

VISIBILITY ANALYSIS

**BETHEL WEST 2
51 GREAT PASTURE ROAD
DANBURY, CT 06810**



Prepared for:

**Verizon Wireless
99 East River Drive
East Hartford CT 06108**

Prepared by:

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

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Project Introduction

Cellco Partnership d/b/a Verizon Wireless is pursuing a Certificate of Environmental Compatibility and Public Need from the Connecticut Siting Council (“Council”) for the development of a new wireless communications facility (“Facility”) at 15 Great Pasture Road in Danbury, Connecticut (the “Property”). At the request of Verizon Wireless, All-Points Technology Corporation, P.C. (“APT”) prepared this Visibility Analysis to evaluate the potential visual impacts associated with the proposed Facility from within a two-mile radius (the “Study Area”). Generally equal portions of the Town of Bethel and City of Danbury comprise the Study Area.

Site Description and Setting

The Property consists of an approximately 14-acre industrially developed wooded parcel that lies within both municipalities, along the west side of Great Pasture Road; the Facility would be located in Danbury. The area proposed for the Facility (the “Site”) is located southwest of the building -central at an approximate ground elevation of 387 feet Above Mean Sea Level (“AMSL”). The proposed Facility would include a 120-foot tall steel monopole surrounded by a 50-foot by 50-foot, gravel base equipment compound. Verizon Wireless antennas would extend above the top of the monopole to a height of 103 feet above ground level (“AGL”).

Land use within the immediate vicinity of the Property is primarily industrial in the Great Pasture Road area with residential development to the west across South Street. The topography within the Study Area is characterized generally by steep hills and river valleys; ground elevations range from approximately 290 feet AMSL to 870 feet AMSL. The tree cover within the Study Area (consisting of mixed deciduous hardwoods with interspersed stands of conifers) occupies approximately 4,256 acres of the 8,042-acre study area ($\pm 53\%$). The average tree canopy is estimated to be approximately 65 feet.

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 balloon float and reconnaissance of the Study Area to record existing conditions, verify results of the model, inventory visible and nonvisible locations, and provide photographic documentation from publicly accessible areas. A description of the procedures used in the analysis is provided below.

Preliminary 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 height, 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 LiDAR¹-based digital elevation and land use data. The LiDAR-based Digital Elevation Model (“DEM”) represents topographic information for the state of Connecticut that was derived through the spatial interpolation of airborne LiDAR-based data collected in the year 2000 and has a horizontal resolution of ten (10) feet. In addition, multiple land use data layers were created from National Agricultural Imagery Program (USDA) aerial photography (1-foot resolution, flown in 2012) using IDRISI image processing tools. The TerrSet tools develop 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, water and other distinct land use features. This information is manually cross-checked with the recent USGS topographic land characteristics to quality assure the imaging analysis.

Once the data layers were entered, an assumed, conservative average tree height of 50 feet was added, and image processing tools were applied and overlaid onto USGS topographic base maps and aerial photographs to achieve an estimate of locations where the Facility might be visible. Additional data was reviewed and incorporated into the visibility analysis, including protected private and public open space, parks, recreational facilities, hiking trails, schools, and historic districts. No trail systems are located within the Study Area. Based on a review of publicly-available information, no designated state scenic roads exist within the Study Area.

Field Reconnaissance

To supplement and fine tune the results of the computer modeling efforts, APT completed in-field verification activities consisting of a balloon float, vehicular and pedestrian reconnaissance, and photo-documentation.

Balloon Float and Field Reconnaissance

A balloon float and field reconnaissance were conducted May 7, 2015 to evaluate the visibility associated with the proposed Facility and to obtain photographs for use in this report. The balloon float consisted of raising an approximately four-foot diameter, red helium-filled balloon tethered to a string height of 120 feet above ground level (“AGL”) at the proposed Facility location. Weather conditions were favorable for the in-field activities, with calm winds (less than 5 miles per hour) and mostly sunny skies. Once the balloon was secured, APT conducted a Study Area reconnaissance by driving along the local and State roads and other

¹ LiDAR is 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.

publicly accessible locations to document and inventory where the balloon could be seen above/through the tree canopy. Visual observations from the reconnaissance were also used to evaluate the results of the preliminary visibility mapping and identify any discrepancies in the initial modeling.

During the balloon float and in-field activities, several trees were randomly surveyed using a hand-held infrared laser range finder and a Suunto Tandem clinometer to ascertain their heights. The heights of trees adjacent to the site were field measured to document the surrounding canopy elevation. Numerous off-site locations were also selected to obtain tree canopy heights, including along roadways, wooded lots, and high- and low-lying areas to provide for the irregularities associated with different land characteristics and uses found within the Study Area. The average canopy height was developed based on measurements and comparative observations, in this case approximately 65 feet AGL. Throughout Connecticut, the tree canopy height varies from about 55 feet to in excess of 80 feet (where eastern white pine becomes a dominant component of the forest type, average tree heights may be even slightly higher). This general uniformity is most likely the result of historic state-wide clear cutting of forests for charcoal production in the late 1800s and early 1900s. Approximately 69% of Connecticut's forests are characterized as mature².

