ALL-POINTS TECHNOLOGY CORPORATION

VISIBILITY ANALYSIS

BAIRD SUBSTATION
STRATFORD AVENUE
STRATFORD, CONNECTICUT

Prepared for:

The United Illuminating Company
180 Marsh Hill Road
Orange CT 06477

Prepared by:

All-Points Technology Corporation, P.C.
3 Saddlebrook Drive
Killingworth, CT 06419

Project Introduction

The United Illuminating Company ("UIC") proposes to construct a new electrical Substation at 1770 Stratford Avenue in Stratford, Connecticut (the "Site"). The proposed Substation will replace the existing Baird Substation. At the request of UIC, All-Points Technology Corporation, P.C. ("APT") prepared this Visibility Analysis to evaluate potential views associated with the proposed Substation from locations within one (1) mile of the Site (the "Study Area").

Site Description and Setting

The western portion of the 3.5+ acre Site is currently developed with the existing Baird substation; the new Substation will be constructed on the eastern side of the Site, which is currently undeveloped woods. The Site is bbounded by Stratford Avenue and commercial development to the south, the Two Roads Brewery to the east, more commercial properties to the west, and the MetroNorth Railroad ROW to the north. Residential development lies farther to the north across the active railroad tracks.

The new Substation will consist of an irregularly shaped fenced facility containing two transformers, support buildings, bus work and other associated equipment. The tallest features of the Substation will be a new 80-foot tall communications pole, six (6) new, 70-foot tall lightning masts and six (6) replacement transmission line support structures[1] (ranging in heights from 70 to 85 feet tall). UIC is coordinating with the Town of Stratford for the construction of a new round-about intersection fronting the Site.

Topography within the Study Area is generally characterized as relatively level.

Methodology

APT used the combination of a predictive computer model and in-field analysis to evaluate the visibility associated with the proposed facility on both a quantitative and qualitative basis. The predictive model provides a measurable assessment of potential visibility throughout the entire Study Area including private properties and other areas inaccessible for direct observations. The in-field analyses included a reconnaissance of publicly-accessible locations within the Study Area to record existing conditions, verify results of the model, inventory visible and nonvisible locations associated with the existing substation, and provide photographic documentation. A description of the procedures used in the analysis is provided below.

[1] Additional replacement support structures, ranging in heights from 80 to 95 feet tall, will also be located within the right-of-way in association with transmission line upgrades (under a separate UIC project).

Computer Modeling

To conduct this assessment, a predictive computer model was developed specifically for this project using TerrSet, an image analysis program developed by Clark Labs at Clark University, to provide an estimation of potential visibility throughout the Study Area. The predictive model incorporates Project- and Study Area-specific data, including the site location, its ground elevation and the proposed facility component heights, as well as the surrounding topography, existing vegetation, and structures (which are the primary features that can block direct lines of sight).

Information used in the model included lidar[2]-based digital elevation data and customized land use data layers developed specifically for this analysis. Lidar is a remote-sensing technology that develops elevation data in meters by measuring the time it takes for laser light to return from the surface to the instrument's sensors. The varying reflectivity of objects also means that the returns can be classified based on the characteristics of the reflected light, normally into categories such as "bare earth," "vegetation," "road," or "building." The system is also designed to capture many more data points than older radar-based systems. Thus, lidar-based digital elevation models ("DEM"s) have a much finer resolution and can also identify the different features of the landscape at the time that it was captured.

Viewshed analysis using lidar data provide a much more detailed view of the potential obstacles (especially trees and buildings), and therefore the viewshed modeling produces results with many smaller areas of visibility than those produced by using radar-based DEMs. Its precision makes lidar a superior source of data, but at present it is only available for limited areas of the state. The viewshed results are also checked against the most current aerial photographs in case significant changes (a new housing development, for example) have occurred since the time the lidar data was captured.

The lidar-based DEM created for this analysis represents topographic information for the state of Connecticut that was derived through the spatial interpolation of airborne LiDAR-based data collected in the years 2007 through 2012 and has a horizontal resolution of approximately two (2) feet. In addition, multiple land use data layers were created from the Natural Resources Conservation Service (through the USDA) aerial photography (1-meter resolution, flown in 2012) using the image processing tools. Terrset develops light reflective classes defined by statistical analysis of individual pixels, which are then grouped based on common reflective values such that distinctions can be made automatically between deciduous and coniferous tree species, as well as grassland, impervious surface areas, surface water and other distinct land use features.

