EXHIBIT K

AVIAN RESOURCE/MIGRATORY BIRD IMPACT ANALYSIS

For the Proposed Wireless Facility
Known As

Glastonbury / CT-0114

Located At

Sequin Drive
Glastonbury, Connecticut 06033

March 11, 2021

Prepared For:

Arx Wireless, LLC
100 Washington Avenue
North Haven, Connecticut 06473

Prepared By:

EBI Consulting
environmental | engineering | due diligence

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE

This Avian Resource/Migratory Bird Impact Analysis (MBIA) report has been prepared in support of a Federal Communications Commission (FCC) National Environmental Policy Act (NEPA) review concerning a proposed wireless facility (see Section 1.2 below). The FCC has licensing authority over wireless communications facilities, and the granting of such a license by the FCC represents a major federal undertaking. This EA includes an evaluation of the potential impacts of the proposed facility on migratory birds. EBI has prepared this report to assess these potential impacts.

1.2 PROJECT DETAILS

Proposed Action:	Proposed wireless facility identified as Glastonbury / CT-0114, consisting of a 115-foot monopole tower and associated ground equipment.
Project Location:	Sequin Drive Glastonbury, Hartford County, Connecticut 06033 Lat / Long: 41° 42' 51.27" N / 73° 34' 54.32" W
Lead Federal Agency:	Federal Communications Commission 445 12th Street, SW Washington, DC 20554
Applicant:	Arx Wireless, LLC 100 Washington Avenue North Haven, Connecticut 06473
Authorized Agent:	EBI Consulting 21 B Street Burlington, MA 01803

2.0 PROJECT SUMMARY

2.1 PROJECT LOCATION

The address of the proposed wireless facility installation is Sequin Drive, Glastonbury, Hartford County, CT 06033 (herein, the Subject Property). The Subject Property is located approximately 1,000 feet east/northeast of Oakwood Drive along Sequin Drive and then approximately 300 feet north into an undeveloped portion of the Subject Property.

2.2 PROJECT SCOPE

As of the date of this Review, Arx Wireless proposes to construct a new communications facility on the Subject Property. The proposed facility will include a 115-foot (including appurtenance) monopole tower and associated support equipment located within fenced 50-foot by 50-foot lease area. Access and utilities will be gained via a joint easement emanating north/northwest from Sequin Drive for approximately 550 feet to the proposed facility. Please see the attached drawings for complete details.

2.3 ONGOING ACTIVITIES

Following the completion of construction, ongoing activities will generally consist of regular maintenance and operation of the facility. The impacts of any proposed future expansion of the currently proposed facility described herein, will be evaluated in a separate assessment.

3.0 ENVIRONMENTAL SETTING

3.1 ACTION AREA

The Action Area includes the proposed installation area (described in Section 2.2 above) and adjacent areas that may be impacted by construction and/or ongoing facility operation and maintenance activities. Specifically, the Action Area consists of the physical footprint of the proposed communications facility, proposed access and utility easements, and any adjacent area with the potential to be impacted directly (e.g. construction) or indirectly (i.e. sedimentation, runoff, etc.). The Action Area was previously disturbed/cleared (Circa 2016) and currently consists of ruderal grasses/shurbs, and undeveloped wooded land.

3.2 MIGRATION FLYWAY/CORRIDOR & IMPORTANT BIRD AREAS

A migration flyway/corridor refers to the routes birds follow as they migrate between nesting and wintering areas. North America is divided into four major migratory flyways, which collectively encompass the entirety of the continental United States. The proposed facility is located within the Atlantic Flyway, which extends across 24 states along the Atlantic Ocean Coast of the United States. Approximately 500 different avian species utilized this Flyway annually.

An Important Bird Area (IBA) consists of biologically diverse habitats suitable for migratory bird species to utilize throughout all stages of migration. There are 28 IBAs listed within the State of Connecticut totaling approximately 19,550 acres; and two IBAs located within Hartford County, CT (Northwest Park, Station 43 Marsh/Sanctuary). The proposed Action Area is not located within any of the two IBAs located within Hartford County, CT.

3.3 BREEDING BIRD SURVEY

EBI utilized information from the USGS North American Breeding Bird Survey (BBS), an annual cooperative effort between the U. S. Geological Survey's Patuxent Wildlife Research Center and Environment Canada's Canadian Wildlife Service, which conducts a volunteer-based bird survey along predetermined routes (approximately 25-miles long with 50 point count stops) across North America to collect data for monitoring the status and trends of North American bird populations. The Buckingham Route (#18003) is located approximately 2.7 miles southeast of the Project Site within Harford, CT. However, due to demographics of the proposed tower design (115 feet in overall height, no guy wires, no lighting) and distance between the Project Site and closest BBS Route (Buckingham), the proposed Project will not impact any of the migratory birds identified along this BBS Route.

3.4 HAWK WATCH

EBI utilized information from HawkWatch International, a non-profit organization that aims to protect all raptor species and their habitat through scientific research and public education. HawkWatch assists in scientific research through data collection through volunteers which conduct migratory hawk counts at specific sites throughout North America. The Beelzebub Street is the closest and located approximately 7.7 miles northeast of the Project Site. Due to the distance between the Project Site and Beelzebub Street and the proposed tower dynamics (115 feet in overall height, no guy wires, no lighting), it is not anticipated that the proposed Project will not impact any of the raptor species identified at this HawkWatch Site.

3.5 BALD EAGLE SURVEY ROUTE

The Bald and Golden Eagle Protection Act (BGEPA; 16 U.S.C. 668-668d) prohibits the "taking" of bald and golden eagles in the absence of a permit issued by the Secretary of the Interior. Based on EBI's on-site observations, assessment of habitat, and review of publicly-available occurrence data, the proposed installation is not anticipated to result in the "take" of any Bald or Golden Eagles.

Further, EBI utilized information from the Midwinter Bald Eagle Count (Count), conducted from 1986 through 2005, to assess the potential distance between the Project Site and any identified Bald eagle (*Haliaeetus leucocephelaus*) nests. According to information obtained from the Count, the closest survey route is *RT 291-MASS STATE LINE (Survey Station: 03)* located approximately 16.0 – 16.5 miles northwest of the Project Site. Please note, as defined within the USFWS 2007 National Bald Eagle Management Guidelines that the USFWS recommended buffer for Bald eagle nests is 660 feet. There are no known Bald eagle nests within 660 feet of the Project Site.

3.6 WATERFOWL / WATERBIRD / LANDBIRD NATIONAL PRIORITY AREAS (ATLANTIC COAST JOINT VENTURE)

EBI utilized information obtained from the Atlantic Coast Joint Venture, a regional collaborative including 16 state wildlife agencies from Maine to Florida, Puerto Rico, Federal conservation agencies, and numerous other regional partnerships, assisting in the restoration and sustainment of native bird populations and habitats throughout the ACJF region. Data acquired indicated that the proposed Project Site is not located within a Waterfowl Priority Area located; however, is located within a Waterbird and Landbird Priority Area. Although the Project Site is located within a Waterbird and Landbird Priority Area, there are no waterbird habitats located at the Project Site, and minimal to no nesting habitat for land birds capable to support these species.

3.7 CONNECTICUT DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION (DEEP)

3.7.1 Natural Diversity DataBase (Endangered / Threatened / Species of Special Concern)

In addition, EBI also reviewed online resources including a map of Natural Diversity Database (NDDB) data displaying potential sensitive habitats and/or species, maintained by the Connecticut Department of Energy and Environmental Protection (DEEP, https://portal.ct.gov/DEEP/Endangered-Species/Endangered-Species-Listings/Endangered-Threatened-and-Special-Concern-Species-listed-by-County), within Hartford, CT. Based on EBI's review of these online resources, there are 255 state-protected (threatened, endangered, species of concern) species within Hartford, CT. Please note that the Project Site is located approximately 100 feet south of state and/or federally listed species.

3.7.2 Migratory Waterfowl Data

EBI utilized data gathered from the CT DEEP open GIS website, which depicts the concentration areas of migratory waterfowl as determined by DEEP wildlife biologist in 1999. According to data acquired from CT DEEP the Connecticut/Park/Hog River concentration area is located the closest located approximately 1.75 miles west of the Project Site. Due to the proposed dynamics of the tower (115 feet in overall height, no guy wires, no lighting) and distance between the Project Site and Connecticut/Park/Hog River, it is not anticipated that the proposed Project will not impact any of the waterfowl known to occur at this concentration area.