Photographic Documentation and Simulations

During the balloon float and field reconnaissance, APT drove the public roads within the Study Area and recorded observations, including photo-documentation, of those areas where the balloon was and was not visible. Photographs were obtained from several vantage points to document the views of a proposed Facility. The geographic coordinates of the camera's position at each photo location were logged using global positioning system ("GPS") technology. 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

Final Visibility Mapping

Information obtained during the field reconnaissance was incorporated into the mapping data layers, including observations of the balloon float, the photo locations, areas that experienced recent land use changes and those places where the initial model was found to over-predict visibility. The revised average tree canopy height data (65 feet AGL) was merged with the DEM and added to the base ground elevations of the forested areas data layer. Once the additional data was integrated into the model, APT re-calculated the visibility of the proposed Facility from within the Study Area to assist in producing the final viewshed map.

² USDA Resource Bulletin NE-160, 2004.

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

Photographic Simulations

Photographic simulations were generated to portray scaled renderings of the proposed Facility from representative locations where the proposed Facility would be visible on a year-round basis. Using field data, site plan information and 3-dimension (3D) modeling software, spatially referenced models of the site area and Facility 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 simulations were then created using a combination of renderings generated in the 3D model and photo-rendering software programs⁴.

For presentation purposes in this report, the photographs were taken with a 50 mm focal length and produced in an approximate 7-inch by 10.5-inch 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.

Photo-documentation of the balloon float and photo-simulations of the proposed Facility are presented in the attachment at the end of this report. The balloon float photos provide visual reference points for the approximate height and location of the proposed Facility relative to the scene. The photo-simulations are intended to provide the reader with a general understanding of the different views that might be achieved of the Facility. It is important to consider that the publicly-accessible locations selected are typically representative of a “worst case” scenario. They were chosen to present unobstructed view lines (wherever possible), are static in nature and do not necessarily fairly characterize the prevailing views from all locations within a given area. From several locations, moving a few feet in any direction will result in a far different perspective of the Facility than what is presented in the photographs. In several cases, a view of the Facility may be limited to the immediate area of the specific photo location.

⁴ As a final step, the accuracy and scale of select simulations are tested against photographs of similar existing facilities with recorded camera position, focal length, photo location, and tower location.

Photograph Locations

The table below summarizes characteristics of the photographs and simulations presented in the attachment to this report including a description of each location, view orientation, the distance from where the photo was taken relative to the proposed Facility and the general characteristics of that view. The photo locations are depicted on the visibility analysis maps provided as attachments to this report.

View	Location	Orientation	Distance to Site	View Characteristics
1	Wooster Street	West	±0.21 Mile	Seasonal
2	Wooster Street	Southwest	±0.14 Mile	Year-round
3	Wooster Street	Southwest	±0.14 Mile	Year-round
4	Apollo Road	West	±0.47 Mile	Year-round
5	Apollo Road	Southwest	±0.38 Mile	Year-round
6	Apollo Road	Southwest	±0.36 Mile	Seasonal
7	Great Hill Drive	Southwest	±0.51 Mile	Year-round
8	Great Pasture Road	Southeast	±0.24 Mile	Year-round
9	South Street	Southeast	±0.36 Mile	Year-round
10	Grassy Plain Street	East	±0.13 Mile	Year-round
11	Bainbridge Boulevard	Northeast	±0.25 Mile	Year-round
12	Penny Lane	Northeast	±0.36 Mile	Year-round
13	Willow Street	North	±0.36 Mile	Year-round
14	South Street	North	±0.96 Mile	Not Visible
15	Bonnette Drive	Northeast	±0.70 Mile	Not Visible
16	Tucker Street	East	±0.34 Mile	Year-round
17	South Street	Southeast	±0.55 Mile	Not Visible
18	Briarwood Drive	Southeast	±0.96 Mile	Not Visible
19	Skyline Drive	South	±0.88 Mile	Not Visible
20	Kingswood Drive	Northwest	±0.78 Mile	Year-round

Visibility Analysis Results

Results of this analysis are graphically displayed on the viewshed maps provided in the attachment at the end of this report. Areas from where the proposed Facility would be visible above the tree canopy year-round comprise a total of approximately 38 acres. When the leaves are off the trees, seasonal views through intervening tree trunks and branches are anticipated to occur over some locations within an area of 255± additional acres.

In general, year-round views of portions of the Facility appear limited to locations within 0.5 mile of the Property. At nearby locations (0.25± mile of the Facility), and primarily within the industrial park along Great Pasture Road, large portions of the monopole may be visible. Beyond 0.25 mile, views become more sporadic and intervening vegetation and existing infrastructure serve to obstruct large portions of the Facility.