With these data inputs, the model was then queried to: determine where at least the top of the proposed lightning masts might be seen from any point(s) within the Study Area; and, similarly,

[2] Lidar (a word invented to mean "light radar") may also be referred to as LiDAR, an acronym for Light Detection and Ranging. It is a technology that utilized lasers to determine the distance to an object or surface. LiDAR is similar to radar, but incorporates laser pulses rather than sound waves. It measures the time delay between transmission and reflection of the laser pulse.

where portions of the lower ground equipment might be visible. The results of the analysis are intended to provide a representation of those areas where portions of the facility **may** potentially be visible to the human eye without the aid of magnification, based on a viewer eye-height of five (5) feet above the ground and the combination of intervening topography, trees and other vegetation, and structures. The facility however may not necessarily be visible from all locations within those areas identified by the predictive model. It is important to note that the computer model cannot account for mass density, the height, diameter and branching variability of the trees, or the degradation of views that occur with distance. In addition, each point – or pixel - represents about one square meter in area, and thus is not predicting visibility from all viewpoints through all possible obstacles. Although large portions of the predicted viewshed may theoretically offer visibility of the facility, because of these unavoidable limitations the quality of those views may not be sufficient for the human eye to recognize specific features or discriminate them from other surrounding objects. Visibility also varies seasonally with increased, albeit obstructed, views occurring during "leaf-off" conditions. Beyond the density of woodlands found within the given Study Area, each individual tree has its own unique trunk, pole timber and branching pattern characteristics that provide varying degrees of screening in leafless conditions which cannot be precisely modeled.

Once the data layers were entered, image processing tools were applied and overlaid onto USGS topographic base maps and aerial photographs to achieve an estimate of locations where the ffacility components might be visible.

In-Field Activities

To supplement and substantiate the results of the computer modeling efforts, APT completed in-field verification activities consisting of vehicular and pedestrian reconnaissance and photo-documentation. Information obtained from the field reconnaissance was subsequently incorporated into the computer model to refine the visibility map.

Field Reconnaissance

APT visited the Site and conducted field reconnaissance on May 20, 2015. These events included both a pedestrian reconnaissance of the immediate Site vicinity and a drive-by inspection of the local and State roads within the Study Area. Those locations where infrastructure associated with the existing substation could be seen were inventoried. Visual observations from the reconnaissance were also used to evaluate the results of the preliminary visibility mapping and assess any potential discrepancies in the initial modeling.

Photographic Documentation

During the May field reconnaissance, APT photo-documented conditions from areas surrounding the existing substation and Project area. Photographs were obtained from several vantage points to document the view towards the Site. At each photo location, the geographic coordinates of the camera's position were logged using global positioning system ("GPS") equipment technology.

Photographic renderings of the proposed Substation expansion and modifications were generated to portray scaled representations of those portions of the facility that would be visible upon completion.

Photographs were taken with a Canon EOS 6D digital camera body and Canon EF 24 to 105 millimeter ("mm") zoom lens, with the lens set to 50 mm.

> *"The lens that most closely approximates the view of the unaided human eye is known as the normal focal-length lens. For the 35 mm camera format, which gives a 24x36 mm image, the normal focal length is about 50 mm.[3]"*

Photographs and Renderings

Photographic renderings were generated to portray scaled representations of those portions of the new Substation that would be visible from nearby locations. Photographs and renderings are provided in the attachment to this report. Using field data, site plan information and 3-dimension (3D) modeling software, spatially referenced models of the site area and Substation were generated and merged. The geographic coordinates obtained in the field for the photograph locations were incorporated into the model to produce virtual camera positions within the spatial 3D model. Photo renderings were then created using a combination of images generated in the 3D model and photo-rendering software programs.

For presentation purposes in this report, the photographs are produced in an approximate 7" by 10.5" format. When viewing in this format size, we believe it is important to provide the largest representational image while maintaining an accurate relation of sizes between objects within the frame of the photograph.

Visibility Analysis Results

The results of our analysis are graphically displayed on the View Shed Map provided in the attachment to this report. In general, year-round views of the Substation and associated structures would be limited to a modest geographic footprint surrounding the Site by the combination of the relatively short heights of the majority of the infrastructure and the intervening development and existing vegetation.

The tallest structures proposed for the Project are the new communications tower (80 feet tall), the transmission support structures (ranging from 70 to 85 feet tall) and six (6) lightning masts (70 feet tall). The tops of these structures may be visible year-round above the trees from some locations within a total area of approximately 34 acres. The majority of these views would occur within the

[3] Warren, Bruce. Photography, West Publishing Company, Eagan, MN, c. 1993, (page 70).

immediate area of the Site and extend approximately 0.3 mile to the south and up to 0.75 mile to the east and west. To the north, views would be more limited because of intervening structures and vegetation. Seasonally, when the leaves are off the trees, views may extend to some locations over an additional 7± acres. The proposed new structures would create views that are similar to what exist today.

The primary portions of the modified Substation are lower structures extending upwards of approximately 26 feet above the ground. Year-round views may be achieved from locations within an area of approximately 22 acres; seasonally, views could extend to locations within an additional six (6) acres. Views of the new Substation may be gained from adjoining parking lots and portions along Stratford Avenue and portions of the streets to the south, but once the facility is operative and the existing substation removed, views in the general area will not be substantially different from existing conditions.

The results of this analysis demonstrate that the new Baird Substation will not have a substantial adverse visual effect on the surrounding environment.