3.8 USFWS Protected Bird Species (Threatened, Endangered, Migratory) and Critical Habitat

EBI utilized the USFWS Information for Planning and Consultation (IPaC) online project review tool to identify any federally-listed (i.e. endangered or threatened) or migratory bird species that are known to occur within the project vicinity. Based on EBI's research of online files maintained by the USFWS, no such federally-listed bird species or migratory bird species are known to occur within the project vicinity. Additionally, EBI utilized the USFWS online Critical Habitat Portal[1] online mapping tool, and determined that the proposed Facility location is not within a designated critical habitat.

4.0 Impact Minimization Measures

4.1 Discussion of USFWS Tower Siting & Design Recommendations

In April 2018, the United States Fish and Wildlife Service (USFWS) updated their "Recommended Best Practices for Communications Tower Design, Siting, Construction, Operation, Maintenance and Decommissioning" (https://www.fws.gov/migratorybirds/pdf/management/usfwscommtowerguidance.pdf), which provides avoidance and minimization measures to reduce the risk of avian mortality as a result of communications towers. These recommendations and a discussion of each (*in italic font*) as they pertain to the proposed facility follows below:

1. Any company/applicant/licensee proposing to construct a new communications tower should be strongly encouraged to collocate the communications equipment on an existing communication tower or other structure (e.g., billboard, water tower, or building mount). Depending on tower load factors, from 6 to 10 providers may collocate on an existing tower.

   The proposed tower height is required to meet operational and service coverage objectives for Arx Wireless, which are not available through existing communications towers within the vicinity of the proposed Action Area. Additionally, the tower will also subsequently accommodate future antenna collocations, thereby reducing the need for future towers in the immediate vicinity.

2. If collocation is not feasible, and a new tower or towers are to be constructed, communications service providers should be strongly encouraged to construct towers no more than 199 feet above ground level (AGL), using construction techniques which do not require guy wires (e.g., use a lattice structure, monopole, etc.). Such towers should be unlighted if Federal Aviation Administration regulations permit.

   The proposed facility will consist of a 115-foot monopole tower with no lighting.

3. If constructing multiple towers, providers should consider the cumulative impacts of all of those towers to migratory birds and threatened and endangered species as well as the impacts of each individual tower.

   This proposed project consists of the construction of one communications tower.

4. If at all possible, new towers should be sited within existing "antenna farms" (clusters of towers). Towers should not be sited in or near wetlands, other known bird concentration areas (e.g., state or Federal refuges, staging areas, rookeries), in known migratory or daily movement flyways, or in habitat of threatened or endangered species. Towers should not be sited in areas with a high incidence of fog, mist, and low ceilings.

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[1] USFWS Critical Habitat Portal URL: http://criticalhabitat.fws.gov

The proposed tower is located within the Atlantic Flyway. The FCC has no set definition of a "tower farm;" however, the authors of this report acknowledge that the proposed tower is not located within what could be characterized as a "cluster of towers".

EBI also reviewed online resources maintained by the USFWS (http://ecos.fws.gov/ipac) to identify any species that are federally-listed under the Endangered Species Act (ESA) as either endangered or threatened, and that are known to occur within the project vicinity. Based on EBI's research of online files maintained by the USFWS, no federally-protected (i.e. endangered, threatened, migratory) bird species are known to occur within the project vicinity. Further, based on a review of the USFWS online Critical Habitat Portal (http://criticalhabitat.fws.gov), the proposed communications facility is not located within designated critical habitat.

The proposed facility is not located within any state or Federal refuge, staging area, or rookeries.

Further, EBI did not observe within the Action Area, any readily-identifiable wetlands or wetland characteristics (e.g. standing water, hydrophytic vegetation, soil saturation and inundation, drainage patterns and sediment deposition, watermarks and drift lines on trees and vegetation, or water stained leaves). A review of the USFWS National Wetlands NWI map did not identify any wetlands within the Action area. Further, the closest waterbody is the Housatonic River located approximately 0.75-miles east of the Project Site.

If taller (>199 feet AGL) towers requiring lights for aviation safety must be constructed, the minimum amount of pilot warning and obstruction avoidance lighting required by the FAA should be used. Unless otherwise required by the FAA, only white (preferable) or red strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. The use of solid red or pulsating red warning lights at night should be avoided. Current research indicates that solid or pulsating (beacon) red lights attract night-migrating birds at a much higher rate than white strobe lights. Red strobe lights have not yet been studied.

Not Applicable (The proposed facility will consist of a 115-foot monopole tower with no lighting).

5. Tower designs using guy wires for support which are proposed to be located in known raptor or waterbird concentration areas or daily movement routes, or in major diurnal migratory bird movement routes or stopover sites, should have daytime visual markers on the wires to prevent collisions by these diurnally moving species.

   Not Applicable (The proposed facility will not utilize guy wires).

   For guidance on markers, see Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute, Washington, D.C., 78 pp, Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines. Edison Electric Institute/Raptor Research Foundation, Washington, D.C., 128 pp. Avian Power Line Interaction Committee (APLIC). 2006. Mitigating Bird Collisions with Power Lines: The State of the Art in 2006. Edison Electric Institute, Washington, D.C., 207 pp (available online as a PDF). Copies can be obtained via the Internet at http://www.aplic.org/, or by calling 1-800-334-5453.

6. Towers and support facilities should be sited, designed and constructed so as to avoid or minimize habitat loss within and adjacent to the tower "footprint." However, a larger tower footprint is preferable to the use of guy wires in construction. Road access and fencing should be minimized to reduce or prevent habitat fragmentation and disturbance, and to reduce above ground obstacles to birds in flight.

   The proposed tower and facility is located approximately 1,000 feet east/northeast of Oakwood Drive along Sequin Drive and then approximately 300 feet north into an undeveloped portion of the Subject Property. The proposed

Action Area was previously disturbed/cleared (Circa 2016) and currently consists of ruderal grasses/shrubs, and undeveloped wooded land.

7. If significant numbers of breeding, feeding, or roosting birds are known to habitually use the proposed tower construction area, relocation to an alternate site should be recommended. If this is not an option, seasonal restrictions on construction may be advisable in order to avoid disturbance during periods of high bird activity.

   The tower is to be located within the Atlantic Flyway. Spring migration takes place from approximately April 1st through approximately June 1st. The breeding season takes place from approximately June 1st through approximately August 15th. The majority of fall migration takes place from August 15th through October 31st. However, due to the limited amount of suitable nesting habitat, demographics of the proposed tower (115 feet in overall height, no guy wires, no lighting), and the lack of identified protected bird species known to occur within the immediate vicinity of the Project Site, there are no recommended construction timeframes and work may proceed at any time.

8. In order to reduce the number of towers needed in the future, providers should be encouraged to design new towers structurally and electrically to accommodate the applicant/licensee's antennas and comparable antennas for at least two additional users (minimum of three users for each tower structure), unless this design would require the addition of lights or guy wires to an otherwise unlighted and/or un-guyed tower.

   The design of the proposed tower will be sufficient to support future collocations; however, information regarding the total space available for future collocations is currently undetermined as it is dependent upon the engineering requirements of such collocations.

9. Security lighting for on-ground facilities and equipment should be down-shielded to keep light within the boundaries of the site.

   Not applicable (There will be no lighting so no need for down shielding).

10. If a tower is constructed or proposed for construction, Service personnel or researchers from the Communication Tower Working Group should be allowed access to the site to evaluate bird use, conduct dead-bird searches, to place net catchments below the towers but above the ground, and to place radar, Global Positioning System, infrared, thermal imagery, and acoustical monitoring equipment as necessary to assess and verify bird movements and to gain information on the impacts of various tower sizes, configurations, and lighting systems.

    USFWS and research personnel associated with the Communication Tower Working Group will be permitted to access to the tower site (excluding the fenced equipment compound area) in order to study the effects of the proposed tower on migratory birds.

11. Towers no longer in use or determined to be obsolete should be removed within 12 months of cessation of use.

    This project involves the proposed construction of a new tower. If this tower is determined to be obsolete it will be removed within 12 months of cessation of use.

5.0 <u>EVALUATION OF IMPACTS</u>

The proposed tower facility consists of a 115-foot monopole tower and support equipment within a fenced enclosure. The Action Area currently consists of an asphalt-paved surface void of any vegetative communities or migratory bird habitat. Please note that although data obtained from the Breeding Bird Survey, HawkWatch, Department of Energy and Environmental Protection, and Atlantic Coast Joint Venture did identify different migratory bird species within the vicinity of the Project Site, due to the distance from the site, tower dynamics, and existing conditions of the Action Area, the proposed facility will not impact any of these identified migratory bird species. Finally, no federally-protected (http://ecos.fws.gov/ipac) were identified as being potentially located within the vicinity of the proposed facility.