Proximity to Schools And Commercial Child Day Care Centers

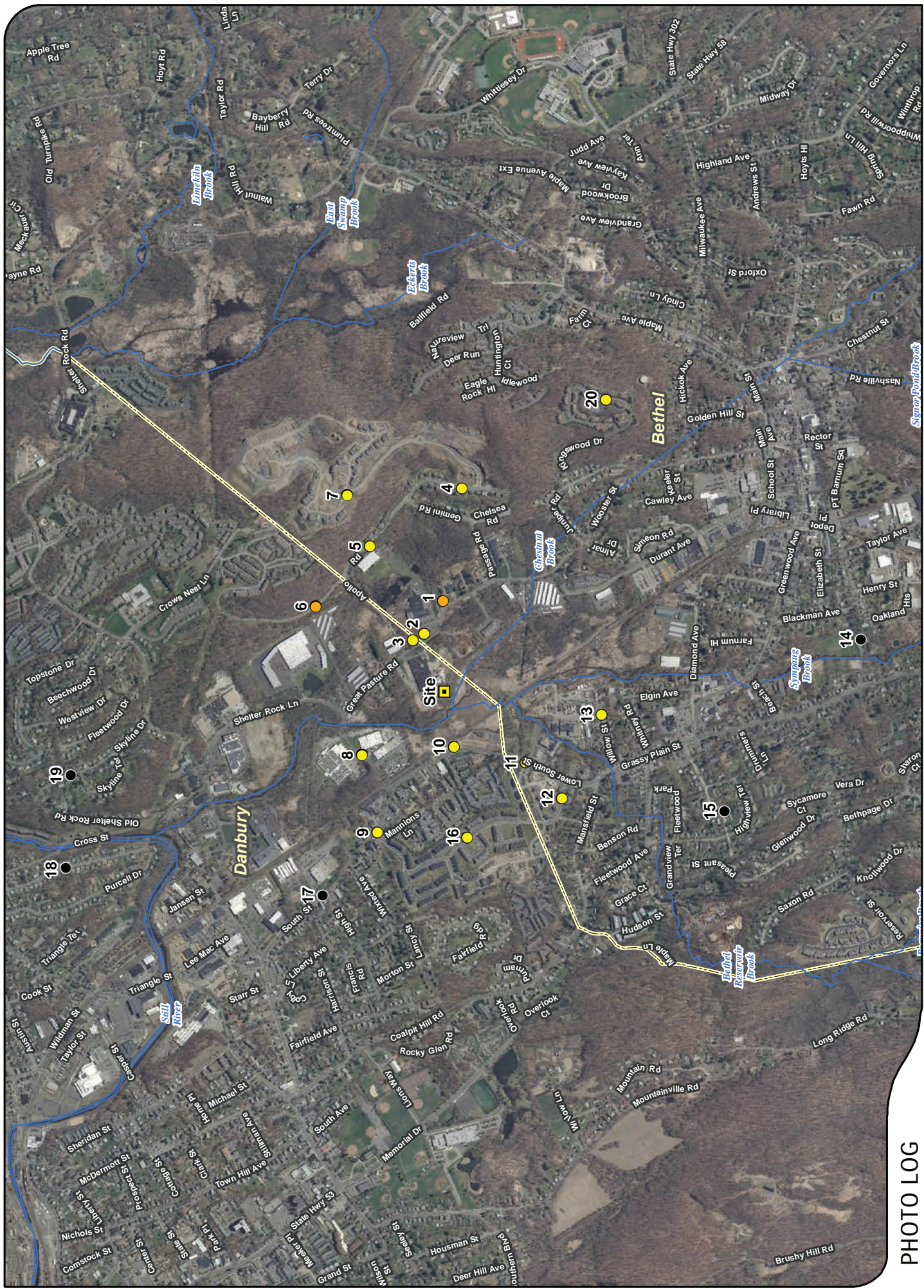
No schools or commercial child day care centers are located within 250 feet of the Property. The nearest school, the Hudson Country Montessori School (44 Shelter Rock road in Danbury) is located approximately 0.66 mile to the northwest. The nearest commercial child day care center, at the YMCA Children's Center, is located at 57 Grassy Plain Street in Bethel, approximately 0.67 mile to the south/southwest. No views of the Facility are anticipated from either of these locations.

Limitations

The viewshed maps 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 and an assumed tree canopy height of 60 feet. 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 balloon floats and 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 the day of the balloon float included partly cloudy skies and the photo-simulations presented in this report provide an accurate portrayal of the Facility during comparable conditions.

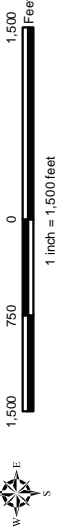
ATTACHMENTS



Legend

- Site
- Year Round Visibility
- Not Visible
- Municipal Boundary

PHOTO LOG





EXISTING

PHOTO

1

LOCATION

WOOSTER STREET

ORIENTATION

WEST

DISTANCE TO SITE

+/- 0.21 MILE

VISIBILITY

SEASONAL



PROPOSED

PHOTO

1

LOCATION

WOOSTER STREET

ORIENTATION

WEST

DISTANCE TO SITE

+/- 0.21 MILE

VISIBILITY

SEASONAL



EXISTING

PHOTO

2

LOCATION

WOOSTER STREET

ORIENTATION

SOUTHWEST

DISTANCE TO SITE

+/- 0.14 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
2	WOOSTER STREET	SOUTHWEST	+/- 0.14 MILE	YEAR ROUND



EXISTING

PHOTO

3

LOCATION

WOOSTER STREET

ORIENTATION

SOUTHWEST

DISTANCE TO SITE

+/- 0.14 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
3	WOOSTER STREET	SOUTHWEST	+/- 0.14 MILE	YEAR ROUND