Proximity to Schools And Commercial Child Day Care Centers

No schools or commercial child day care centers are located within 250 feet of the Site. The nearest school (Franklin Elementary School) is located at 1895 Barnum Avenue, approximately 0.5 mile to the north of the Site, well beyond the limits of visibility associated with the Substation or its infrastructure. The nearest commercial child day care center (The Fun Learning Day Care Home on Evelyn Street) is located approximately 0.35 mile to the east-southeast. Similarly, this location would have no views of the proposed Substation, lightning masts, or new transmission structures.

Limitations

The viewshed map presented in the attachment to this report depict areas where the proposed facility may potentially be visible to the human eye without the aid of magnification based on a viewer eye-height of 5 feet above the ground and intervening topography. This analysis may not necessarily account for all visible locations, as it is based on the combination of computer modeling, incorporating 2012 aerial photographs, and in-field observations from publicly-accessible locations. No access to private properties was provided to APT personnel. This analysis does not claim to depict the only areas, or all locations, where visibility may occur; it is intended to provide a representation of those areas where the facility is likely to be seen.

The simulations provide a representation of the facility under similar settings as those encountered during the time of the reconnaissance. Views of the facility can change throughout the seasons and the time of day, and are dependent on weather and other atmospheric conditions (e.g., haze, fog, clouds); the location, angle and intensity of the sun; and the specific viewer location. Weather conditions on May 20, 2015 included partly cloudy skies and the photo-simulations presented in this report provide an accurate portrayal of the facility during comparable conditions.

