry Arm Brook	Burrillville, RI	Providence, RI		0.0	+/-*	+/-*	
Mowry Brook	Burrillville, RI	Providence, RI		0.0	+	+/-*	
Round Top Brook	Burrillville, RI; Douglas, MA	Providence, RI; Worcester, MA	28	0.0	+/-*	+/-*	-
Round Pond	Burrillville, RI	Providence, RI	7	0.1	+	+/-*	-
Big Round Top Pond	Burrillville, RI	Providence, RI	27, 28	0.2	+	+/-*	-
Iron Mine Brook	Burrillville, RI	Providence, RI		0.3	+/-*	-	

Visually Sensitive Resource	Location			Distance[2]	Project Visibility[3] +Visible - Not Visible +/- Partially Visible		
	Town	County	VP Number[1]	Miles from Transmission Line	Topographic Viewshed	Topographic & Vegetation Viewshed	Field Review
Little Round Top Pond	Burrillville, RI	Providence, RI	22	0.4	+	+/-*	-
Tinkerville Brook	Douglas, MA	Worcester, MA		0.4	+/-	+/-*	
Cedar Swamp Brook	Douglas and Uxbridge, MA	Worcester, MA		0.5	+/-*	-	
Greene Brook	Douglas, MA	Worcester, MA		0.5	+	-	
Cedar Swamp Pond	Burrillville, RI	Providence, RI		0.6	+/-*	-	
Wilson Reservoir	Burrillville, RI	Providence, RI	10	0.6	+/-*	+/-*	-
Goat Rock Brook	Burrillville, RI	Providence, RI		0.7	+/-*	-	
Croft Farm Brook	Burrillville, RI	Providence, RI		0.9	-	-	
Leland Brook	Burrillville, RI	Providence, RI		0.9	+/-*	-	
Wakefield Pond	Burrillville, RI	Providence, RI		0.9	+/-*	-	
Case Pond	Douglas, MA	Worcester, MA		1.0	+/-	-	
RIDEM Land							
Round Top Fishing Area	Burrillville, RI	Providence, RI	22, 25, 27, 28	0.0	+/-*	+/-*	-
Schofield/Gillis Conservation Easement	Burrillville, RI	Providence, RI		0.9	+/-*	-	
Wakefield Pond Access Area	Burrillville, RI	Providence, RI		0.9	+/-*	-	
Flowage (Nipmuc River) Land Conservation Easement	Burrillville, RI	Providence, RI		1.0	+	-	
Golf Courses							
Blissful Meadows Golf Course	Douglas and Uxbridge, MA	Worcester, MA		1.0	+	-	
Cemeteries							
Young-White Lot Cemetery	Burrillville, RI	Providence, RI		0.2	+	+/-*	
Abigail Cemetery	Burrillville, RI	Providence, RI		0.3	+	+/-*	
Aldrich-Thayer Cemetery	Burrillville, RI	Providence, RI		0.3	+	+/-*	

Visually Sensitive Resource	Location: Town	Location: County	VP Number[1]	Distance[2] Miles from Transmission Line	Project Visibility[3] (+Visible - Not Visible +/- Partially Visible): Topographic Viewshed	Topographic & Vegetation Viewshed	Field Review
Logee Lot Cemetery	Burrillville, RI	Providence, RI		0.3	+	-	
Paine Lot	Burrillville, RI	Providence, RI		0.3	+	-	
Brown-Millard Lot Cemetery	Burrillville, RI	Providence, RI		0.4	+	-	
Howard Lot Cemetery	Burrillville, RI	Providence, RI		0.4	+	-	
Arnold Lot	Burrillville, RI	Providence, RI		0.5	+	-	
Rev Moab Paine Lot Cemetery	Burrillville, RI	Providence, RI		0.5	+	-	
Rufus Aldrich Cemetery	Burrillville, RI	Providence, RI		0.5	+/-*	-	
Jacobs Cemetery	Uxbridge, MA	Worcester, MA		0.6	+	+/-*	
Sayles Lot Cemetery	Burrillville, RI	Providence, RI		0.6	+	-	
Robbins-Lapham Lot Cemetery	Burrillville, RI	Providence, RI		0.7	+	-	
Sherman-Burlingame Lot Cemetery	Burrillville, RI	Providence, RI		0.7	+	-	
Taft Lot Cemetery	Burrillville, RI	Providence, RI		0.7	+	-	
White Lot Cemetery	Burrillville, RI	Providence, RI		0.7	+/-*	-	
Albee-Paine Cemetery	Burrillville, RI	Providence, RI		0.8	+	-	
Hicks-Smith Lot Cemetery	Burrillville, RI	Providence, RI		0.8	+	-	
Samuel Smith Lot Cemetery	Burrillville, RI	Providence, RI		0.9	+	+/-	
Paine Lot Cemetery	Burrillville, RI	Providence, RI		0.9	+	+/-	
Whipple Lot Cemetery	Burrillville, RI	Providence, RI		0.9	+	-	

Appendix B

Photo Log
and
Field Notes

EDR Project: Burrillville Interconnection Project

Date: 9/17 Weather: Clear Sunny Camera: D7100 Sheet: 1 of ___ Initials: GWP

VP #	GPS #	Photo Reference	Time	Location/ Sensitive Resource/ Comments	Direction of View
01	001	6072 - 6083	1037	Buck Hill Road Crossing	180
02	002	6084 - 6097	1041	Buck Hill Road	90
03	003	6098 - 6109	1042	Buck Hill Rd.	180
04	004	6110 - 6114	1044	Buck Hill Rd	NE
05	005	6115 - 6120	1045	Buck Hill Rd	SW
06	006	6121 - 6124	1103	Doe Crossing Rd. Round Pond Scenic Area	E
07	007	6125 - 6134	1109	Round Pond	E
08	008	6135 - 6148	1119	Wallum Lake Rd	180
09	009	6149 - 6168	1122	Wallum Lake Rd	180
10	010	6169 - 6176	1135	E.Wallum Lk Rd - Wilson Reservoir	W
11	011	6177 - 6196	1151	E.Wallum Lk Rd - Crossing T.Farm Rd Scenic Area	E+W
12	012	6205 - 6212	1203	Nr. mapped Bike Trail (Trail not found)	E+W
13	013	6215 - 6216	1222	J. Millard House ?	N
14	014	6217 - 6218	1226	Algonquin Line Crossing	N
15	015	6219 - 6232		Town Farm Road Scenic	E+W
16	016	6233 - 6238	12:38	Town Farm Rd Scenic	N
17	017	6239 - 6245	12:40	Town Farm Rd Scenic	S
18	018	6246 - 6257	12:42	Town Farm Rd Scenic	E+W
19	019	6258 - 6265	1256	Hill Rd	S
20	020	6266 - 6280	1258	Hill Rd	E+W
21	021	6281 - 6288	1302	Hill Rd	E
22	022	6289 - 6299	1321	Round Top MA Public Fishing Area	N
23	023	6300 - 6311	1339	Collins Taft Rd.	W
24	024	6312 - 6327	1340	Collins Taft Rd	W+E
25	025	6328 - 6332	1353	Round Top Rd.	S
26	026	6333 - 6345	1356	Round Top Rd	W+E
27	027	6346 - 6347	1403	Round Top Fishing Area	N
28	028	6348 - 6353	1404	Round Top Fishing Area	N
29	029	6355 6367	1416	Sherman Farms Rd	E+W
30	030	6368 - 6376	1418	Sherman Farms Rd	E+W
31	031	6377 - 6380	1426	Douglas Pike Black Hut MA	W
32	032	6381 - 6386	1445	E Wallum Lake Rd. + Stone Barn Rd.	S