EXISTING

PHOTO

4

LOCATION

APOLLO ROAD

ORIENTATION

WEST

DISTANCE TO SITE

+/- 0.47 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO

4

LOCATION

APOLLO ROAD

ORIENTATION

WEST

DISTANCE TO SITE

+/- 0.47 MILE

VISIBILITY

YEAR ROUND



EXISTING

PHOTO

5

LOCATION

APOLLO ROAD

ORIENTATION

SOUTHWEST

DISTANCE TO SITE

+/- 0.38 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
5	APOLLO ROAD	SOUTHWEST	+/- 0.38 MILE	YEAR ROUND



EXISTING

PHOTO

6

LOCATION

APOLLO ROAD

ORIENTATION

SOUTHWEST

DISTANCE TO SITE

+/- 0.36 MILE

VISIBILITY

SEASONAL



PROPOSED

PHOTO

6

LOCATION

APOLLO ROAD

ORIENTATION

SOUTHWEST

DISTANCE TO SITE

+/- 0.36 MILE

VISIBILITY

SEASONAL



EXISTING

PHOTO

7

LOCATION

GREAT HILL DRIVE

ORIENTATION

SOUTHWEST

DISTANCE TO SITE

+/- 0.51 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO

7

LOCATION

GREAT HILL DRIVE

ORIENTATION

SOUTHWEST

DISTANCE TO SITE

+/- 0.51 MILE

VISIBILITY

YEAR ROUND



EXISTING

PHOTO

8

LOCATION

GREAT PASTURE ROAD

ORIENTATION

SOUTHEAST

DISTANCE TO SITE

+/- 0.24 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO

8

LOCATION

GREAT PASTURE ROAD

ORIENTATION

SOUTHEAST

DISTANCE TO SITE

+/- 0.24 MILE

VISIBILITY

YEAR ROUND



EXISTING

PHOTO

9

LOCATION

SOUTH STREET

ORIENTATION

SOUTHEAST

DISTANCE TO SITE

+/- 0.36 MILE

VISIBILITY

YEAR ROUND





PROPOSED

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
9	SOUTH STREET	SOUTHEAST	+/- 0.36 MILE	YEAR ROUND