ATTACHMENTS

PHOTO LOG

Legend

Photo Location — Proposed Substation Layout

BAIRD SUBSTATION

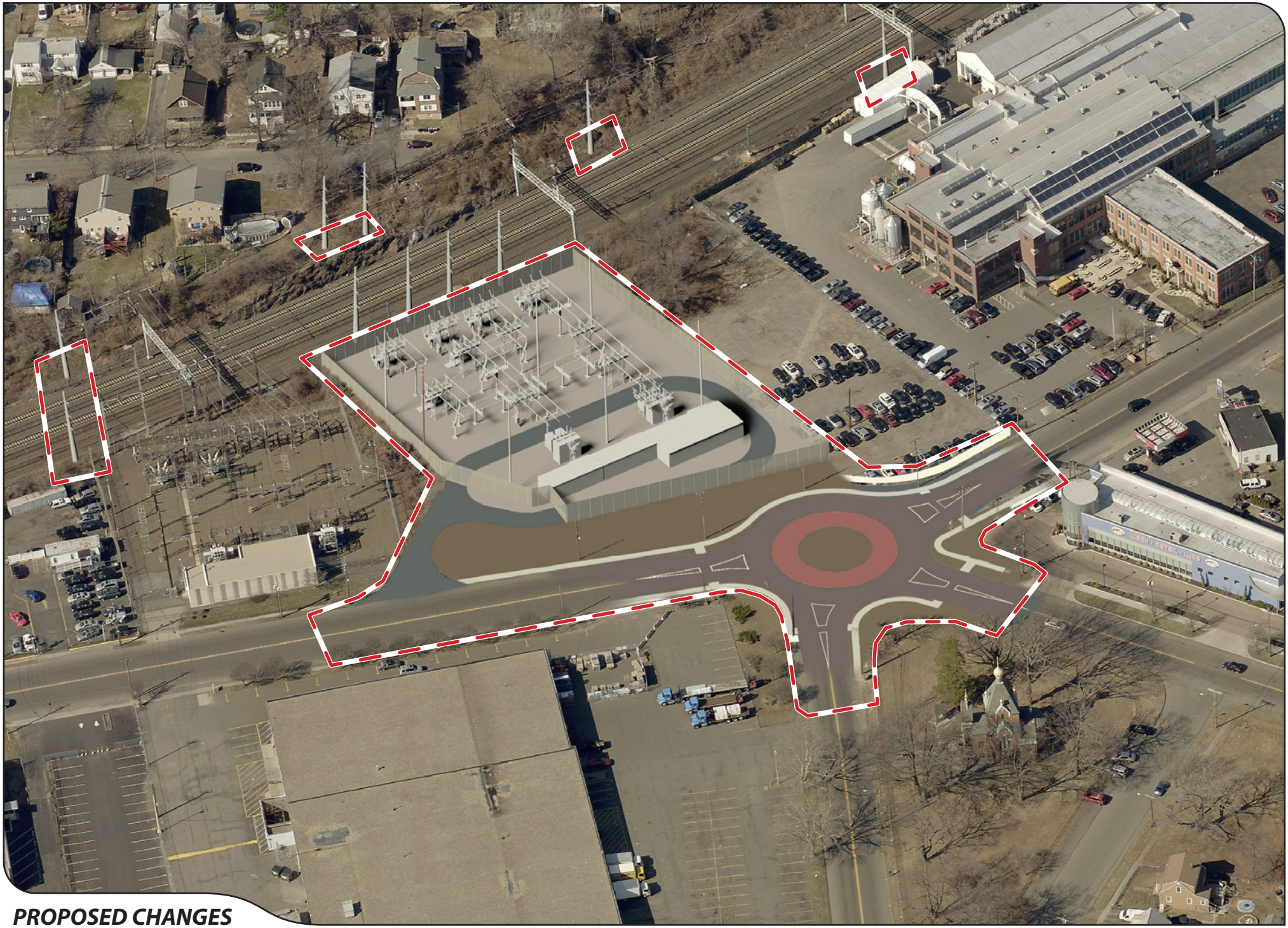
125 62.5 0 125 Feet

1 inch = 125 feet

ALL-POINTS TECHNOLOGY CORPORATION

The United Illuminating Company

EXISTING CONDITIONS



PROPOSED CHANGES

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The United Illuminating Company

FINAL CONFIGURATION

DOCUMENTATION

PHOTO	LOCATION	ORIENTATION
1	**INTERSECTION OF LINES PLACE AND STRATFORD AVENUE**	**WEST**

SIMULATION

PHOTO	LOCATION	ORIENTATION
1	**INTERSECTION OF LINES PLACE AND STRATFORD AVENUE**	**WEST**

DOCUMENTATION

PHOTO	LOCATION	ORIENTATION
2	**SOUTH AVENUE**	**NORTHWEST**

ALL-POINTS TECHNOLOGY CORPORATION
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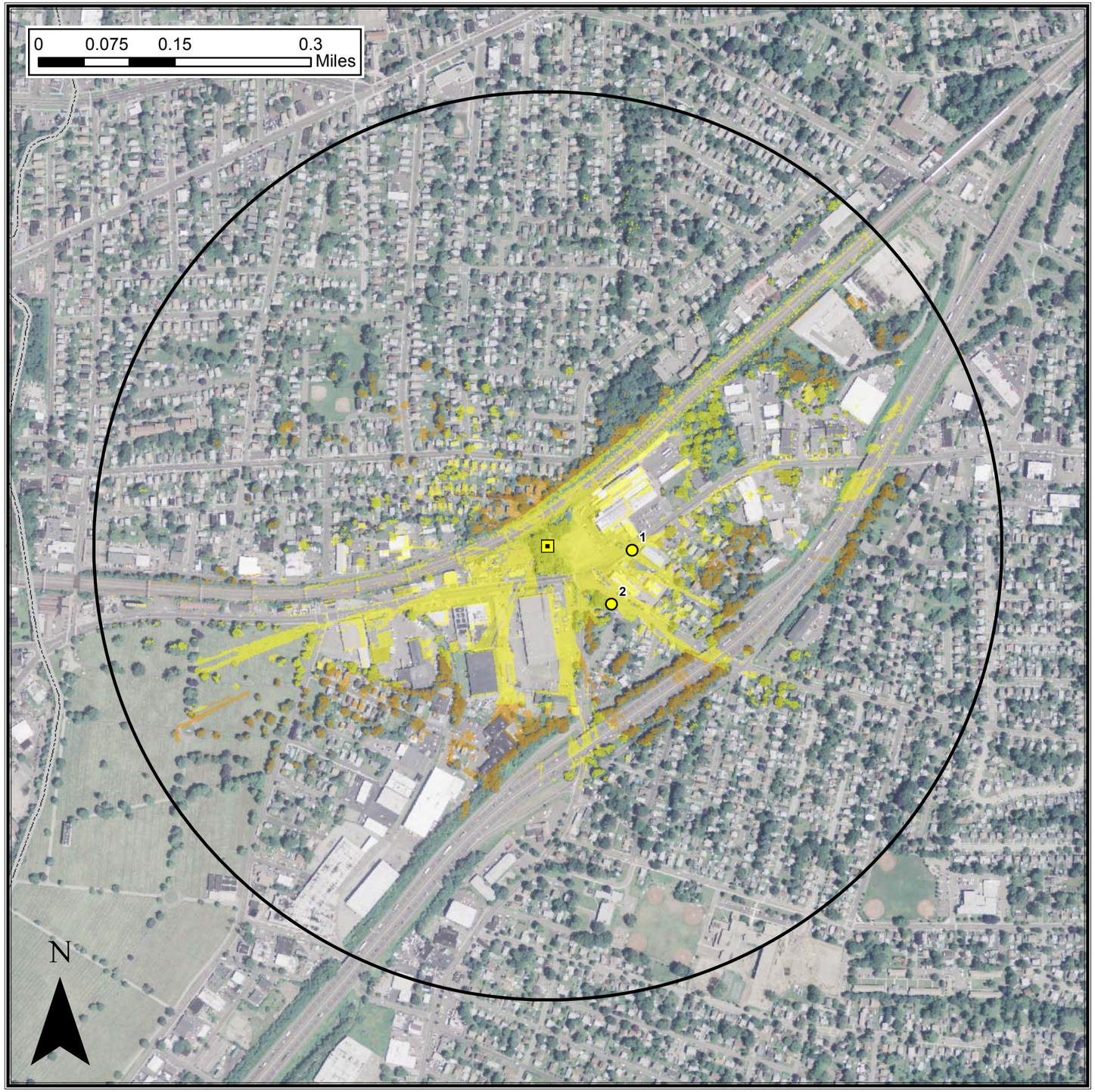
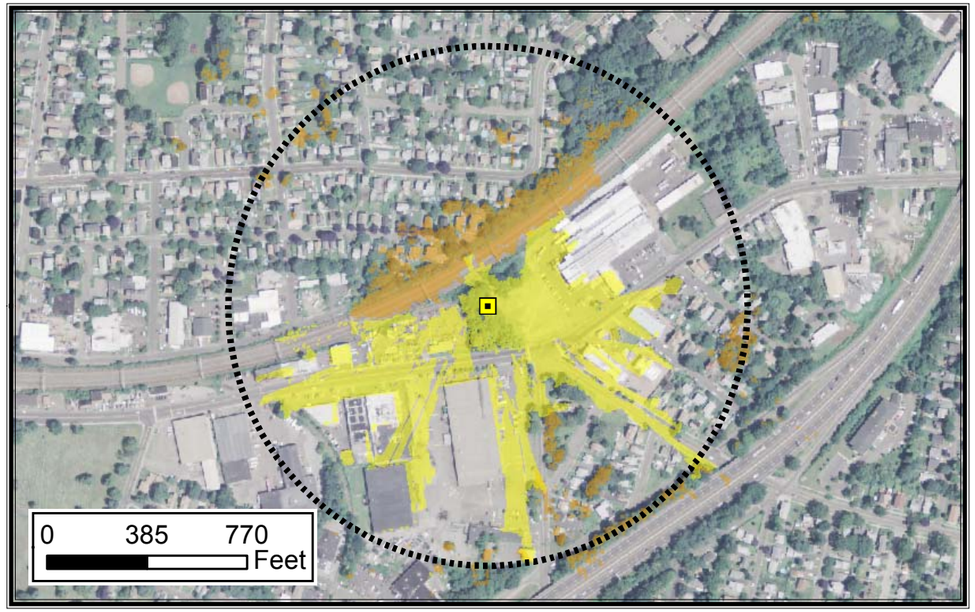
SIMULATION