Viewpoint 1

Location:
Buck Hill Road

Direction of View:
Southwest

Viewpoint 2

Location:
Buck Hill Road

Direction of View:
Northeast

Viewpoint 3

Location:
Buck Hill Road

Direction of View:
Southwest

Viewpoint 4

Location:
Buck Hill Road

Direction of View:
Southwest

Viewpoint 5

Location:
Buck Hill Road

Direction of View:
Northeast

Viewpoint 6

Location:
Doe Crossing Drive - Round Pond Scenic Area

Direction of View:
East

Viewpoint 7

Location:
Round Pond

Direction of View:
Northeast

Viewpoint 8

Location:
Wallum Lake Road

Direction of View:
Southwest

Viewpoint 9

Location:
Wallum Lake Road

Direction of View:
West

Viewpoint 10

Location:
E. Wallum Lake Road -
Wilson Reservoir

Direction of View:
Northwest

Viewpoint 11

Location:
E. Wallum Lake Road Crossing - T. Farm Road Scenic Area

Direction of View:
Southwest

Viewpoint 12

Location:
Near Mapped Bike Trail

Direction of View:
Southwest

Viewpoint 13

Location:
E. Wallum Lake Road

Direction of View:
Northwest

Viewpoint 14

Location:
E. Wallum Lake Road

Direction of View:
Northwest

Viewpoint 15

Location:
Town Farm Road

Direction of View:
Northeast

Viewpoint 16

Location:
Town Farm Road

Direction of View:
Northwest

Viewpoint 17

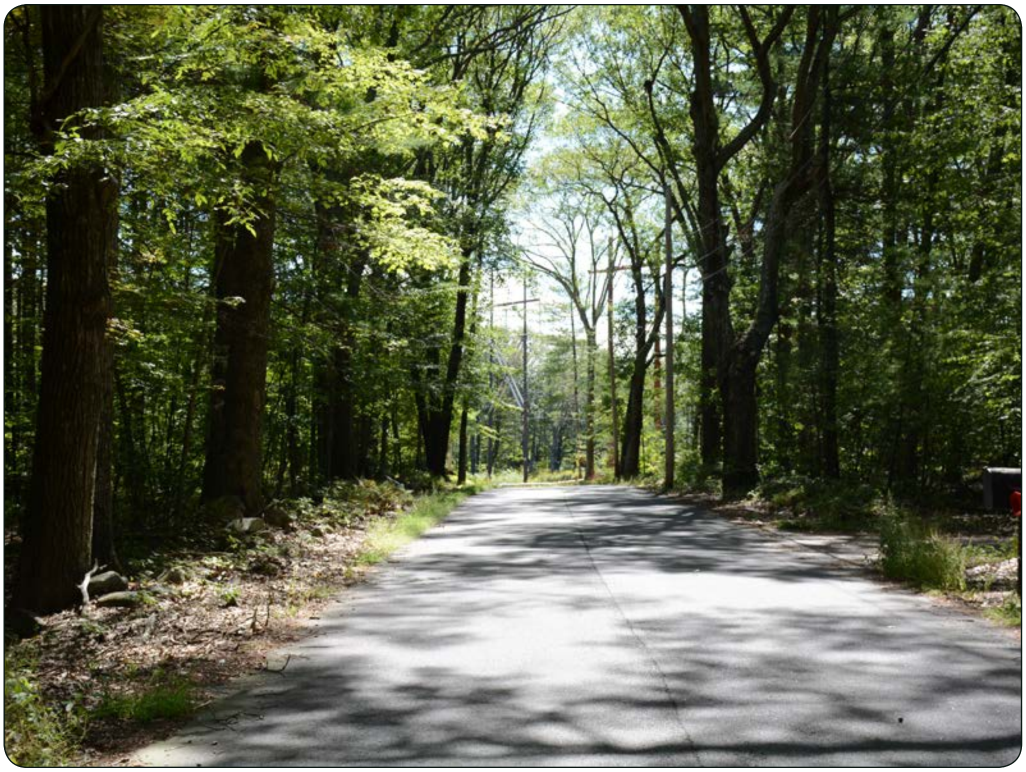
Location:
Town Farm Road

Direction of View:
Southeast

Viewpoint 18

Location:
Town Farm Road

Direction of View:
Southwest



Viewpoint 19

Location:
Hill Road

Direction of View:
South

Viewpoint 20

Location:
Hill Road

Direction of View:
Southwest

Viewpoint 21

Location:
Hill Road

Direction of View:
Northeast

Viewpoint 22

Location:
Little Round Top Pond

Direction of View:
Northwest

Viewpoint 23

Location:
Collins Taft Road

Direction of View:
Southwest

Viewpoint 24

Location:
Collins Taft Road

Direction of View:
East

Viewpoint 25

Location:
Round Top Road

Direction of View:
Southeast

Viewpoint 26

Location:
Round Top Road

Direction of View:
Northeast

Viewpoint 27

Location:
Big Round Top Pond

Direction of View:
North

Viewpoint 28

Location:
Big Round Top Pond

Direction of View:
Northwest

Viewpoint 29

Location:
Sherman Farm Road

Direction of View:
West

Viewpoint 30

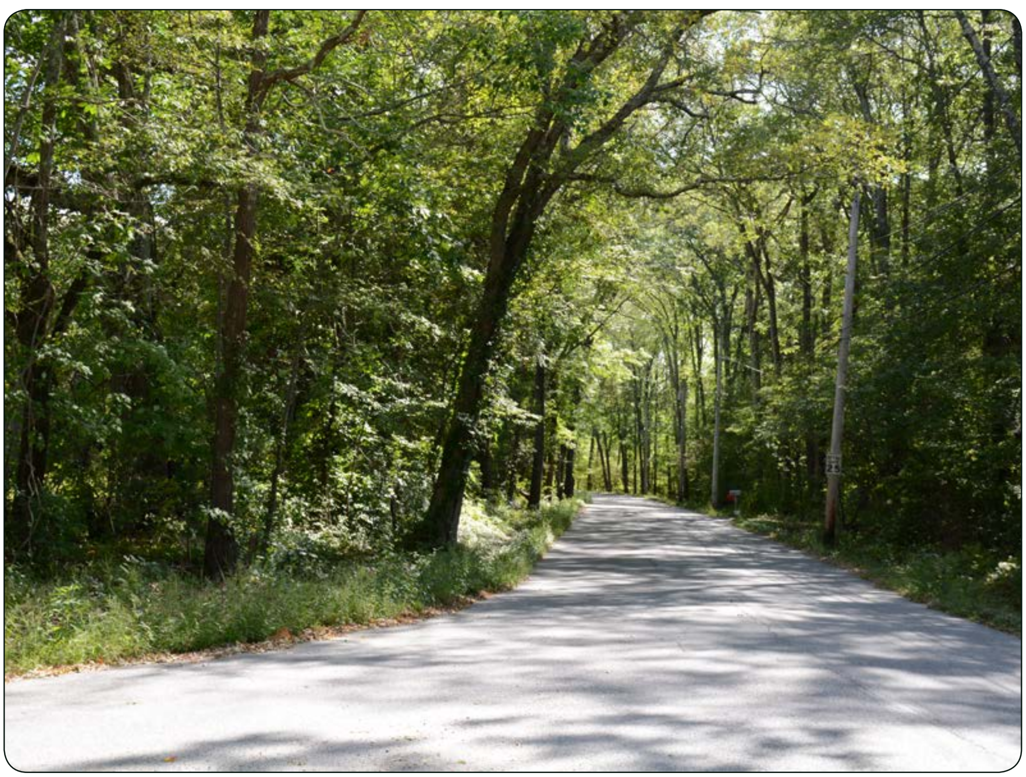
Location:
Sherman Farm Road

Direction of View:
East

Viewpoint 31

Location:
W. Ironstone Road

Direction of View:
West



Viewpoint 32

Location:
E. Wallum Lake Road and
Stone Barn Road

Direction of View:
South

Appendix C

Contrast Rating Forms and Resumes

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: Jocelyn Gravitt
Date: 11/11/16

Viewpoint Information:
Viewpoint Number: 1
Viewpoint Location: Buck Hill Road
Direction of View: Southwest
Landscape Similarity Zone: Forested

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☒ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*
Utility line corridor populated with two transmission lines. Wide swath of land cleared to accomodate structures.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0	Additional structures highly visible but in keeping with existing conditions.
Vegetation	1	Additional forest cleared to accomodate new structures
Land Use	.5	Same, expanded
Water	N/A	N/A
Sky	1	Additional clearing opens view to sky.
Viewer Activity	0	Insignificant
TOTAL	2.5	*Total all scores above*
AVERAGE	0.5	*Average all scores above*

Contrast Rating Score Chart
- 0 Insignificant
- .5
- 1 Minimal
- 1.5
- 2 Moderate
- 2.5
- 3 Appreciable
- 3.5
- 4 Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 1
Buck Hill Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal Foliage could influence contrast between cleared swath and adjacent forest.