EXISTING

PHOTO

10

LOCATION

GRASSY PLAIN STREET

ORIENTATION

EAST

DISTANCE TO SITE

+/- 0.13 MILE

VISIBILITY

YEAR ROUND



ALL-POINTS
TECHNOLOGY CORPORATION



verizon wireless



PROPOSED

PHOTO

10

LOCATION

GRASSY PLAIN STREET

ORIENTATION

EAST

DISTANCE TO SITE

+/- 0.13 MILE

VISIBILITY

YEAR ROUND



EXISTING

PHOTO

11

LOCATION

BAINBRIDGE BOULEVARD

ORIENTATION

NORTHEAST

DISTANCE TO SITE

+/- 0.25 MILE

VISIBILITY

YEAR ROUND





PROPOSED

PHOTO

11

LOCATION

BAINBRIDGE BOULEVARD

ORIENTATION

NORTHEAST

DISTANCE TO SITE

+/- 0.25 MILE

VISIBILITY

YEAR ROUND



EXISTING

PHOTO

12

LOCATION

PENNY LANE

ORIENTATION

NORTHEAST

DISTANCE TO SITE

+/- 0.36 MILE

VISIBILITY

YEAR ROUND





PROPOSED

PHOTO
12

LOCATION
PENNY LANE

ORIENTATION
NORTHEAST

DISTANCE TO SITE
+/- 0.36 MILE

VISIBILITY
YEAR ROUND



EXISTING

PHOTO

13

LOCATION

WILLOW STREET

ORIENTATION

NORTH

DISTANCE TO SITE

+/- 0.36 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO

13

LOCATION

WILLOW STREET

ORIENTATION

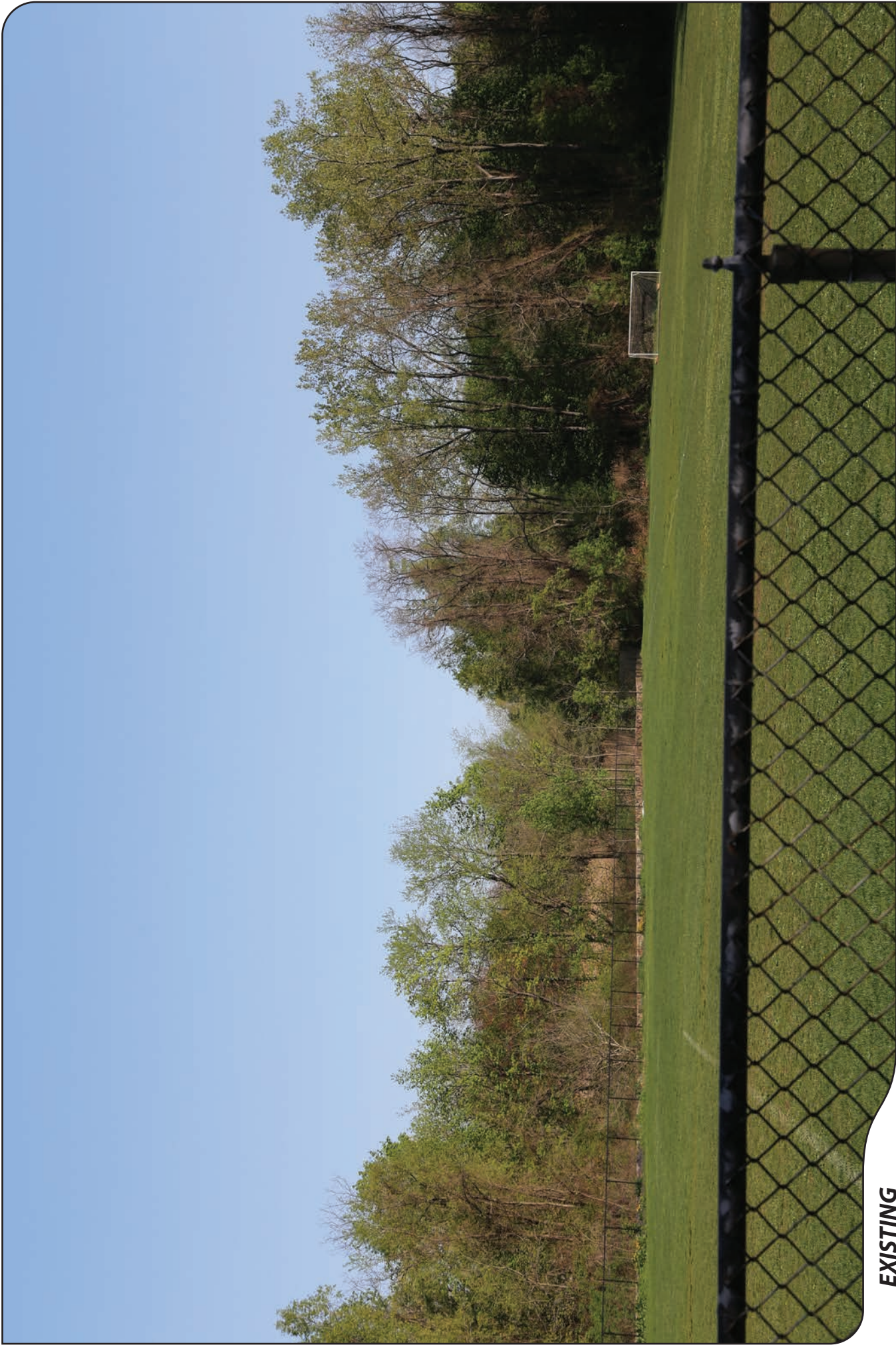
NORTH

DISTANCE TO SITE

+/- 0.36 MILE

VISIBILITY

YEAR ROUND



EXISTING

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
14	SOUTH STREET	NORTH	+/- 0.96 MILE	NOT VISIBLE