PHOTO	LOCATION	ORIENTATION
2	**SOUTH AVENUE**	**NORTHWEST**

Estimated Visibility of Communication Tower, Lightning Masts and Transmission Structures



Estimated Visibility of Substation Ground Equipment



Viewshed Map – Aerial Base

Proposed Baird Substation
Stratford Avenue, Stratford, CT

NOTES
- Viewshed analysis conducted using Clark University's TerrSet.
- Areas of potential visibility are calculated based on facility location and equipment heights, Study Area topography, and Study Area vegetation.
- Maximum heights of proposed structures are 85, 80 75, 70, and 26 feet AGL, respectively.
- Heights of forest canopy and structures are derived from lidar data.
- Study Area encompasses a one-mile radius and includes 2,010 acres of land.

DATA SOURCES
- Digital elevation model (DEM) derived from 10-foot contours obtained from official CT DEEP and CLEAR sources.
- Forest areas are generated with TerrSet (Clark University) image processing from 2012 NRCS/NAIP digital orthophotos with one-foot pixel resolution.
- Municipal Open Space, State Recreation Areas, Trails, and Town Boundary data obtained from CT DEEP and the towns.

Legend

Proposed Substation Location

Photo Locations

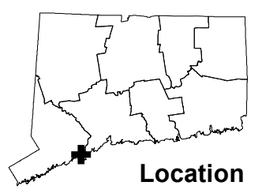
Visible

Predicted Seasonal Visibility

Predicted Year-Round Visibility

Towns

1-Mile Study Area



Location

ALL-POINTS TECHNOLOGY CORPORATION

ALL-POINTS TECHNOLOGY CORPORATION

SUPPLEMENTAL VISUAL ANALYSIS

BAIRD SUBSTATION
STRATFORD AVENUE
STRATFORD, CONNECTICUT

Prepared for:

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180 Marsh Hill Drive
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Prepared by:

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DECEMBER 2015

SUPPLEMENTAL VISUAL ASSESSMENT

At the request of United Illuminating, All-Points Technology Corporation, P.C. ("APT") completed a supplemental visual assessment of the proposed Baird Substation project on Stratford Avenue to evaluate potential views from residential streets to the north of the project site. Supplemental photographs, a computer-generated photo-simulation and sight-line profile were also prepared to illustrate existing and future views from this area.

The Jackson Avenue, Hollister Street and Knowlton Street neighborhood is situated north of the Substation site, across the MetroNorth Railroad tracks. Currently, some of the infrastructure associated with the electrified corridor is visible from locations on these residential roads.