Perceived effect on scenic quality/viewer enjoyment:

Proposed structures add to the poor quality of the existing view, making it somewhat more noticeable and less pleasant. Little impact will be had on viewer enjoyment as the scene was already full of utilities.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: Jocelyn Gavitt

Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 8

Viewpoint Location: Wallum Lake Road

Direction of View: Southwest

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☐ Repeated/Regular

☒ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Existing view is dominated by utility structures and a large cleared corridor with some wild growth of low plants.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1	Utility structures dominate the landform - before and after
Vegetation	1	Some vegetation is removed.
Land Use	1	Stays the same - but proposed structures create higher intensity
Water	N/A	
Sky	2	Proposed structures are more dominant against the skyline than existing.
Viewer Activity	1.5	Proposed alterations increase visual intensity of utilities
TOTAL	6.5	*Total all scores above*
AVERAGE	1.3	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 8
Wallum Lake Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal foliage might alter contrast of utility structures against mature vegetation.

Perceived effect on scenic quality/viewer enjoyment:

Proposed changes increase the visual dominance of utility structures in this already cluttered viewpoint.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: JOCELYN GRAVITT

Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 11

Viewpoint Location: E. Wallum Lake Road - Town Farm Road Scenic Area

Direction of View: Southwest

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☐ Repeated/Regular

☒ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Existing view is a perspectival view down a utility corridor, widely cleared and populated with tall, visible structures.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0	Widening of cleared swath does not have any significant effect on view
Vegetation	1	Elimination of some vegetation to widen cleared area creates minimal contrast
Land Use	.5	Proposed utilities consistent with existing.
Water	N/A	N/A
Sky	0	Additional utilities and clearing are hardly noticeable
Viewer Activity	0	Insignificant change/contrast
TOTAL	1.5	*Total all scores above*
AVERAGE	0.3	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 11

E. Wallum Lake Road - Town Farm Road Scenic Area

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal defoliation might alter the level of contrast that the additional clearing creates by a slight amount.

Perceived effect on scenic quality/viewer enjoyment:

This is not a high quality view to begin with, due to presence of existing utilities. Little change occurs overall with regard to the proposed changes in the simulation.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: Jocelyn Gavitt

Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 17

Viewpoint Location: Town Farm Road

Direction of View: Southeast

Landscape Similarity Zone: Forested/Rural Residential

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☐ Low ☒ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular

☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Existing view down a road corridor, through forest canopy, with a clearing in the mid-ground. Somewhat visible overhead wires above clearing area.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1	Deforestation creates a more open landform in the center of this view.
Vegetation	2.5	Elimination of forest vegetation decreases sense of enclosure around road.
Land Use	2	The shift from forest to open clearing is visible.
Water	N/A	
Sky	1	The reduction of forest makes sky slightly more prominent.
Viewer Activity	2	Viewer will notice the larger expanse of open area along this drive.
TOTAL	8.5	*Total all scores above*
AVERAGE	1.7	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 17
Town Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal defoliation may affect the perception/contrast due to the elimination of the forest edge along the utility corridor.

Perceived effect on scenic quality/viewer enjoyment:

A viewer traveling down this forested road will likely notice a difference due to the larger expanse needed to cross the utility corridor. The road feels less enclosed. But overall contrast is moderate at best.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: Jocelyn Gavitt
Date: 11/11/16

Viewpoint Information:
Viewpoint Number: 18
Viewpoint Location: Town Farm Road
Direction of View: Southwest
Landscape Similarity Zone: Forested

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☒ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*
Wide open utility corridor populated with vertical supports, and flanked by forest on each side.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1	Additional clearing expands focus of long open landform.
Vegetation	2	Reduction of adjacent forest increases impact of utility corridor.
Land Use	.5	Slightly more intense use of existing utility corridor.
Water	N/A	
Sky	.5	Clearing of forest opens additional view of sky.
Viewer Activity	0	Changes in corridor will likely have no effect on viewer activity
TOTAL	4	*Total all scores above*
AVERAGE	0.8	*Average all scores above*

Contrast Rating Score Chart
0 Insignificant
.5
1 Minimal
1.5
2 Moderate
2.5
3 Appreciable
3.5
4 Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 18
Town Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal defoliation could alter contrast slightly as some forest vegetation has been removed

Perceived effect on scenic quality/viewer enjoyment:

While alterations are noticeable in this viewpoint, the existing conditions already have detracted from the scenic quality, and the addition of more structures and clearing do not significantly alter the viewer's enjoyment.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: Jocelyn Gavitt
Date: 11/11/16

Viewpoint Information:
Viewpoint Number: 21
Viewpoint Location: Hill Road
Direction of View: Northeast
Landscape Similarity Zone: Forested

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☒ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*
Existing view is densely populated with utility structures in the mid-ground. These dominate view.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1	Additional structures more intensely populate the landform.
Vegetation	1.5	Clearing of forest edge to accommodate structures increases contrast.
Land Use	1	Increase in intensity of land use as utility corridor.
Water	N/A	N/A
Sky	2	Deforestation opens sky. Additional structures highly noticeable against sky.
Viewer Activity	.5	Little change — higher intensity utility line will have little change in viewer activity.
TOTAL	6	Total all scores above
AVERAGE	1.2	Average all scores above

Contrast Rating Score Chart
0 Insignificant
.5
1 Minimal
1.5
2 Moderate
2.5
3 Appreciable
3.5
4 Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 21
Hill Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal foliage could alter impact of view of structures against backdrop of green vegetation.

Perceived effect on scenic quality/viewer enjoyment:

The proposed changes create a visible change in intensity of utility structures, but since the view had many to begin with, overall impact is not strong.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: Jocelyn Gantt

Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 26

Viewpoint Location: Round Top Road

Direction of View: Northeast

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☐ Repeated/Regular

☒ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Utility corridor populated with vertical structures, overhead lines and enclosed on each side by forest.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1.5	Widening of corridor opens up the land and further dominates view.
Vegetation	2.5	Elimination of vegetation to accomodate additional utilities creates contrast.
Land Use	1.5	Land use is noticeably intensified.
Water	N/A	
Sky	1	Elimination of forest opens view of sky.
Viewer Activity	1.5	Intensification of use of this corridor is noticeable.
TOTAL	8	*Total all scores above*
AVERAGE	1.6	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 26

Round Top Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal foliage/defoliation can alter impact of utility structures against vegetative background.

Perceived effect on scenic quality/viewer enjoyment:

Overall, the widening of this utility corridor and the addition of structures is noticeable. Due to its existing use/view as a utility area - the contrast is only moderate

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: Jocelyn Gavitt
Date: 11/11/16

Viewpoint Information:
Viewpoint Number: 30
Viewpoint Location: Sherman Farm Road
Direction of View: East
Landscape Similarity Zone: Industrial

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☒ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*
Large utility structures dominate the view. View is generally low quality and cluttered with structures. Forest vegetation frames view.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	2	Clearing opens up central low area as focal point
Vegetation	2.5	Large amount of vegetation removed.
Land Use	2	More land area and more structures given over to "utility" landscape
Water	N/A	
Sky	1.5	Elimination of vegetation opens view to sky
Viewer Activity	1	Alterations noticeable but generally in keeping with existing land use
TOTAL	8.5	*Total all scores above*
AVERAGE	1.7	*Average all scores above*

Contrast Rating Score Chart
- 0 Insignificant
- .5
- 1 Minimal
- 1.5
- 2 Moderate
- 2.5
- 3 Appreciable
- 3.5
- 4 Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 30
Sherman Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Seasonal foliage might have slight impact on contrast levels.