EXISTING

PHOTO

15

LOCATION

BONNETTE DRIVE

ORIENTATION

NORTHEAST

DISTANCE TO SITE

+/- 0.70 MILE

VISIBILITY

NOT VISIBLE



EXISTING

PHOTO

16

LOCATION

TUCKER STREET

ORIENTATION

EAST

DISTANCE TO SITE

+/- 0.34 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO

16

LOCATION

TUCKER STREET

ORIENTATION

EAST

DISTANCE TO SITE

+/- 0.34 MILE

VISIBILITY

YEAR ROUND



EXISTING

PHOTO
17

LOCATION
SOUTH STREET

ORIENTATION
SOUTHEAST

DISTANCE TO SITE
+/- 0.55 MILE

VISIBILITY
NOT VISIBLE



EXISTING

PHOTO

18

LOCATION

BRIARWOOD DRIVE

ORIENTATION

SOUTHEAST

DISTANCE TO SITE

+/- 0.96 MILE

VISIBILITY

NOT VISIBLE



EXISTING

PHOTO

19

LOCATION

SKYLINE DRIVE

ORIENTATION

SOUTH

DISTANCE TO SITE

+/- 0.88 MILE

VISIBILITY

NOT VISIBLE



EXISTING

PHOTO

20

LOCATION

KINGSWOOD DRIVE

ORIENTATION

NORTHWEST

DISTANCE TO SITE

+/- 0.78 MILE

VISIBILITY

YEAR ROUND



PROPOSED

PHOTO

20

LOCATION

KINGSWOOD DRIVE

ORIENTATION

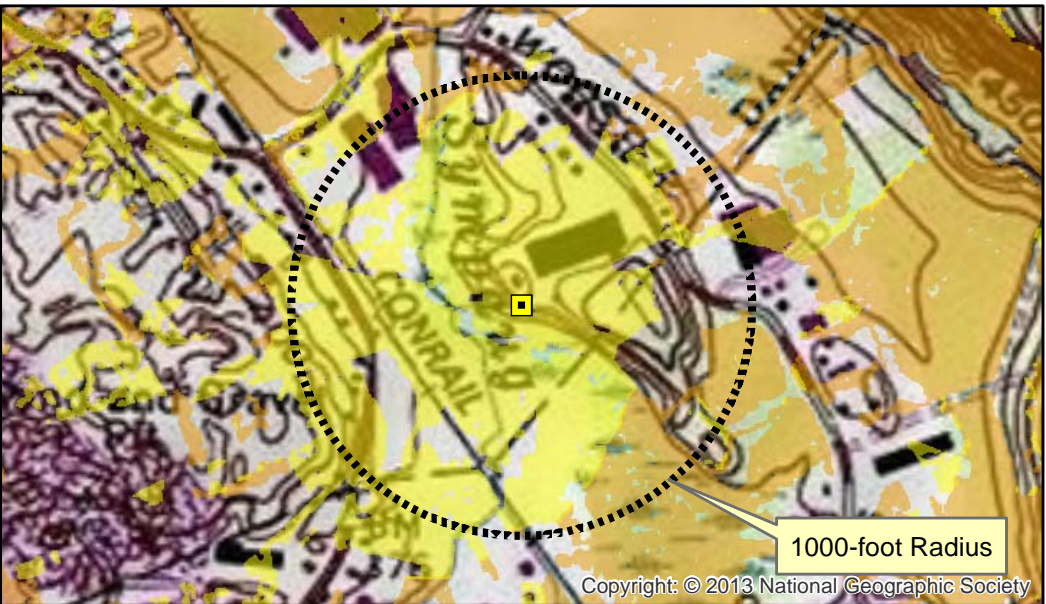
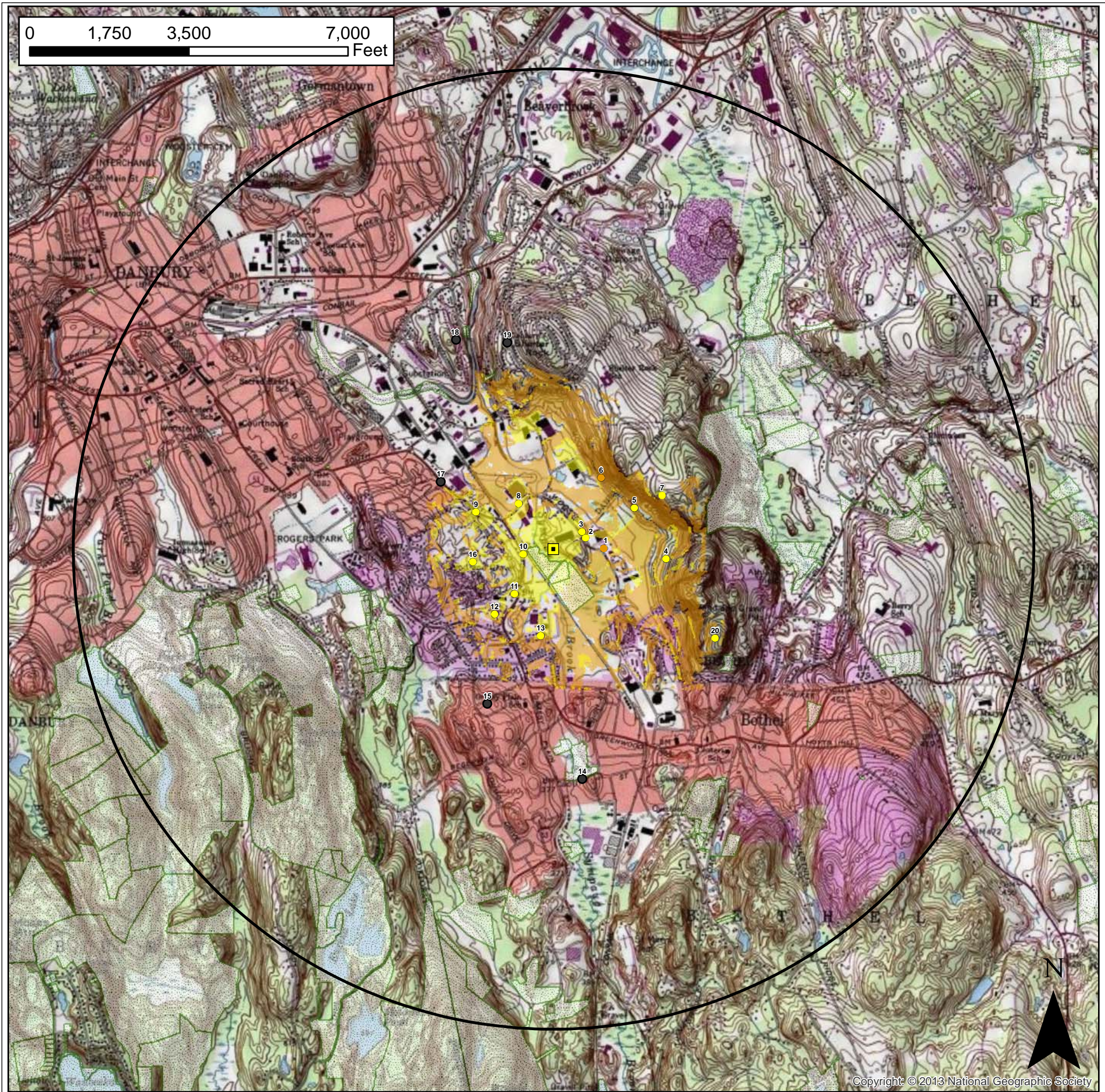
NORTHWEST

DISTANCE TO SITE

+/- 0.78 MILE

VISIBILITY

YEAR ROUND



Viewshed Map – Topo Base
 Proposed Wireless Telecommunications Facility
 Bethel West 2
 15 Great Pasture Road, Danbury, CT

Proposed facility height is 123 feet AGL.
 Existing tree canopy height estimated as 65 feet.
 Study area encompasses a two-mile radius and includes 8,042 acres of land.