On November 23 and December 1, 2015, APT personnel conducted a field reconnaissance to determine where the Substation might be visible and to photo-document existing conditions. From street level, the eastern end of Jackson Avenue may offer limited views of new transmission line structures on the north side of the railroad tracks; the tops of additional new support structures on the south side of the tracks may also be visible from some locations (please see Photo 1 simulation). However, the Substation itself would not be visible due to a ground elevation differential of 38± feet (Jackson Avenue sites substantially at higher elevation than Stratford Avenue). This is depicted in the attached Schematic for Photo 1 and Cross Section View (Photo 1A).

Moving westward along Jackson Avenue, the presence of intervening homes and trees substantially block direct lines of sight in the direction of the Substation. Similarly, locations on Hollister Street and Knowlton Street have no direct views towards the Substation as result of intervening homes and trees (even during leaf-off conditions). See Photos 2 and 3 as examples.

The results of this assessment indicate that the proposed Substation project will not substantially affect views from the neighborhood to the north of the MetroNorth Railroad.

Methodology Employed

The geographic coordinates of the camera's position at each photo location were logged via GPS. Photographs were taken with a Canon EOS 6D digital camera body and Canon EF 24 to 105 millimeter ("mm") zoom lens, with the lens set to 50 mm, which is generally similar to what the human eye might perceive.

> *"The lens that most closely approximates the view of the unaided human eye is known as the normal focal-length lens. For the 35 mm camera format, which gives a 24x36 mm image, the normal focal length is about 50 mm."* [1]

Three-dimensional computer models were developed for the project area and Substation components from digital elevation models and AutoCAD information. A photographic simulation was generated to portray a scaled rendering of the proposed Substation from a location on the east end of Jackson Avenue to provide a representation of the facility where it could be visible. Using field data, site plan information and image editing

[1] Warren, Bruce. Photography, West Publishing Company, Eagan, MN, c. 1993, (page 70).

software, the Substation and associated appurtenances were scaled to the correct locations and heights, relative to the photo location and surrounding area. For presentation purposes in this report, all of the photographs were produced in an approximate 7-inch by 10.5-inch format[2].

Limitations

This analysis does not claim to depict the only areas, or all locations, where visibility may occur; it is intended to provide a representation of those areas where the Facility is likely to be seen from publicly accessible locations at ground level. The photo-simulations provide a representation of the proposed project under similar settings as those encountered during the field reconnaissance. Views of the project can change throughout the seasons and the time of day, and are dependent on weather and other atmospheric conditions (e.g., haze, fog, clouds); the location, angle and intensity of the sun; and the specific viewer location. Weather conditions on the days of the reconnaissance ranged from mostly sunny skies to overcast and the photo-simulations presented in this report provide an accurate portrayal of the Facility during comparable conditions.

Prepared by:

All-Points Technology Corporation, P.C.

Michael Libertine
Vice President, Director of Siting & Permitting

[2] When viewing in this format size, we believe it is important to provide the largest representational image while maintaining an accurate relation of sizes between objects within the frame of the photograph and depicting the subject in a way similar to what an observer might see, to the greatest extent possible.