Perceived effect on scenic quality/viewer enjoyment:

This is already a degraded, low quality view. Additional clearing and structures amplify negative effect to some degree.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson

Date: 11.14.2016

www.edrdpc.com

Viewpoint Information:

Viewpoint Number: 1

Viewpoint Location: Buck Hill Road

Direction of View: Southwest

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular

☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Existing utility corridor creates visual clutter, that disrupts any order. No dominant focal point. No change in form, line, color and texture throughout fore, mid and backgrounds. Atomopshpere conditions were favorable.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0.5	No dominant feature - existing structures already break up view - new structures and clearing add small amount of additional contrast.
Vegetation	0.0	Vegetation consitis of cleared ROW shrubs and low ground ground covers in center of view with forest at the edge. Additional structures and clearing do not add additional contrast.
Land Use	0.0	Co-located with existing utility corridor
Water	N/A	No water Present
Sky	1.0	New structures are taller than existing and push further into the open sky above tree line.
Viewer Activity	0.5	Limited Viewer interaction from viewpoint. Duration of crossing will be since it is wider which adds contrast
TOTAL	2.0	*Total all scores above*
AVERAGE	2/5 = .4	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 1

Buck Hill Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

The introductions of the proposed project would have a non-adverse effect on the typical user. Viewpoint is within an existing utility corridor with low cultrual sensitivity. Viewtype is local traveler since. Since this is a view 90 degrees perpendicular to the roadway the duration of view is very limited.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson

Date: 11.14.2016

Viewpoint Information:

Viewpoint Number: 8

Viewpoint Location: Wallum Lake Road

Direction of View: Southwest

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular
☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Discordant existing utility corridor. No views to any prominant features or forms and no contrast or interest in the line, color or texture of the view. Existing structures create order within the ROW but contrasts with the lack or natural order. Limited background and midground views because of exisiting vegetation and lack of topography.
Conditions are favorable with clear skies and a few clouds for shadows and depth.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0.5	Larger ROW clearing will detract from the existing forested landform.
Vegetation	0.0	Vegetation will remain the same post installation - more transitional shrub zone will be present but contrast between mix of forest and shrub remains constant.
Land Use	0.0	Co-located with existing utility corridor, appropriate land use.
Water	N/A	
Sky	0.5	Limited additional contrast from proposed project
Viewer Activity	0.5	Viewer will experience corridor for longer because of additional clearing
TOTAL	1.5	*Total all scores above*
AVERAGE	1.5/5 = .3	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 8

Wallum Lake Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

Relative to the existing low scenic quality the overall change from the proposed project would result in a non-adverse contrast rating. The typical user, local traveler, has a limited duration of view that would not be changed with the proposed upgrades incorporated.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson

Date: 11.14.2016

www.edrdpc.com

Viewpoint Information:

Viewpoint Number: 11

Viewpoint Location: E. Wallum Lake Road - Town Farm Road Scenic Area

Direction of View: Southwest

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular

☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Limited Topography with no dominant features - background ridge is visible. Existing ROW provides form and contrast along with the different vegetation areas associated with the existing conditions. Existing structures break skyline in the foreground and the ridgeline in background.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1.5	Proposed structures break the existing hillside and contrast with ridgeline. Distance is far and visibility is low so overall contrast change is limited
Vegetation	0.0	Vegetation will remain the same post installation - more transitional shrub zone will be present but contrast between mix of forest and shrub remains constant.
Land Use	0.0	Co-located with existing utility corridor
Water	N/A	
Sky	0.5	Existing conditions create contrast in both the fore and backgrounds, where structures are present within the skyline.
Viewer Activity	0.5	duration of view will be extended due to additional clearing, with limited overall contrast change
TOTAL	2.5	*Total all scores above*
AVERAGE	2.5/5 = .5	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 11

E. Wallum Lake Road - Town Farm Road Scenic Area

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

Based on the simulation and the information provided this view would have an adverse effect on the typical user, local traveler. This would come from the intruduction of new structures outside of any existing utility corridor along with the additional clearing to the fore and midgrounds. That being said the distance to the viewer from the new structures allows for only limited visibility and the structures are not so tall as to break the top of the ridge and extend into the sky. Taking into consideration all aspects of the view the final contrast rating is still relatively low and does not raise to a level of concern.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson
Date: 11.14.2016

Viewpoint Information:

Viewpoint Number: 17
Viewpoint Location: Town Farm Road
Direction of View: Southeast
Landscape Similarity Zone: Forested/Rural Residential

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality)*

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view)*

☐ Continuous ☒ Repeated/Regular
☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*
Typical rural tree lined road no shoulder and limited open views to the side. Sun allowed in by utility ROW crossing provides contrast onto vegetation and highlights the natural edge along the constructed ROW. View down the road ROW adds character as it disapears into the background like a vegetated tunnel.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0.0	There is no change in the percived landform - Road surface and focal point of view remain similar
Vegetation	1.0	Vegetation change where the additional clearing takes place creates additional contrast. This will be limited to this direction of view.
Land Use	0.0	Co-located with existing utility corridor
Water	N/A	
Sky	0.0	Limited visibility of sky with no change post installation
Viewer Activity	0.5	Limited change to viewer - duration of ROW will be extended
TOTAL	1.5	*Total all scores above*
AVERAGE	1.5/5 = .3	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 17

Town Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

Base on the limited duration that a local traveler would have at this moment along their journey and with the limited amount of change proposed. The proposed project will have a non-adverse effect on the scenic quality of the view.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson

Date: 11.14.2016

www.edrdpc.com

Viewpoint Information:

Viewpoint Number: 18

Viewpoint Location: Town Farm Road

Direction of View: Southwest

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular
☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Large existing utility corridor with a thick forested edge. No dominant features in topography with limited contrast between vegeation species and the natural patterns that are present, but limited. Background view down the ROW allows for a glimpse of a background ridge. No clear view is obatainable with existing structures breaking the ridgeline into the sky.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0.0	There is no change to the existing conditions
Vegetation	0.5	Additional clearing allows for more shrub/successional area and lowers contrast of forest edge
Land Use	0.0	Co-located with existing utility corridor
Water	N/A	
Sky	0.5	Existing structures are present within the skyline - proposded additional structures will add limited contrast
Viewer Activity	0.5	Clearing of ROW is extended therefore duration of view is longer allowing for a slight uptick on contrast
TOTAL	1.5	*Total all scores above*
AVERAGE	1.5/5 = .3	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 18

Town Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

With limited change to the view, duration of view and expectations of the viewer the proposed project will have a non adverse effect on this view. In some aspects because of the additional clearing there is a greater chance to view the background ridge which hightens the scenic quality.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson

Date: 11.14.2016

Viewpoint Information:

Viewpoint Number: 21

Viewpoint Location: Hill Road

Direction of View: Northeast

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular
☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Existing utility corridor with views of the foreground. Because of corridor layout views to the midground and background are limited with more vegetative contrast in present in the foreground. Skyline is broken up by both structures and conductors

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0.0	No change to existing landform from introduction of proposed project
Vegetation	0.0	Due to the variety of foreground vegetation the addition of the project does not have an effect on the visual quality
Land Use	0.0	Co-located with existing utility corridor
Water	N/A	
Sky	0.5	Replacement structures are talller and puch further up into the skyline. This along with the additional structures creates additional contrast
Viewer Activity	0.0	Based on the current low scenic quality, viewer expectations and perception of scenic quality remain similar.
TOTAL	0.5	*Total all scores above*
AVERAGE	0.5/5 = .1	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 21
Hill Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

With limited change to the view, duration of view and expectations of the viewer the proposed project will have a non adverse effect on this view.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson

Date: 11.14.2016

www.edrdpc.com

Viewpoint Information:

Viewpoint Number: 26

Viewpoint Location: Round Top Road

Direction of View: Northeast

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular

☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Foreground and Midground views of existing utility corridor. No dominant features, limited topography and vegeatation contrast. Recent construction can be seen in the fresh hydroseed along road and on the visible laydown area. This is temporary contrast that will not be present in the future.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0.5	Additional ROW clearing adds contrast
Vegetation	0.0	Existing contrast between forested edge and low grow area remains constant and unchanged with no added contrast.
Land Use	0.0	Co-located with existing utility corridor
Water	N/A	
Sky	0.5	Additional ROW clearing and structures add contrast by further breaking into the skyline
Viewer Activity	0.5	Clearing of ROW is extended therefore duration of view is longer allowing for a slight uptick on contrast
TOTAL	1.5	*Total all scores above*
AVERAGE	1.5/5 = .3	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 26

Round Top Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

With limited change to the view, duration of view and expectations of the viewer the proposed project will have a non adverse effect on this view.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:

Your Name: Matthew Robinson

Date: 11.14.2016

www.edrdpc.com

Viewpoint Information:

Viewpoint Number: 30

Viewpoint Location: Sherman Farm Road

Direction of View: East

Landscape Similarity Zone: Industrial

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular
☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Vegetative contrast in the foreground adds scenic quality to the view. Background with existing substation and power plant break up skyline and any natural patterns present. Existing infrastructure pushes into the sky in the mid-ground

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0.5	Additional ROW clearing adds contrast
Vegetation	0.5	Existing contrast between forested edge and low grow area remains constant and unchanged with limited added contrast.
Land Use	0.0	Co-located with existing utility corridor
Water	N/A	
Sky	0.5	Additional ROW clearing and structures add contrast by further breaking into the skyline
Viewer Activity	0.0	Clearing of ROW is extended however the duration of view and viewer activity are not changed
TOTAL	1.5	*Total all scores above*
AVERAGE	1.5/5 = .3	*Average all scores above*

Contrast Rating Score Chart

0 Insignificant
.5
1 Minimal
1.5
2 Moderate
2.5
3 Appreciable
3.5
4 Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 30

Sherman Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Conditions were very favorable to quality photos - no underlying conditions

Perceived effect on scenic quality/viewer enjoyment:

Removal of foreground and midground vegetation opens up views to existing power infrastructure. There is visibility in the existing view with only limited new amounts being revealed. With limited change to the view, duration of view and expectations of the viewer the proposed project will have a non adverse effect on this view.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: STEVE BREITZKA
Date: 11/11/16

Existing Conditions

Simulation

Viewpoint Information:
Viewpoint Number: 1
Viewpoint Location: Buck Hill Road
Direction of View: Southwest
Landscape Similarity Zone: Forested

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☐ Occasional/Brief ☒ Rare

Viewer Description: *Please describe this view in your own words.*
Overhead utility line corridor in an otherwise undeveloped area. The line appears to cut through a predominantly forested area with low lying shrubs and meadow under the lines. Dense mature vegetation on either side of the corridor.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1	Slight rise in the elevation from the foreground to the background pronounces the distant poles more.
Vegetation	2	There is some clearing on the right side of the corridor but a dense tree stand remains.
Land Use	0	There are no other land uses visible from this vantage point.
Water	N/A	
Sky	4	This particular view centers on a new pole centered in the frame. This dominates much of the sky.
Viewer Activity	0	Similar to land use, there are no visible activities here.
TOTAL	7	*Total all scores above*
AVERAGE	1.4	*Average all scores above* 7/5

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

** If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 1
Buck Hill Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

The dense vegetation on the surrounding trees helps to obscure the poles, however, the cor-ten steel still stands out. This will likely be more apparent when the leaves fall. The lines do not appear much taller than the trees.

Perceived effect on scenic quality/viewer enjoyment:

This does not seem like a view that anyone will have on a regular basis. There are no visible trails, campgrounds, or activities. There is no draw to attract people to this location.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: STEVE BREITZKA

Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 8

Viewpoint Location: Wallum Lake Road

Direction of View: Southwest

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☐ Repeated/Regular

☐ Occasional/Brief ☒ Rare

Viewer Description: *Please describe this view in your own words.*

Steel pole utility corridor for overhead lines cutting through a dense, forested area. There is a small area of maintained grass in the foreground, otherwise the space appears wild. There are two rooftops visible in the trees on the left. It is unclear what use these may be.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1	The poles in the distance appear to be perched on a hill or high point.
Vegetation	3	The poles dominate the adjacent trees, towering above throughout the length of the corridor.
Land Use	0	No other visible uses and this is an existing corridor.
Water	N/A	
Sky	4	The lines and towers take up much of the available sky visible in this view.
Viewer Activity	0	No clear activities present.
TOTAL	8	*Total all scores above*
AVERAGE	1.6	*Average all scores above* 8/5

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 8
Wallum Lake Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

The dense vegetation on either side of the corridor provides mass to this view, reducing the weight of the poles. Their presence will be more stark as this view is more exposed.
The white clouds provide a light backdrop for the poles although they are so dark they will stand out no matter what the sky looks like in the daytime.

Perceived effect on scenic quality/viewer enjoyment:

There should be no impact on the scenic quality. This does not appear to be a destination for anything or anyone.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: STEVE BREITZKA
Date: 11/11/16

Viewpoint Information:
Viewpoint Number: 11
Viewpoint Location: E. Wallum Lake Road - Town Farm Road Scenic Area
Direction of View: Southwest
Landscape Similarity Zone: Forested

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☐ Occasional/Brief ☒ Rare

Viewer Description: *Please describe this view in your own words.*
Overhead utility swath cutting through a very dense and consistent forest. The line extends through a shallow valley and a gravel access ~~or~~ a maintenance road follows the corridor.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	.5	There is very little change between existing and proposed. The poles follow the valley.
Vegetation	1	There is clearing on either side of the corridor, however, the trees are so dense it isn't really noticeable.
Land Use	0	No land uses visible.
Water	N/A	
Sky	.5	The existing lines take up a portion of the sky and the proposed adds a very small amount.
Viewer Activity	0	No visible activities.
TOTAL	2	*Total all scores above*
AVERAGE	0.4	*Average all scores above* 2/5

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 11

E. Wallum Lake Road - Town Farm Road Scenic Area

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

The poles will be more pronounced once the trees lose their leaves and there is a blanket of snow on the ground. However, the shallow valley seems to swallow the poles in the midground and background.

Perceived effect on scenic quality/viewer enjoyment:

Despite being in a scenic area (Town Farm Road), it is not clear who would have this view or when they would have it. The proposed changes are insignificant considering this is an existing corridor.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: STEVE BREITZKA

Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 17

Viewpoint Location: Town Farm Road

Direction of View: Southeast

Landscape Similarity Zone: Forested/Rural Residential

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☒ Repeated/Regular (RESIDENCES)

☐ Occasional/Brief ☐ Rare

Viewer Description: *Please describe this view in your own words.*

Rural, two-way, asphalt road lined with dense vegetation on both sides. There are a few residences on the road, discernable only by driveways and mailboxes. The utility corridor is visible across the view only by thin overhead wires.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0	No landform change.
Vegetation	.5	There is a very small amount of tree clearing that is hardly noticeable within the surroundings.
Land Use	0	No change.
Water	N/A	
Sky	0	A very small amount of sky opens with some tree removal but not much.
Viewer Activity	0	No impact or change.
TOTAL	.5	*Total all scores above*
AVERAGE	0.1	*Average all scores above*

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 17
Town Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

The overhead lines may become slightly more visible when the trees drop their leaves, however, the lines are thin and spread out rather than creating one large horizontal line.
Partly cloudy white sky makes the lines pop more.

Perceived effect on scenic quality/viewer enjoyment:

Since this is an existing corridor, the modifications make very little difference to the view. This is not a view many people will see either. It will likely be the residents and an occasional traveler.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:

Your Name: STEVE BREITZKA
Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 18
Viewpoint Location: Town Farm Road
Direction of View: Southwest
Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☐ Repeated/Regular
☐ Occasional/Brief ☒ Rare

Viewer Description: *Please describe this view in your own words.*

Existing overhead utility line corridor through dense and mature vegetation. The corridor is vegetated with small shrubs and meadow plants.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0	No significant landforms in this view.
Vegetation	1	Proposed towers extend above the trees on the left although existing towers are taller.
Land Use	0	No change to land use.
Water	N/A	
Sky	1	Similar to vegetation, the proposed extend into the sky, however, the existing are taller.
Viewer Activity	0	No impact to viewer activity.
TOTAL	2	*Total all scores above*
AVERAGE	0.4	*Average all scores above* 2/5

Contrast Rating Score Chart

0 Insignificant
.5
1 Minimal
1.5
2 Moderate
2.5
3 Appreciable
3.5
4 Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 18
Town Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Very little since the existing utilities dominate so much of the view already. The proposed fit within the existing view.