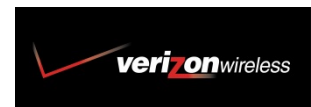
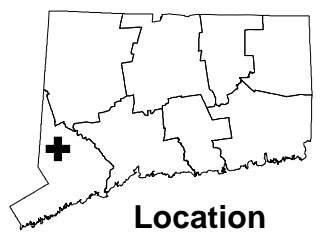
Map compiled 6/15/2015

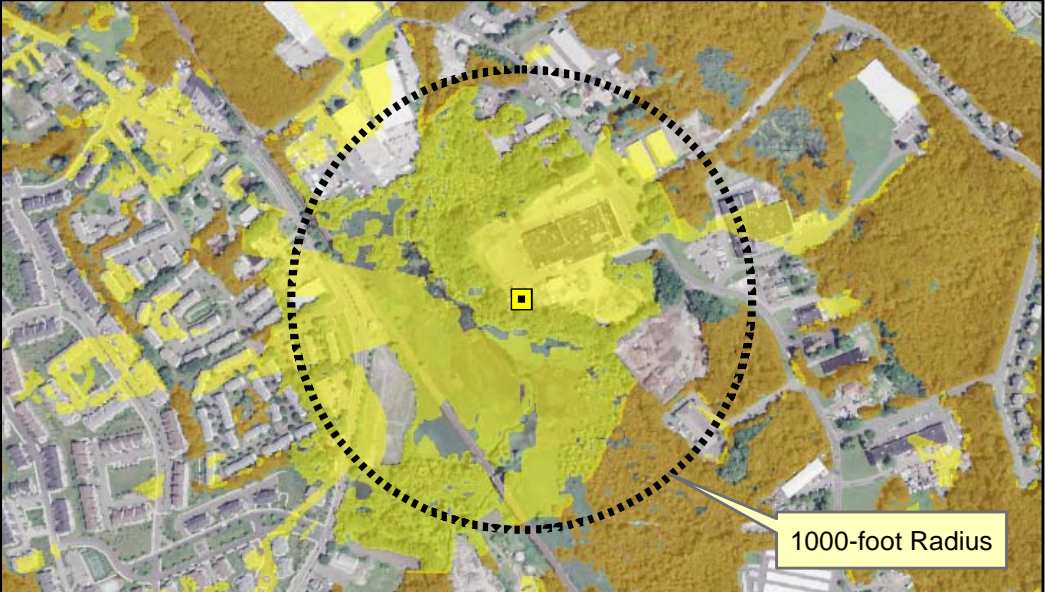
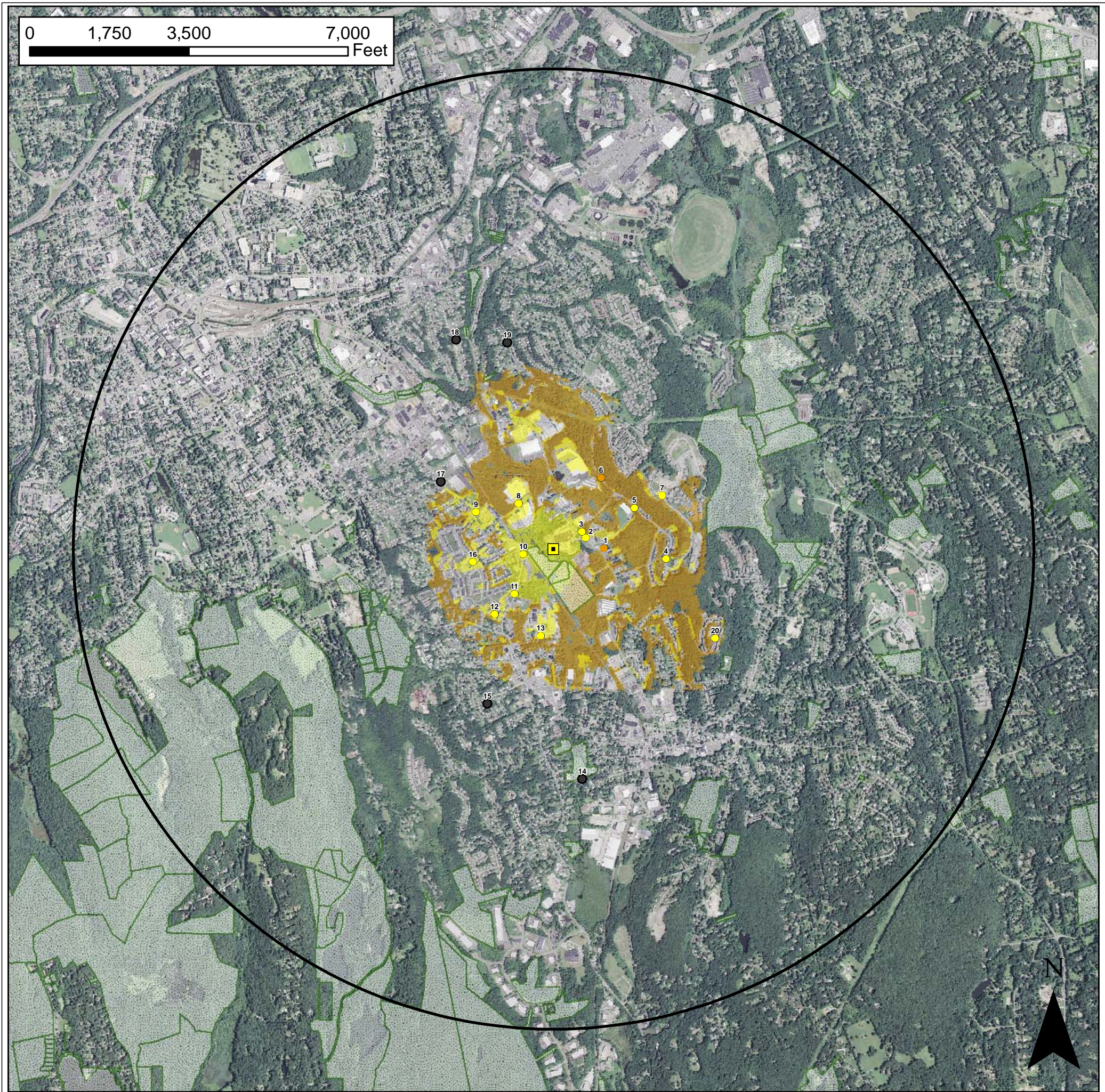
Map information field verified by APT on 5/7/2015.