No designated critical habitat (http://criticalhabitat.fws.gov) was identified by the USFWS within the vicinity of the proposed facility. Additionally, the facility itself is not located within a wetland or near a rookery.

6.0 CONCLUSIONS

The proposed 115-foot monopole tower and associated Action Area will be located within the Atlantic Flyway in Fairfield County, CT. However, please note that the tower is not located within any Important Bird Area, or Waterfowl Priority Habitat, and further will not incorporate any lighting or utilized any guy wires. Additionally, the proposed Facility will not impact any state-protected, federally-protected, migratory birds, sensitive nesting habitats, or critical habitat. Therefore, it is the opinion of EBI Consulting that the proposed project facility will not significantly impact migratory birds.

7.0 REFERENCES

American Bird Conservancy. 2000. Communications Towers: A Deadly Hazard To Birds. American Bird Conservancy, Washington, DC.

Connecticut Department of Energy and Environmental Protection. 2019. Migratory Waterfowl Website (https://ct-deep-gis-open-data-website-ctdeep.hub.arcgis.com/datasets/migratory-waterfowl?geometry=-73.222%2C41.187%2C-73.005%2C41.232). Accessed February 25, 2021. Last Updated October 30, 2019.

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United Stated Geological Survey. 2018. North American Breeding Bird Survey Website (https://www.pwrc.usgs.gov/bbs/index.cfm). Accessed February 23, 2021. Last updated March 2018.

8.0 LIST OF PREPARERS

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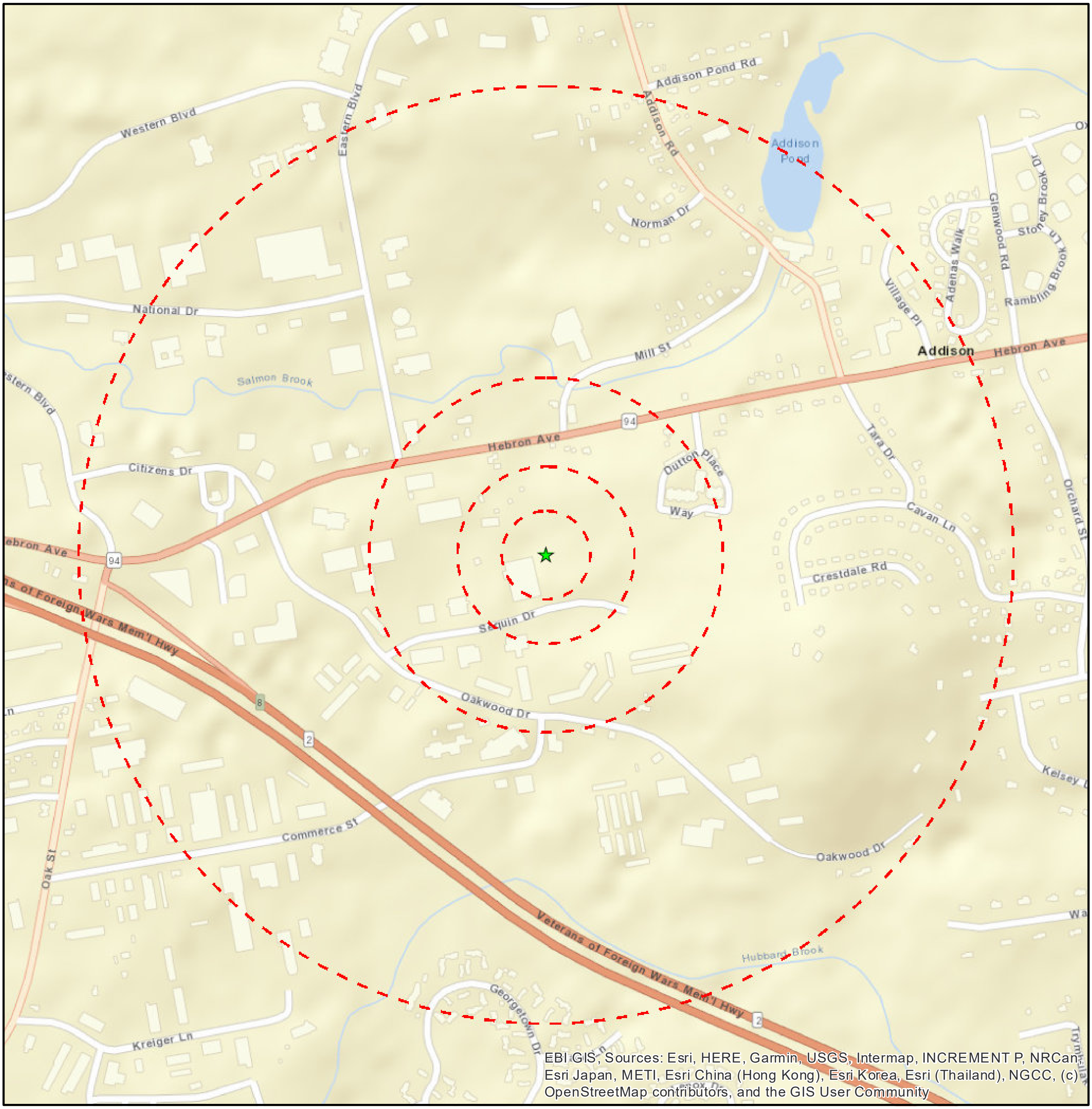
FIGURES



Legend

★ Project Site

Site Radius at 250', 500', 1000' and ½ mile

Date: 12/17/2020

Figure 1: Site Location Map

CT-0114 GLASTONBURY
SEQUIN DRIVE
GLASTONBURY, CT 06033

PN: 6120010499

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environmental | engineering | design

Legend

★ Project Site

Site Radius at 250', 500', 1000' and ½ mile

USGS 24K Quad: Glastonbury, CT 1985

Date: 12/17/2020

Figure 2 - Topographic Map

CT-0114 GLASTONBURY
SEQUIN DRIVE
GLASTONBURY, CT 06033

PN: 6120010499

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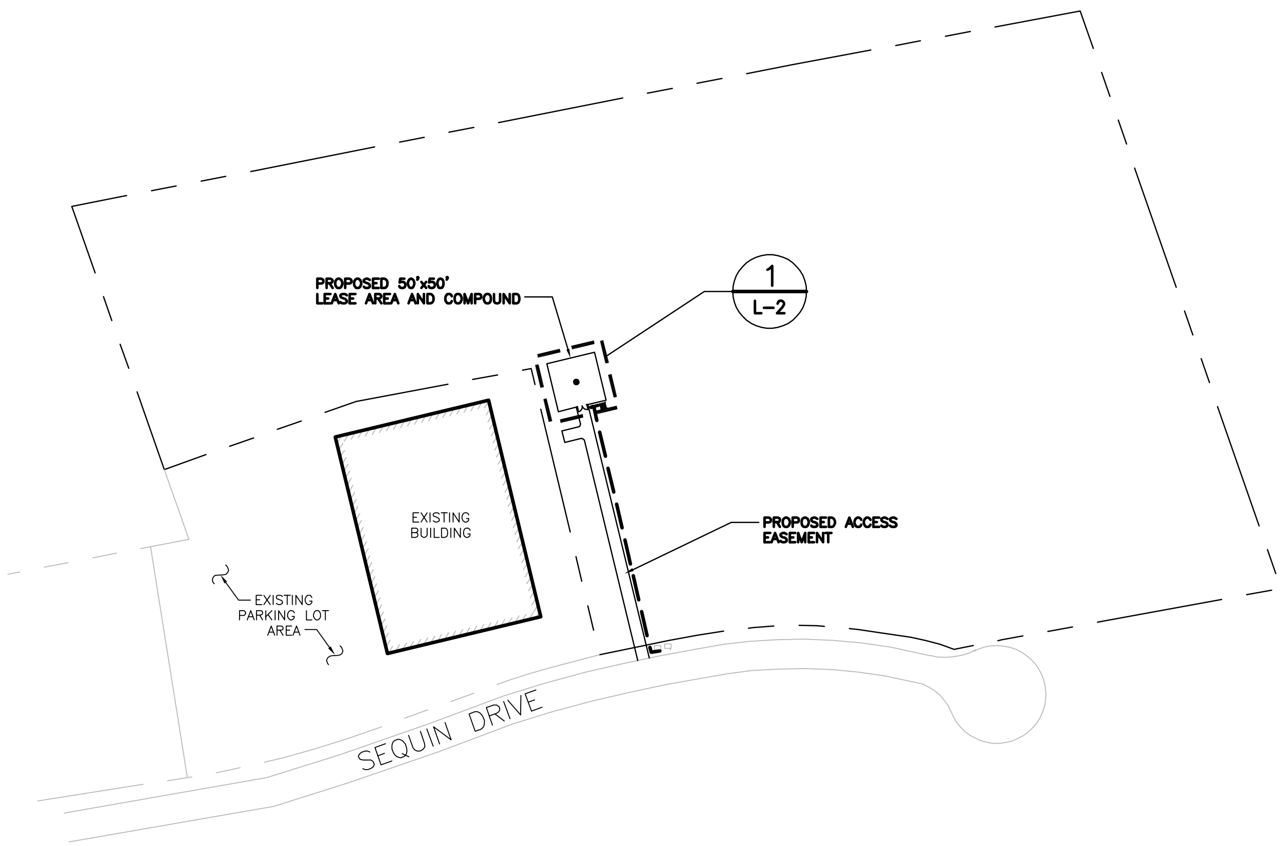
DRAWINGS