Perceived effect on scenic quality/viewer enjoyment:

While this is a peaceful and serene rural woodland and meadow, it does not appear that any viewers would come to this location. There should be no effect.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: STEVE BREITZFAT
Date: 11/11/16

Viewpoint Information:
Viewpoint Number: 21
Viewpoint Location: Hill Road
Direction of View: Northeast
Landscape Similarity Zone: Forested

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☐ Occasional/Brief ☒ Rare

Viewer Description: *Please describe this view in your own words.*
Vehicle access point to an existing overhead line utility corridor. The access road is barricaded by a gate and a No Trespassing sign. Mature trees line either side of the corridor.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0	No change in landform.
Vegetation	1	while there is some clearing to the right and the towers project above the right tree line, the left tree line
Land Use	0	No impact to land uses.
Water	N/A	
Sky	1	There are more towers visible in the sky but since this is an existing corridor, they fit in.
Viewer Activity	0	No impact.
TOTAL	2	*Total all scores above*
AVERAGE	0.4	*Average all scores above* 2/5

establishes a height that reduces the ~~height of~~ overall height of the towers.

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 21
Hill Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

This line of towers will likely look the same no matter the surroundings. The dense foliage provides some mass that will dissipate ~~disappear~~ when the leaves fall, however, the towers will not really stand out more than they already do. Snow cover will make the towers pop more in the landscape.

Perceived effect on scenic quality/viewer enjoyment:

The No Trespassing sign makes it clear that the general public is not welcome here. Adding towers to the existing corridor will have no impact on the scenic quality or viewer enjoyment. It is difficult to imagine who the viewer would be in this case.

Visual Impact Rating Form

Burrillville Interconnection Project

Burrillville, Providence County, Rhode Island

EDR Project No: 16110

Rating Panel Information:

Your Name: STEVE BREITZKA

Date: 11/11/16

Viewpoint Information:

Viewpoint Number: 26

Viewpoint Location: Round Top Road

Direction of View: Northeast

Landscape Similarity Zone: Forested

Viewpoint Sensitivity:

Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)

☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)

☐ Continuous ☐ Repeated/Regular

☐ Occasional/Brief ☒ Rare

Viewer Description: *Please describe this view in your own words.*

Access point to an existing overhead line utility corridor. The wide corridor is surrounded by mature and dense vegetation. Two no trespassing signs and a vehicle gate block entrance to the corridor.

Contrast Rating:

Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	1	Grade drops from the road in the foreground to the distant background. The towers follow this grade change.
Vegetation	3	There is significant clearing on the right side, expanding the corridor width and making the towers more apparent in the landscape.
Land Use	0	No impact to the existing use.
Water	N/A	
Sky	1	The proposed tower in the foreground projects into the sky, ~~tower~~ however, the existing towers had-
Viewer Activity	1	Driving on this road is not much of an activity although the wider corridor is more pronounced more prominence.
TOTAL	6	Total all scores above
AVERAGE	1.2	Average all scores above 6/5

Contrast Rating Score Chart

0	Insignificant
.5	
1	Minimal
1.5	
2	Moderate
2.5	
3	Appreciable
3.5	
4	Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 26
Round Top Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

There are quite a few conifers in the adjacent forest so even when the leaves fall, the towers will fit within the trees.

Perceived effect on scenic quality/viewer enjoyment:

This is not a destination view, but rather a view someone will have while traveling on the road. The expanded corridor will not really diminish the view although it will make the utilities more apparent in the landscape since the corridor will take up more space and remove trees.

Visual Impact Rating Form

Burrillville Interconnection Project
Burrillville, Providence County, Rhode Island
EDR Project No: 16110

Rating Panel Information:
Your Name: STEVE BREITZKA
Date: 11/11/16

Viewpoint Information:
Viewpoint Number: 30
Viewpoint Location: Sherman Farm Road
Direction of View: East
Landscape Similarity Zone: Industrial

Viewpoint Sensitivity:
Rate the scenic quality and viewer exposure for this view.

Scenic Quality: (*Please rate existing scenic quality*)
☒ Low ☐ Moderate ☐ High

Viewer Exposure: (*Frequency and duration of view*)
☐ Continuous ☐ Repeated/Regular
☐ Occasional/Brief ☒ Rare

Viewer Description: *Please describe this view in your own words.*
Existing utility corridor approaching a substation in the background. Mature trees line either side of the corridor. Meadow grasses and shrubs fill the corridor.

Contrast Rating:
Rate the level of contrast between the proposed structures and the existing view.

Component	Score	Description of Contrast
Landform	0	No significant landform.
Vegetation	3.5	The expanded corridor removes mature trees down the right side. The left side still provides a soft edge to the utilities.
Land Use	0	No change to the land use.
Water	2	There is a small pond in a low spot between the trees. Tree removal on the right may have an impact on the water.
Sky	2	The proposed lines and tower remove trees, thus opening the view to more sky, which is filled with overhead wires.
Viewer Activity	0	No obvious impact although it is tough to tell if there is a campground or something on the left side. This is still an existing use though.
TOTAL	7.5	*Total all scores above*
AVERAGE	1.25	*Average all scores above* 7.5/6

Contrast Rating Score Chart
0 Insignificant
.5
1 Minimal
1.5
2 Moderate
2.5
3 Appreciable
3.5
4 Strong

* *If no water is visible in the view, please enter "N/A" in the "Score"*

Viewpoint 30
Sherman Farm Road

Variable factors that may have influenced rating (atmospheric conditions, season, etc.):

Very little will alter this view. The meadow should ~~stke~~ look the same for most of the year except when covered by snow. There is a good mix of deciduous and coniferous trees in the surrounding woodland so even when the leaves fall, the towers will be surrounded by a dense forest.

Perceived effect on scenic quality/viewer enjoyment:

The existing substation completes this industrial view. While the proposed corridor is wider and removes trees, the impact still feels small within the scale of this view. The only real impact would be on the left side. It is unclear if this is a residence, campground, or just some random items and cut wood in the landscape.

Gavitt Associates

Jocelyn Gavitt, RLA, PRINCIPAL

EXPERIENCE SUMMARY

Licensed Landscape Architect with over 20 years experience as a practitioner and educator. Areas of expertise include community planning, community development, identification of catalytic projects, recreation planning and design, institutional design, grant writing and community participatory practices. Experience includes working as a consultant practitioner as well as running community based projects through studio teaching at SUNY College of Environmental Science and Forestry's Landscape Architecture Department.

EDUCATION / REGISTRATIONS

SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY
MS Landscape Architecture, May 2007

CORNELL UNIVERSITY
BS Landscape Architecture, May 1993

PROFESSIONAL REGISTRATION
New York license #1768-1
North Carolina License # 910

EXPERIENCE SUMMARY

GAVITT ASSOCIATES, CAZENOVIA, NEW YORK
Established in 2004

SUNY COLLEGE OF ENVIROMENTAL SCIENCE AND FORESTRY
Faculty 2004 - present

TRINITY ARCHITECTURE AND PLANNING, WINSTON-SALEM, NC
Partner, Landscape Architect. 1999-2001

ARCHITECTURAL DESIGN ASSOCIATES, WINSTON-SALEM, NC
Project Manager, Landscape Architect. 1997-1999

GS MILLER LANDSCAPE ARCHITECTURE, WINSTON-SALEM, NC
Landscape Architect. 1995-1997

PASHEK ASSOCIATES, PITTSBURGH, PA
Landscape Designer. 1993-1995

RECENT PRESENTATIONS

COMMUNITY PARTICIPATORY PRACTICES IN ONEIDA, NEW YORK
April 2015, Upstate ASLA Conference, Saratoga Springs, NY

SIGNIFICANT PROJECT EXPERIENCE

Expert Visual Assessment Evaluations, 2006 - Present
Acting as expert visual consultant to Environmental Design and Research for multiple wind power and transmission line projects in the Northeast.

Main Street Study, Cazenovia NY, 2015
Inventory and Analysis of properties and infastructure along the Ledyard, Forman, Albany and Nelson Street Corridor. GIS based property, building, and tax record information combined with photos, aerials, and location maps. Properties analyzed for existing use, potential use, need for improvements. Community survey of business needs being conducted to inform analysis.

Oneida Flats Planning Study, New York, 2015
Utilized community participatory methods to include residents and city in master plan visioning process for flooded neighborhood. Included extensive research, analysis and information sharing.

Oneida Rail Trail Conceptual Plan, 2014
Studio based design project: Coordinated senior design studio in conceptualization of segments of the proposed Oneida Rail Trail. Project included community participation and conceptual planning.