Only those resources located within the extent of the map are depicted. For a complete list of data sources consulted for this analysis, please refer to the Documentation Page.

Legend

- Proposed Tower
- Photo Locations**
- Not Visible
- Seasonal Views
- Year-round Views
- Predicted Seasonal Visibility (255 Acres)
- Predicted Year-Round Visibility (38 Acres)
- Towns
- 2-Mile Study Area
- Open Space





Viewshed Map – Aerial Base
 Proposed Wireless Telecommunications Facility
 Bethel West 2
 15 Great Pasture Road, Danbury, CT










Proposed facility height is 123 feet AGL.
 Existing tree canopy height estimated as 65 feet.
 Study area encompasses a two-mile radius and
 includes 8,042 acres of land.

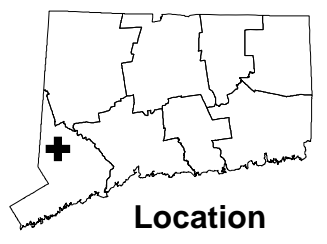
Map compiled 6/15/2015

Map information field verified by APT on 5/7/2015.

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Legend

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-  Predicted Seasonal Visibility (255 Acres)
-  Predicted Year-Round Visibility (38 Acres)
-  Towns
-  2-Mile Study Area
-  Open Space



DOCUMENTATION

SOURCES CONSULTED FOR VIEWSHED MAPS

15 Great Pasture Road
Danbury, Connecticut

Physical Geography / Background Data

Center for Land Use Education and Research, University of Connecticut (<http://clear.uconn.edu>)

- *Land Use / Land Cover (2006)
- *Coniferous and Deciduous Forest (2006)
- *LiDAR data – topography (2000)

United States Geological Survey

- *USGS topographic quadrangle maps – Danbury, Bethel (1984)

National Resource Conservation Service

- *NAIP aerial photography (2012)

Department of Transportation data

- ^State Scenic Highways (updated monthly)

Heritage Consultants

- ^Municipal Scenic Roads

Cultural Resources

Heritage Consultants

- ^National Register
- ^ Local Survey Data

Dedicated Open Space & Recreation Areas

Connecticut Department of Energy and Environmental Protection (DEEP)

- *DEEP Property (May 2007)
- *Federal Open Space (1997)
- *Municipal and Private Open Space (1997)
- *DEEP Boat Launches (1994)

Connecticut Forest & Parks Association

- ^Connecticut Walk Books East & West –

The Guide to the Blue-Blazed Hiking Trails of Eastern Connecticut Western Connecticut, 19th Edition, 2006.

Other

- ^ConnDOT Scenic Strips (based on Department of Transportation data)

*Available to the public in GIS-compatible format (some require fees).

^ Data not available to general public in GIS format. Reviewed independently and, where applicable, GIS data later prepared specifically for this Study Area.

NOTE Not all the sources listed above appear on the Viewshed Maps. Only those features within the scale of the graphic are shown.

LIMITATIONS

The visibility analysis map(s) presented in 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 and an assumed tree canopy height of 65 feet. 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 beyond the host Property 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 photo-simulations in this report are provided for visual representation only. Actual visibility depends on various environmental conditions, including (but not necessarily limited to) weather, season, time of day, and viewer location.