NOTE:
THIS LEASE EXHIBIT IS DIAGRAMMATIC IN NATURE AND IS INTENDED TO PROVIDE GENERAL INFORMATION REGARDING THE LOCATION AND SIZE OF THE PROPOSED WIRELESS COMMUNICATIONS EQUIPMENT FACILITY.



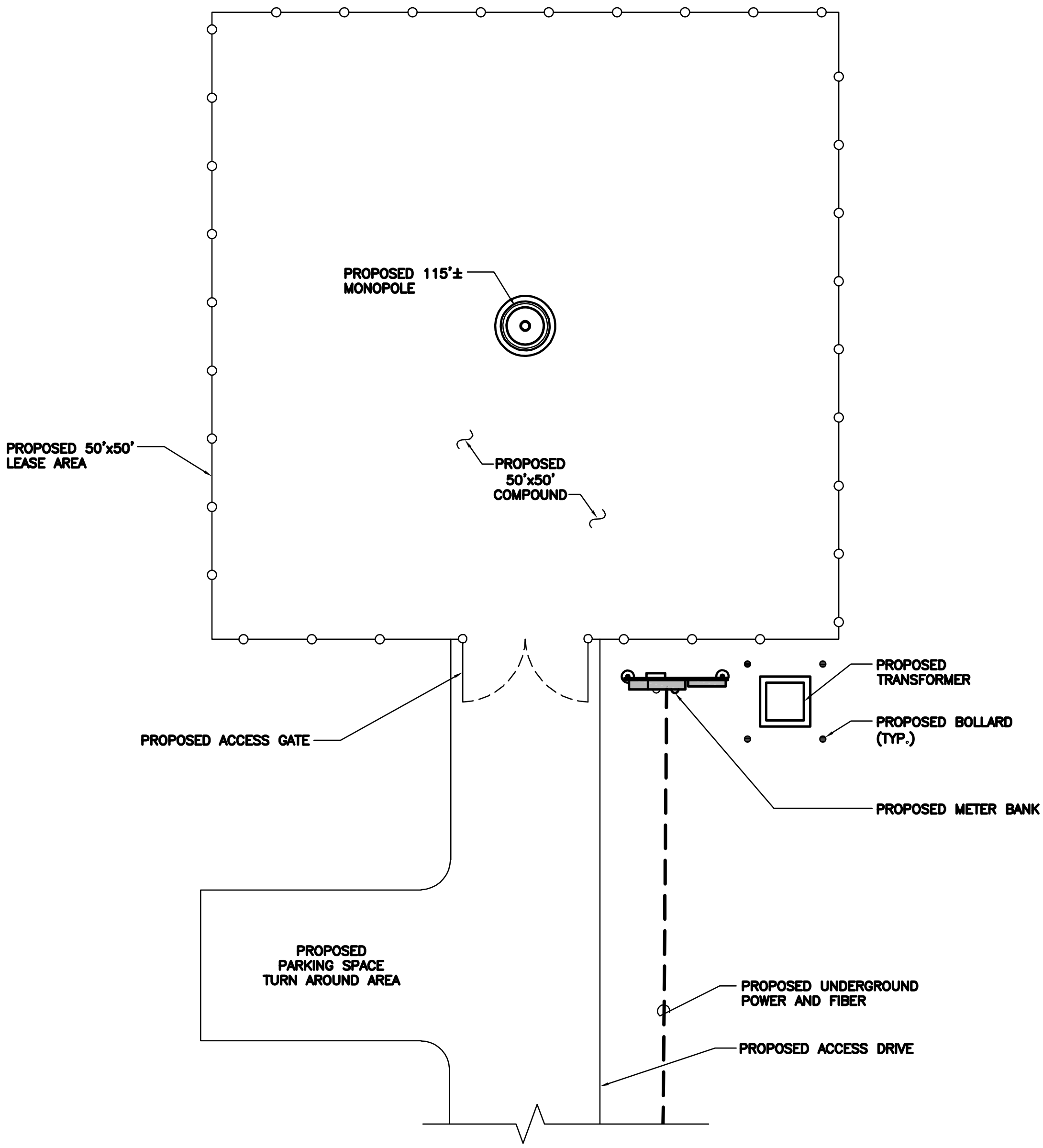
1
LE-1
SITE PLAN
SCALE: 1" = 200'-0"

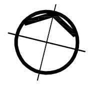
0 50 100 150 200 400

APPROX.
TRUE
NORTH

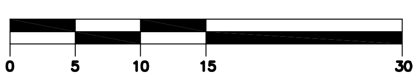
Project No.:	**AECOM** 500 ENTERPRISE DRIVE ROCKY HILL, CONNECTICUT (860)-529-8882	ARX WIRELESS	1 / 12-15-2020 / REVISED	Dwg. No. LE-1
Designed by: MJE		SITE ADDRESS: CT0114A GLASTONBURY LOT N-4 SEQUIN DRIVE GLASTONBURY, CONNECTICUT	REV. / DATE: / DESCRIPTION	
Drawn by: KAP			Scale: AS NOTED	Date: 10-20-2020
Checked by: MJE			Job No.	File No.
Approved by: MJE				Dwg. 1 of 3

NOTE:
THIS LEASE EXHIBIT IS DIAGRAMMATIC IN NATURE AND IS INTENDED TO PROVIDE GENERAL INFORMATION REGARDING THE LOCATION AND SIZE OF THE PROPOSED WIRELESS COMMUNICATIONS EQUIPMENT FACILITY.





1 / LE-2 COMPOUND PLAN
SCALE: 1" = 15'-0"



Project No.:
Designed by: MJE
Drawn by: KAP
Checked by: MJE
Approved by: MJE

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

ARX WIRELESS

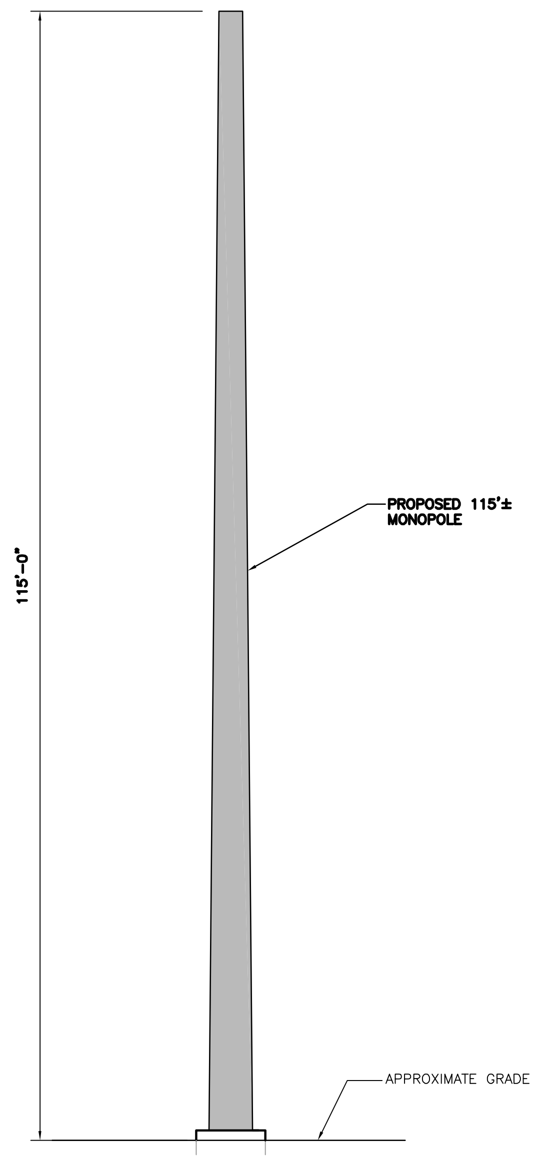
SITE ADDRESS: CT0114A GLASTONBURY
LOT N-4 SEQUIN DRIVE
GLASTONBURY, CONNECTICUT

REV.	DATE:	DESCRIPTION
1	12-15-2020	REVISED

Scale: AS NOTED
Date: 10-20-2020
Job No.
File No.