Canandaigua Lakefront Master Plan Studies, 2013
Studio based design project: Students worked in conjunction with Finger Lakes Museum and independent developers to produce master plan vision options to improve use of brownfield land at Canandaigua Lake waterfront.

GoCaz.com, Economic Development Project, Cazenovia, New York, 2013
Creation, coordination and implementation of GoCaz.com, a program to promote outdoor recreational activities in and around the Cazenovia area. Project includes grant writing assistance, interactive GIS website, mobile phone adaptation design, trail mapping, signage design, and marketing.

International Boxing Hall of Fame, Canastota, New York, 2012
Created a master plan and wrote a grant that was funded through NYS Economic Development Funds for $1M. Assisted in securing legislation for site to be turned over from NYS Thruway Authority to LDC.

Onondaga Boulevard Master Plan Studies, 2011
Studio based project: Community stakeholders and students collaborated to produce master plan ideas for the Onondaga Boulevard Corridor, taking into account the Onondaga Creek Walk, local vacancy, large homeless population and local shelter, railroad tracks and other concerns.

Link Park, Canastota New York, 2002
Designed houses and site layout for planned unit development.

8th Avenue Commercial Revitalization, Homestead, Pennsylvania, 1995
Streetscape design. Assisted in construction documentation and supervision. Project designer while at Pashek Associates.

Recreational Needs Assessment, Pittsburgh, Pennsylvania, 1994
Comprehensive report of playgrounds in government assisted housing. Project designer while at Pashek Associates.

Bridgewater Historic District Study, Bridgewater, Pennsylvania , 1994
Documentation and assessment of existing homes, churches and businesses for the purpose of establishing a formally recognized historic district. Project designer while at Pashek Associates.

Comprehensive Recreational Plan, Hempfield Township, Pennsylvania, 1994
Report and recommendations to create greenway links between existing and proposed park locations. Assisted with graphics and report editing. Project designer while at Pashek Assocciates.

Three Rivers Heritage Trail, Pittsburgh, Pennsylvania, 1993
Riverfront trail along Allegheny River in urban area of Pittsburgh. Project dessigner while at Pashek Associates.

Matthew Robinson
Visualization Project Manager

Matthew is a Visualization Project Manager at EDR. Prior to working at EDR, Matt worked as an Environmental Planner, Associate Landscape Architect, and Project Manager at Landworks in Middlebury, VT. While at Landworks, Matt worked on diverse projects that included visual impact and environmental impact assessments, visual simulations, public outreach and communication graphics, land use planning, signage and wayfinding, streetscape improvements, and site rehabilitation design for utility corridors.

As a Visualization Project Manager with EDR, Matthew is responsible for overseeing and managing various visual impact assessment projects. His role on these projects includes identification of visually sensitive resources, field evaluation and documentation of project visibility from sensitive resources and developing detailed and accurate computer renderings, 3D computer modeling, and visual simulations.

education

Cornell University, Ithaca, NY, *Master of Landscape Architecture, Concentration in Land Planning, Aesthetics and Real Estate*, 2010.

University of Vermont, Burlington, VT, *Bachelor of Arts in Political Science, Minor in History*, 2005.

volunteer work

Deputy Tree Warden, Town of Middlebury*,* Middlebury, VT 2014-2016.

Foster Owner, Long Trial Canine Rescue, Wilder, VT 2014-2016

employment history

Visualization Project Manager, Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C., Syracuse, NY, 2016-Present.

Project Manager, Associate Landscape Architect, LandWorks, Landscape Architecture, Planning and Design, Middlebury, VT, 2004-2007, May 2009 – August 2009, 2010-2016.

Associate, Wagner Hodgson – Landscape Architecture, Burlington, VT, May 2008 – August 2008.

Manager, Ann Roche Casual Furniture, Shelburne, VT, 1998-2008.

project experience

Interstate Route 81 Viaduct Project, City of Syracuse, Onondaga County, NY – Responsible for the development of visual simulations for the replacement of approximately 5 miles of elevated interstate highway.

Galloo Island Wind Project, Jefferson County, NY – Responsible for field photography and preparation of visual simulations for a proposed 62-turbine wind power facility on an island in Lake Ontario.

SUNY University at Albany Emerging Technology and Entrepreneurship Complex (ETEC), Albany, NY – Responsible for preparation of a Visual Impact Assessment for a proposed academic building sited on the New York State Office of General Services (OGS) Harriman Campus.

ConnectNY, Oneida and Dutchess County, NY – Responsible for field photography and preparation of a Visual Impact Assessment for converters stations associated with a proposed DC transmission line that will be installed within the New York State Thruway right-of-way (ROW).

Knapps Corner Substation, Town of Poughkeepsie, NY – Responsible for field photography, visual simulations and preparation of a Visual Impact Assessment of a proposed electric substation.

West River Greenway Trail, Grand Island, NY – Responsible for providing visual simulations in support of landscape architectural design of a proposed 8-mile multi-use/pedestrian trail.

Rochester Main Street, City of Rochester, NY - Responsible for providing visual simulations in support of a streetscape improvement project on East Main Street between the Genesee River and Franklin Street in the City of Rochester.

Antrim Wind Project, Antrim, NH – *Prior to EDR,* provided visual analysis, field photography and resource evaluations in support of a proposed 28.8 MW, nine-turbine wind facility.

Swanton Wind Project, Franklin County, VT – *Prior to EDR,* provided visual analysis, field photography and resource evaluations in support of a proposed 20 MW, seven-turbine wind facility.

Bingham Wind Project, Bingham, ME - *Prior to EDR,* provided visual analysis, field photography and resource evaluations in support of a proposed 185 MW, 56-turbine wind facility.

Bowers Wind Project, Carroll Plantation and Kossuth, Maine - *Prior to EDR,* provided visual analysis, field photography and resource evaluations in support of a proposed 48 MW, 16-turbine wind facility.

Georgia Mountain Community Wind Project, Chittenden and County, VT - *Prior to EDR,* provided visual analysis, field photography and resource evaluations in support of a proposed 10 MW, four-turbine wind facility.

NU-F107 Seacoast Reliability Project, Strafford and Rockingham County, NH – *Prior to EDR,* served as lead Landscape Architect for community relations and mitigation measures. Provided field photography, visual simulations, and various exhibits in support of the Visual Impact Statement and pre-filed testimony for a proposed new 13-mile 115kV transmission line.

Northern Pass Project, Canadian Boarder to Franklin, NH - *Prior to EDR,* served as lead field technician, Visual Simulation technician and was expert visual representative in in support of a 192-mile HVDC transmission line.

Merrimack Valley Reliability Project 345 Transmission Line, Londonderry, NH to Tewksbury, MA - *Prior to EDR,* served as community relations/communications visual expert and provided visual simulations, mitigation plans and mediation services in support of a 24.5-mile long 345kV transmission line.

Kidder Wind Project, Orleans County, Irasburg, VT - *Prior to EDR,* provided visual analysis, field photography and resource evaluations in support of a proposed two turbine project.

Addison Rutland Natural Gas Project, Phase I & II Chittenden and Addison Counties, VT - *Prior to EDR,* provided visual simulations, visual impact analysis and mitigation planting plans for the Vermont Agency of Natural Resources in their review of a 43-mile natural gas pipeline extension and associated facilities.

VELCO Lamoille Country Reliability Project Lamoille County, VT - *Prior to EDR,* provided visual analysis support during the permitting process and testimony for a proposed 10-mile 115kV transmission line and associated relocation of an existing 34.5kV and subsequent substation upgrades.

VELCO Northwest Reliability Project, Rutland and Addison Counties, VT - *Prior to EDR,* provided visual analysis support during permitting and testimony in support of a 35.5-mile proposed 345kV transmission line that included relocation of existing 34.5kV and 115kV lines and subsequent substation upgrades.

BeaverWood Biomass Facility Rutland County, VT - *Prior to EDR,* provided visual simulations and visual impact analysis through multiple stages of the permitting process in support of a 30MW biomass facility and an associated 8-mile-long transmission tap line.

Seneca Mountain Wind Orleans County, VT - *Prior to EDR,* worked closely with developer to provide visual simulations and expert analysis in a community relations/communications role in support of a proposed 20-turbine project.