ATTACHMENTS

PHOTO LOG

Legend

Proposed Substation Layout — Visible — Not Visible

BAIRD SUBSTATION

N W E S

200 100 0 200 Feet

1 inch = 200 feet

ALL-POINTS TECHNOLOGY CORPORATION — The United Illuminating Company

DOCUMENTATION

PHOTO	LOCATION	ORIENTATION
1	**JACKSON AVENUE**	**SOUTHEAST**

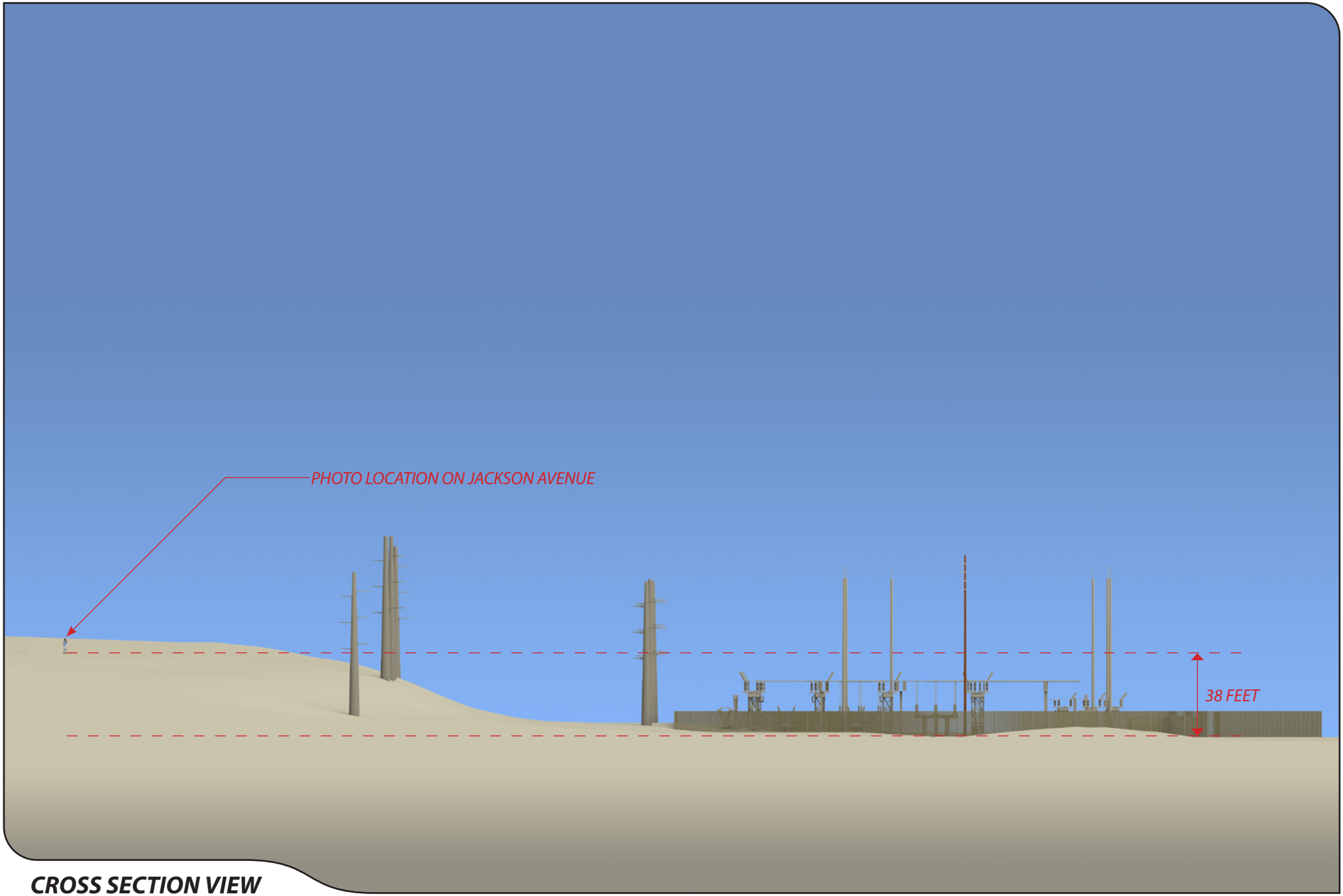
SCHEMATIC

PHOTO	LOCATION	ORIENTATION
1	**JACKSON AVENUE**	**SOUTHEAST**

ALL-POINTS TECHNOLOGY CORPORATION
The United Illuminating Company

SIMULATION

PHOTO	LOCATION	ORIENTATION
1	**JACKSON AVENUE**	**SOUTHEAST**



CROSS SECTION VIEW

PHOTO	LOCATION	ORIENTATION
1A	**JACKSON AVENUE TO BAIRD SUBSTATION**	**N/NORTHEAST**

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DOCUMENTATION

PHOTO	LOCATION	ORIENTATION
2	**HOLLISTER STREET**	**SOUTHEAST**

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DOCUMENTATION

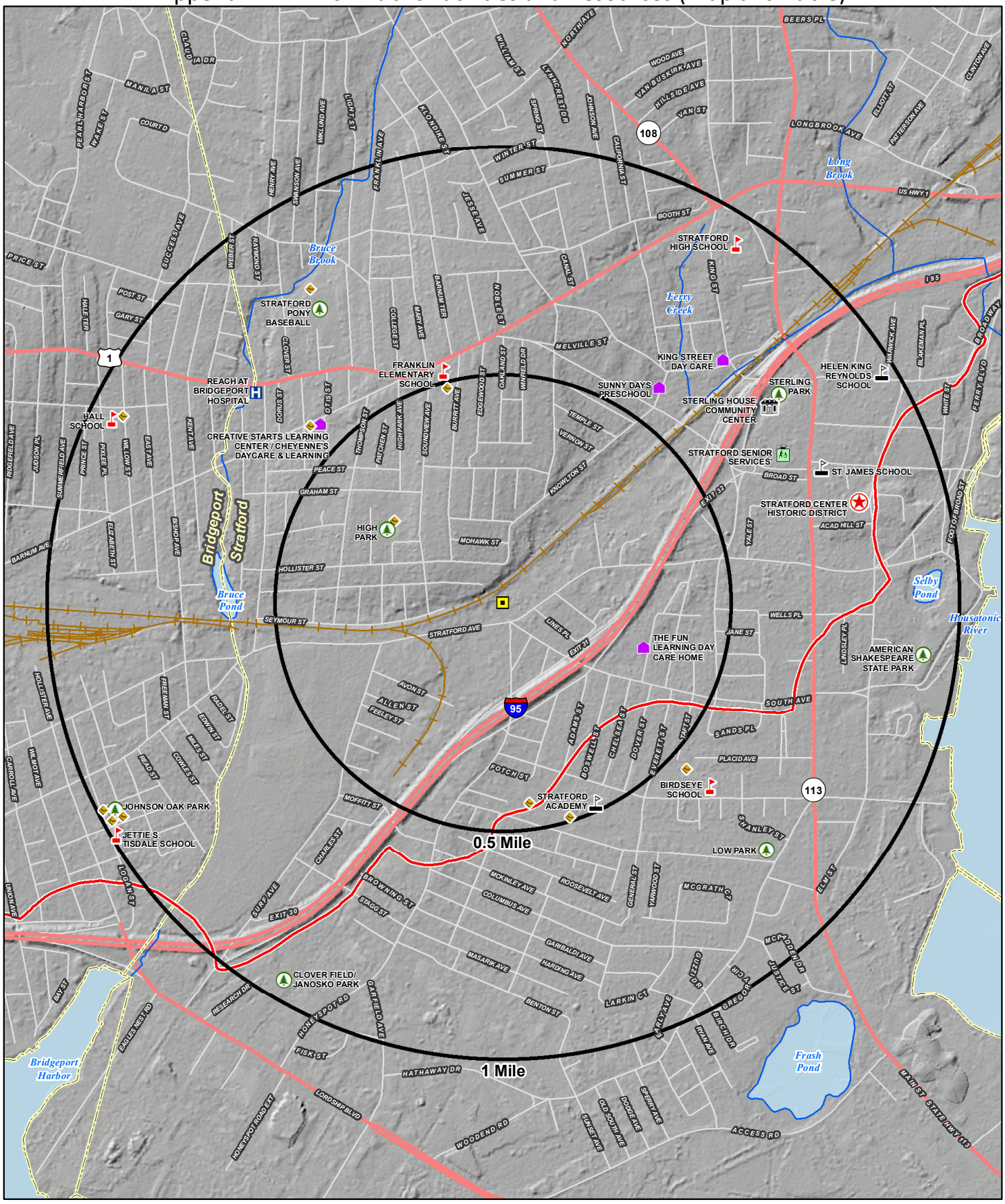
PHOTO	LOCATION	ORIENTATION
3	**KNOWLTON STREET AT HOLLISTER STREET**	**SOUTHWEST**

Appendix A - DR.6 - Public Facilities and Resources (Map and Table)

UI - Stratford Avenue
Public Facilities and Resources

Resource Type	Name	Address (all locations in Stratford, except where noted)	Distance from Substation
Daycare			
	Sunny Days Preschool	61 California Street	0.58 mile northeast
	King Street Day Care	105 King Street	0.72 mile northeast
	The Fun Learning Day Care Home	47 Evelyn Street	0.32 mile southeast
	Creative Starts Learning Center / Cheyenne's Daycare & Learning	2189 Barnum Ave	0.56 mile northwest
Community Center			
	Sterling House Community Center	2283 Main Street	0.72 mile northeast
Historic District			
	Stratford Center Historic District	Main Street Area	0.81 mile northeast
Senior Center			