Dwg. No. LE-2
Dwg. 2 of 3

NOTE:
THIS LEASE EXHIBIT IS DIAGRAMMATIC IN NATURE AND IS INTENDED TO PROVIDE GENERAL INFORMATION REGARDING THE LOCATION AND SIZE OF THE PROPOSED WIRELESS COMMUNICATIONS EQUIPMENT FACILITY.



1
LE-3

TOWER ELEVATION

SCALE: 1" = 20'-0"

0 10 20 40

Project No.:	
Designed by:	MJE
Drawn by:	KAP
Checked by:	MJE
Approved by:	MJE

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

ARX WIRELESS

SITE ADDRESS:
CT0114A GLASTONBURY
LOT N-4 SEQUIN DRIVE
GLASTONBURY, CONNECTICUT

REV.	DATE:	DESCRIPTION
1	12-15-2020	REVISED

Scale: AS NOTED | Date: 10-20-2020

Job No. | File No.

Dwg. No.
LE-3

Dwg. 3 of 3

PROJECT SUMMARY

SCOPE OF WORK:	ARX WIRELESS IS PROPOSING TO INSTALL THE FOLLOWING IMPROVEMENTS: 115 FOOT TOWER AND FOUNDATION TOWER APPROXIMATELY 6500' FROM CLOSEST TOWN LINE 50'x50' FENCED COMPOUND 12' ACCESS DRIVE POWER AND TELCO UTILITIES AT&T EQUIPMENT CABINETS WITH GENERATOR ON 13'x8' CONCRETE PAD, SIX (6) AT&T ANTENNAS, AND TWELVE (12) RRHs WITH ASSOCIATED CABLING AND APPURTENANCES.
SITE ADDRESS:	LOT N-4 SEQUIN DRIVE GLASTONBURY, CT 06033
LATITUDE: LONGITUDE:	N41° 42' 51.27" W72° 34' 54.32"
PROPERTY OWNER:	NEW LAND OF GLASTONBURY LLC 734 HEBRON AVENUE GLASTONBURY, CT 06033
MAP/LOT/BLOCK:	F5-6200-N0004
POWER COMPANY:	EVERSOURCE
TELEPHONE COMPANY:	FRONTIER COMMUNICATIONS
TOWER OWNER/APPLICANT:	ARX WIRELESS INFRASTRUCTURE, LLC. KEITH COPPINS (203) 623-3287 110 WASHINGTON AVENUE NORTH HAVEN, CT 06473

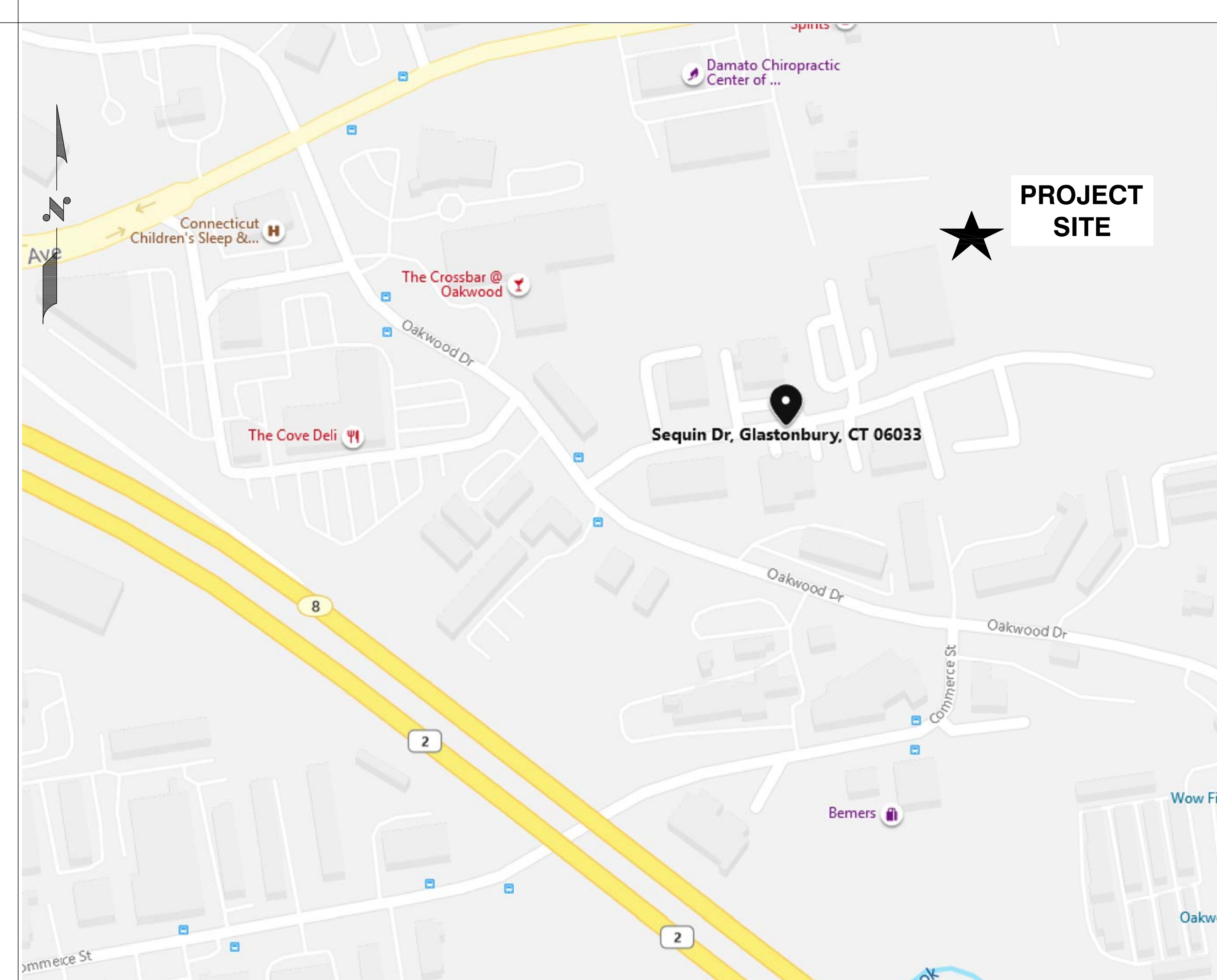
ARX WIRELESS

TECHNICAL REPORT
SITE NUMBER: CT0114A
SITE NAME: GLASTONBURY

TECH REPORT

DRAWING INDEX

VICINITY MAP



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2. THE FACILITY IS AN UNMANNED PRIVATE AND SECURED EQUIPMENT INSTALLATION. IT IS ONLY ACCESSED BY TRAINED TECHNICIANS FOR PERIODIC ROUTINE MAINTENANCE AND THEREFORE DOES NOT REQUIRE ANY WATER OR SANITARY SEWER SERVICE. THE FACILITY IS NOT GOVERNED BY REGULATIONS REQUIRING PUBLIC ACCESS PER ADA REQUIREMENTS.