Sheffield Wind Farm Caledonia County, VT - *Prior to EDR,* provided visual simulations and Visual Impact Assessment (VIA) analysis through multiple stages of the permitting process in support of a proposed 16-turbine facility.

South Village Solar Array, Chittenden County, VT - *Prior to EDR,* provided visual simulations and Visual Impact Assessment (VIA) in support of a 1-acre solar energy project.

Steven M. Breitzka, RLA, LEED AP
Senior Managing Landscape Architect

education

Cornell University, College of Agriculture and Life Sciences, Ithaca, New York, *Bachelor of Science in Landscape Architecture*, 1998

professional affiliations

Registered Landscape Architect, New York (002507)

Member, American Society of Landscape Architects

Member, U.S. Green Building Council

Member, Town & Village of Tully Planning Board

Member, Tully Arts Council

employment history

Landscape Architect and Project Manager, Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C., Syracuse, New York, May 2012 to present.

Landscape Architect and Senior Associate, RNL, Denver, Colorado, 2003-2012.

Landscape Designer and Office Manager, Douglas Ian Associates, Rochester, New York, 2002-2003.

Landscape Designer, Dufresne-Henry Inc., Boston, Massachusetts, 2000-2002.

Landscape Architect, RNL, Denver, Colorado, 1998-2000.

publications

"Drawing Inspiration" Landscape Architect and Specifier News Volume 27, Number 11, November 2011.

project experience

Energy Project Visual Impact Assessments – Landscape Architect – responsible for preparing Visual Impact Assessments (VIAs) for commercial wind power and power line projects in Upstate New York. The VIAs present the visual character and significant aesthetic resources within a 5 or 10 mile visual study radius. Viewshed analysis, line-of-sight cross sections, field review, and computer-assisted visual simulations were used to evaluate the potential visibility and visual impact of these projects. Notable projects include: the CHG & E A&C Line, the Crown City Wind Farm, and the Scioto Ridge Wind Farm.

SUNY State University at Oswego, North Corridor Dormitory Project, Phase I – Senior Managing Landscape Architect – responsible for coordinating conceptual site planning and design to enhance North Corridor Dormitory project.

SUNY State University of New York at Morrisville, Academic Quad – Senior Managing Landscape Architect – responsible for coordinating schematic design and writing accompanying reports for the centralized 5.5-acre quadrangle site surrounded by the Campus academic buildings.

SUNY State University of New York at Oneonta, Physical Science Building – Senior Managing Landscape Architect – responsible for coordinating site planning and design services for $30M renovation and addition of the Physical Science Building. The spaces on the southwest side of the building have potential to serve as outdoor classrooms displaying sustainable stormwater and native landscape initiatives. Scope includes the design of the bio-swales, meadows, and the building entry plazas. *LEED™ Silver (target rating)*.

SUNY State University at Oswego, West Campus, Onondaga & Seneca East Quadrangle – Senior Managing Landscape Architect – responsible for coordinating conceptual design for the 2-acre quadrangle site surrounded by three dormitory buildings, two dining halls, and a fitness center.

SUNY State University of New York at Plattsburgh, Hawkins Hall Pond Infrastructure Replacement – Senior Managing Landscape Architect – responsible for coordinating concept design through bid document phase services for a landscape design surrounding the historic pond. Landscape includes restoration of disturbed areas for approximately 110,000 SF (low level restoration) and 20,000 SF of plantings including trees, shrubs, and perennials. Improvements include site furniture, lighting layout, benches, relocation and restoration of memorial benches, waterfall and water aeration features.

Cazenovia College, Christakos Field Gateway Project – Senior Managing Landscape Architect - responsible for coordinating site planning and design services for design and construction documents to install gateway elements including brick clad freestanding columns, custom steel swing gates, custom metal signage and steel fencing, grading and pavement areas.

Le Moyne College, Dewitt, NY – Senior Managing Landscape Architect – developed a Statuary Placement Master Plan including final design for the St. Ignatius sculpture at the Panasci Family Chapel. Worked with nationally-recognized sculptor, Brian Hanlon of Hanlon Studios.

Le Moyne College, Dewitt, NY – Senior Managing Landscape Architect – responsible for designing multiple exterior staircase options at Reilly Hall to improve pedestrian circulation over 26 vertical feet of grade change.

Steven M. Breitzka, RLA, LEED AP
Senior Managing Landscape Architect

project experience (cont.)

The Greens at Sunset Ridge Golf Club, Marcellus, NY – Senior Managing Landscape Architect – developed preliminary master plan options and cost estimating for the senior living community. Prepared documentation for New York State Consolidated Funding Application.

Onondaga Nation Fire House, Nedrow, NY – Senior Managing Landscape Architect – responsible for coordinating site design and landscape design for the new nation fire house and community center.

McAuliffe Health Center, DeWitt, NY – Senior Managing Landscape Architect – responsible for coordinating the site and landscape design approvals process for this adult daycare center through the Town of DeWitt Planning Board and Zoning Board of Appeals.

Embracing Age, Baldwinsville, NY – Senior Managing Landscape Architect – coordinated the concept design and the preliminary municipal review process through the Village Planning Board for the 18-acre senior living community. Project included new roadway infrastructure, stormwater management, walking paths, clubhouse amenities, and associated outdoor spaces for the 190 unit community.

Miron Residence, Skaneateles, NY – Senior Managing Landscape Architect – responsible for coordinating site design and approvals process through the Town Planning Board. Design includes shoreline and outdoor patios and garden spaces.

Wallace Residence, Skaneateles, NY – Landscape Architect – responsible for new deck and railing design and layout documents and modeling.

Skaneateles Country Club, Skaneateles, NY – Senior Managing Landscape Architect – responsible for coordinating preliminary design documents for Phases 1-3 of the clubhouse master plan.

Up the Creek Farm, Fairport, NY – Landscape Architect – responsible for landform design to serve as a visual and auditory buffer adjacent for a horse farm located adjacent to a major highway.

Emerson Park, Auburn, NY – Senior Managing Landscape Architect – responsible for coordinating grant application materials including a boat launch improvement master plan and cost estimate.

Katlynn Marine, Sodus Point, NY – Senior Managing Landscape Architect – responsible for coordinating overall marina master plan including updated circulation patterns, new outdoor spaces, and sustainable site initiatives.

previous experience with other firms

Research Support Facility, National Renewable Energy Laboratory, Golden, CO – Collaborated on the environmentally sensitive design for the primary entry plaza, outdoor employee café, and surrounding landscape and stormwater strategies for the 222,000 square foot *LEED™ Platinum Plus Zero Energy Building*. Initiated new submittal and review process throughout all design-build stages. Created template for campus interpretive signage program showcasing sustainable practices. Lead Quality Control for each drawing and specification submittal.

The Crossing, Church of the Nazarene, Broomfield, CO – Master planned the full build-out vision for the mixed-use 78-acre site. Designed entry experience, Great Lawn, sustainable parking areas, and plazas for Phase 1 – a 68,000 square foot church. Coordinated zoning and entitlement process through the City and County of Broomfield.

One Steamboat Place, Steamboat Springs, CO – Designed one-acre public outdoor space, outdoor pool and plaza, and overall site for the private "cowboy chic" luxury condominiums at the base of Steamboat Mountain. Developed project from concept design through construction administration. Designed signature site elements including custom lighting and outdoor fireplaces to compliment the distinctive architectural style and unique client flair. Lead Quality Control for the multi-disciplinary site design team.

Salvation Army Red Shield Community Center, Denver, CO – Lead entitlement process through the City and County of Denver including rezoning, site development, and traffic engineering plans. Designed landscape and entry plaza for the neighborhood youth center.

Ball Aerospace and Technologies Corporation, Boulder, CO – Designed 280-space porous asphalt parking lot as part of 15 year campus implementation plan. Coordinated project through the City of Boulder entitlement and engineering process.

Eastlake Boardwalk and Overlook, Thornton, CO –Evaluated fire-proof design options for a replacement deck system. Designed innovative overlook inspired by material re-use, local stone quarries, and lightweight structure.

Lambertson Lakes, Thornton, CO – Utilized a narrative + 3D visualization approach to generate four concepts for a new trail system and landscape focused around upgraded dam projects.