	Stratford Senior Services	1000 W Broad Street	0.69 mile northeast
Hospital			
	Reach At Bridgeport Hospital	305 Boston Avenue # 1	0.71 mile northwest
School			
	Birdseye School	Birdseye Street	0.60 mile southeast
	Franklin Elementary School	1895 Barnum Avenue	0.52 mile northwest
	Hall School	290 Clermont Ave, Bridgeport	0.94 mile northwest
	Helen King Reynolds School	868 E Broadway	0.97 mile northeast
	Jettie S. Tisdale School	250 Hollister Ave, Bridgeport	0.98 mile southwest
	St. James School	50 Harvey Place	0.76 mile northeast
	Stratford Academy	719 Birdseye Street	0.48 mile southeast
	Stratford High School	45 N Parade Street	0.94 mile northeast
Recreational / Park			
	American Shakespeare State Park		0.93 mile east
	Clover Field/Janosko Park	409 Cannon Road	0.95 mile southwest
	High Park	Graham St	0.30 mile northwest
	Johnson Oak Park	Bridgeport	0.96 mile southwest
	Low Park	Woodend Road/Sedgeick Avenue	0.79 mile southeast
	Sterling Park	2283 Main Street	0.76 mile northeast
	Stratford Pony Baseball	4140 Main Street	0.76 mile northwest
Youth Camp			
	None		

Appendix A - DR.6 - Public Facilities and Resources (Map and Table)



Legend

- Proposed Substation Site
- Railroad
- Watercourse
- Open Water
- CTDEEP Coastal Boundary
- Municipal Boundary

Surrounding Features

- Park
- Hospital
- Historic District
- Community Center
- Senior Center
- Private School
- Public School
- Public Playground
- Daycare

Surrounding Features

Baird Substation
Stratford Avenue
Stratford, Connecticut

Base Map Source: ESRI & CTECO Shaded Relief
Map Scale:1 inch = 1,500 feet
Map Date: May 2015

N W E S

1,500 750 0 1,500 Feet

The United Illuminating Company

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