ARX WIRELESS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

CHECKED BY: DJR

APPROVED BY: DJR

SUBMITTALS

REV.	DATE	DESCRIPTION	BY
1	12/15/2020	ISSUED FOR REVIEW	KAM
0	12/09/2020	ISSUED FOR REVIEW	KAM

SITE NAME:

CT0114A
GLASTONBURY

SITE ADDRESS:

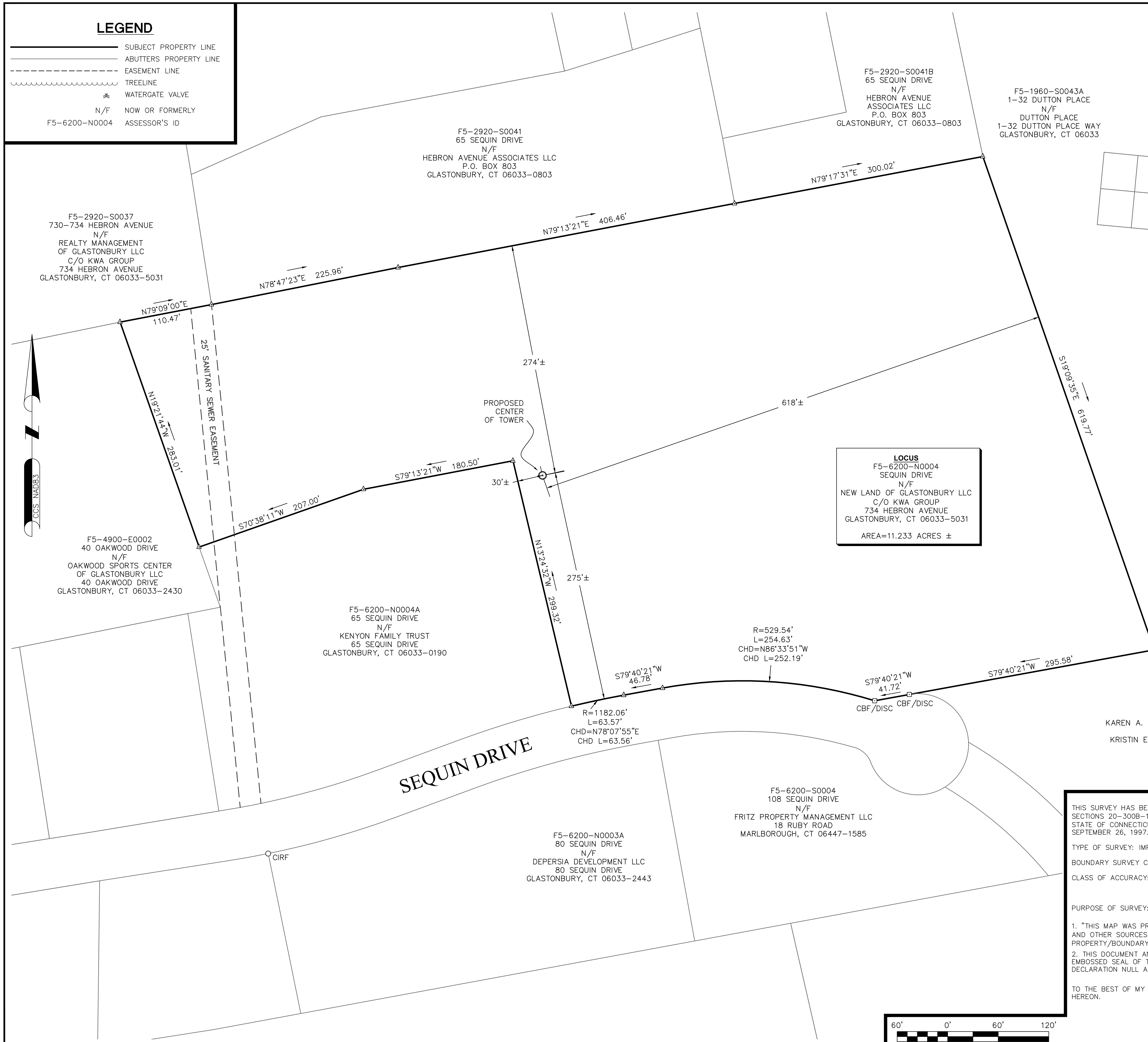
LOT N-4 SEQUIN DRIVE
GLASTONBURY, CT 06033

SHEET TITLE

SITE PLAN

SHEET NUMBER

T-1



SITE SPECIFIC NOTES:

1. FIELD SURVEY DATE: 11-19-2020
2. HORIZONTAL DATUM: NORTH AMERICAN DATUM OF 1983 (NAD83)
3. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
4. OWNER: NEW LAND OF GLASTONBURY LLC C/O KWA GROUP 734 HEBRON AVENUE GLASTONBURY, CT 06033-5031
5. SITE NAME: CT0114A GLASTONBURY
6. SITE ADDRESS: SEQUIN DRIVE GLASTONBURY, CT 06033
7. JURISDICTION: TOWN OF NORTH GLASTONBURY HARTFORD COUNTY
8. TAX ID: F5-6200-N0004
9. DEED REFERENCE: DEED VOL. 2547 PAGE 107
10. PLAN REFERENCE: PLAN: 3814
11. ZONING DISTRICT: PLANNED COMMERCE
12. THE HORIZONTAL DATUM AND VERTICAL DATUM WERE DERIVED FROM AN RTK GPS SURVEY.
13. ALL UNDERGROUND UTILITY INFORMATION PRESENTED HEREON WAS DETERMINED FROM SURFACE EVIDENCE AND PLANS OF RECORD. ALL UNDERGROUND UTILITIES SHOULD BE LOCATED IN THE FIELD PRIOR TO COMMENCEMENT OF ALL SITE WORK. CALL DIGSAFE 1-800-322-4844 A MINIMUM OF 72 HOURS PRIOR TO PLANNED ACTIVITY.
14. ACCORDING TO FEDERAL EMERGENCY MANAGEMENT AGENCY MAPS, THE PROPOSED IMPROVEMENTS ON THIS PROPERTY ARE LOCATED IN AN AREA DESIGNATED AS ZONE X (UNSHADED), AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN. COMMUNITY PANEL NO. 09003C 0529F EFFECTIVE DATE: 9/26/2008
15. FIELD SURVEY BY EDM TOTAL STATION & RTK GPS. THE HORIZONTAL DATUM AND VERTICAL DATUM WERE DERIVED FROM AN RTK GPS SURVEY.
16. **THIS IS NOT A BOUNDARY SURVEY.**
17. ALL PROPERTY LINES SHOWN ARE FROM DEEDS AND PLANS OF RECORD, MONUMENTS FOUND AND THE TOWN OF GLASTONBURY GIS AND ARE APPROXIMATE ONLY.
18. ABUTTING PROPERTY LINES ARE TAKEN FROM THE REFERENCE PLANS AND THE TOWN OF GLASTONBURY GIS AND ARE APPROXIMATE ONLY.

THIS SURVEY HAS BEEN PREPARED PURSUANT TO THE REGULATIONS OF CONNECTICUT STATE AGENCIES SECTIONS 20-300B-1 THROUGH 20-300B-20 AND THE "STANDARDS FOR SURVEYS AND MAPS IN THE STATE OF CONNECTICUT" AS ADOPTED BY THE CONNECTICUT ASSOCIATION OF LAND SURVEYORS INC. ON SEPTEMBER 26, 1997.

TYPE OF SURVEY: IMPROVEMENT LOCATION SURVEY

BOUNDARY SURVEY CATEGORY: DEPENDENT RESURVEY

CLASS OF ACCURACY: HORIZONTAL CLASS C
VERTICAL CLASS V-2
TOPOGRAPHIC CLASS T-2

PURPOSE OF SURVEY: SITE PLAN FOR CELLULAR MONOPOLE

1. "THIS MAP WAS PREPARED FROM RECORD RESEARCH, OTHER MAPS, LIMITED FIELD MEASUREMENTS AND OTHER SOURCES. IT IS NOT TO BE CONSTRUED AS A PROPERTY/BOUNDARY OR LIMITED PROPERTY/BOUNDARY SURVEY AND IS SUBJECT TO SUCH FACTS AS SAID SURVEYS MAY DISCLOSE."
2. THIS DOCUMENT AND COPIES THEREOF ARE VALID ONLY IF THEY BEAR THE LIVE SIGNATURE AND EMBOSSED SEAL OF THE DESIGNATED PROFESSIONAL. UNAUTHORIZED ALTERATIONS RENDER ANY DECLARATION NULL AND VOID.

TO THE BEST OF MY KNOWLEDGE AND BELIEF, THIS MAP IS SUBSTANTIALLY CORRECT AS NOTED HEREON.

CHARLES G. GIDMAN, P.L.S. #70103

ARX WIRELESS
ARX WIRELESS
110 WASHINGTON AVENUE
NORTH HAVEN, CT 06473

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

NORTHEAST SURVEY CONSULTANTS
116 Pleasant St. Ste. 302
P.O. Box 109
Easthampton, MA 01027
(413) 203-5144
northeastsurvey.com

STATE OF CONNECTICUT CHARLES G. GIDMAN 70103 LICENSED LAND SURVEYOR

CHECKED BY: BCF

APPROVED BY: CGG

SUBMITTALS

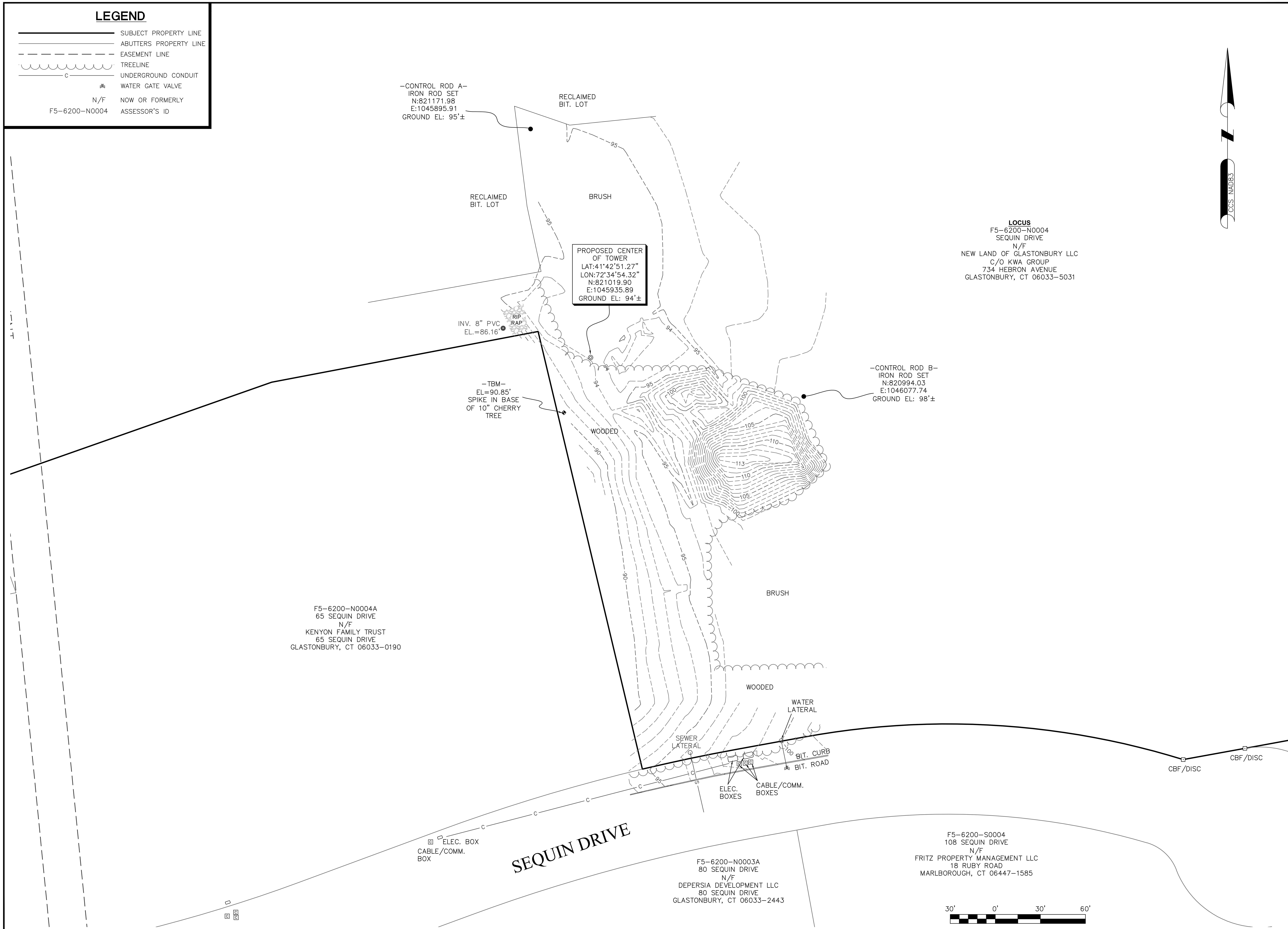
REV.	DATE	DESCRIPTION	BY
0	12/9/2020	ISSUED FOR REVIEW	BCF

SITE NAME:
CT0114A GLASTONBURY

SITE ADDRESS:
SEQUIN DRIVE
GLASTONBURY, CT 06033

SHEET TITLE
ABUTTERS PLAN

SHEET NUMBER
C-1



ARX WIRELESS

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110 WASHINGTON AVENUE
NORTH HAVEN, CT 06473

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CHECKED BY: BCF

APPROVED BY: CGG

SUBMITTALS

REV.	DATE	DESCRIPTION	BY
0	12/09/2020	ISSUED FOR REVIEW	BCF

SITE NAME:

CT0114A
GLASTONBURY

SITE ADDRESS:

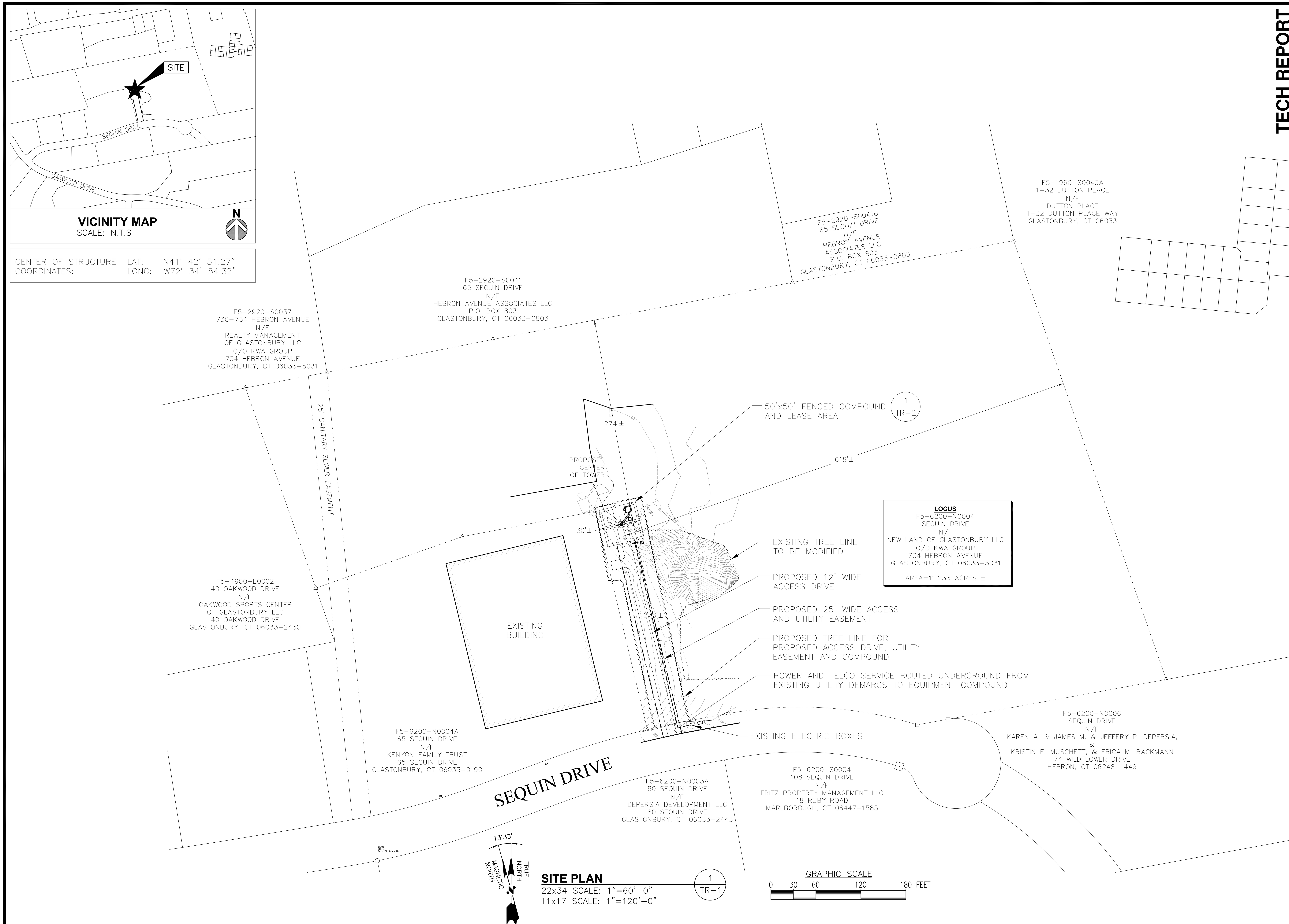
SEQUIN DRIVE
GLASTONBURY, CT 06033

SHEET TITLE

EXISTING CONDITIONS PLAN

SHEET NUMBER

C-2



SITE PLAN
22x34 SCALE: 1"=60'-0"
11x17 SCALE: 1"=120'-0"
1 TR-1

TECH REPORT

ARX WIRELESS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

CHECKED BY: DJR

APPROVED BY: DJR

SUBMITTALS

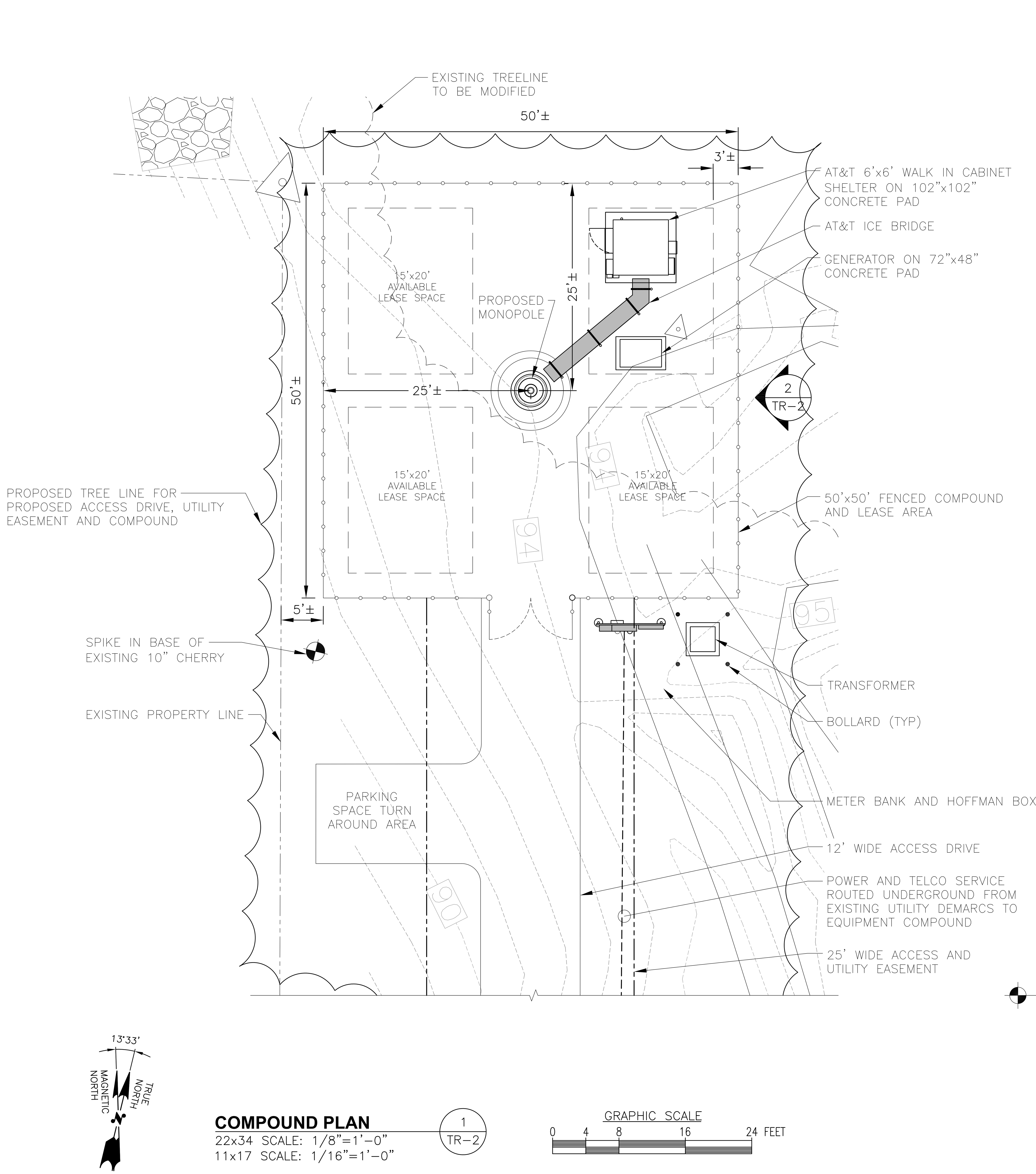
REV.	DATE	DESCRIPTION	BY
1	12/15/2020	ISSUED FOR REVIEW	KAM
0	12/09/2020	ISSUED FOR REVIEW	KAM

SITE NAME:
CT0114A
GLASTONBURY

SITE ADDRESS:
LOT N-4 SEQUIN DRIVE
GLASTONBURY, CT 06033

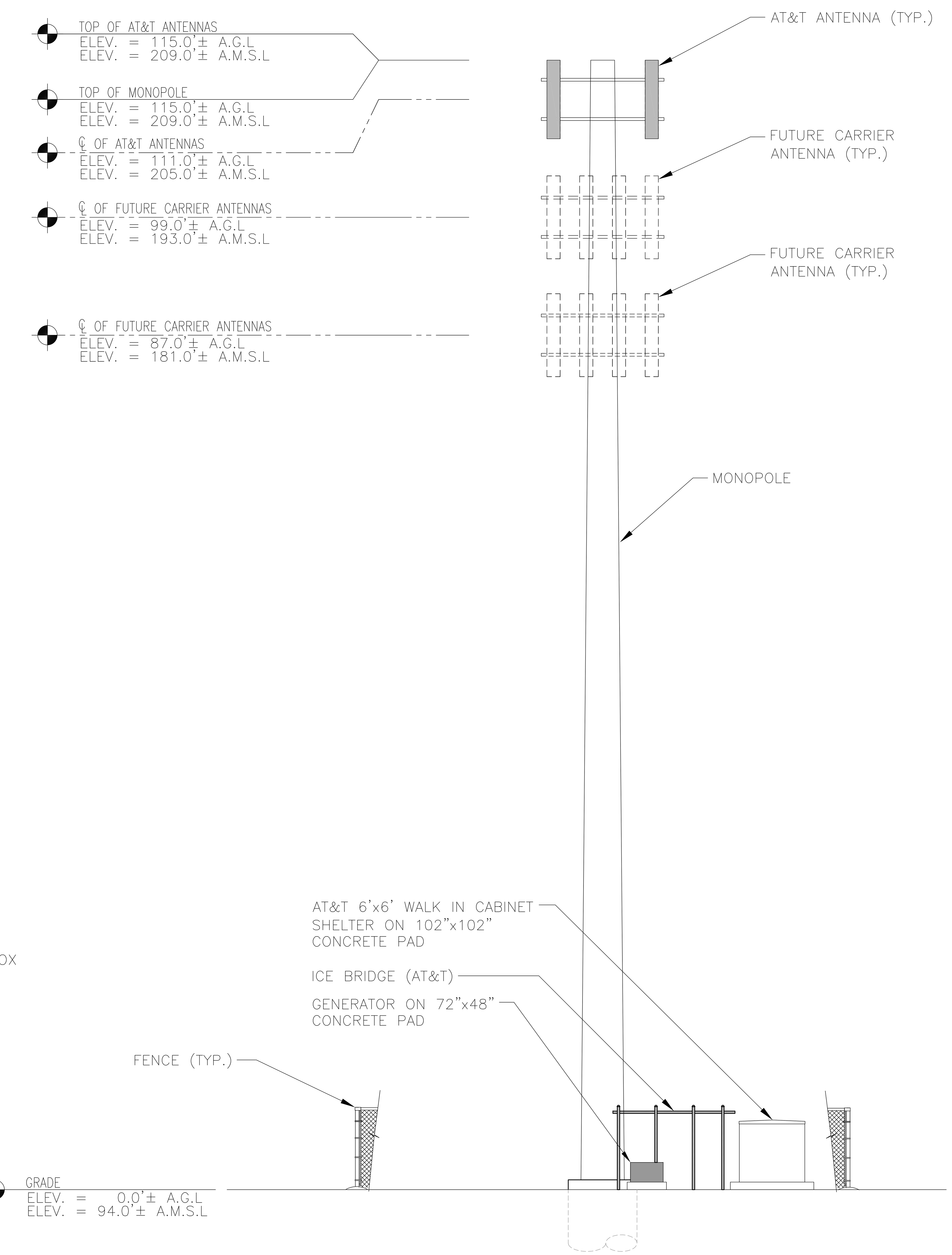
SHEET TITLE
SITE PLAN

SHEET NUMBER
TR-1



COMPOUND PLAN (1 / TR-2)
22x34 SCALE: 1/8"=1'-0"
11x17 SCALE: 1/16"=1'-0"

GRAPHIC SCALE
0 4 8 16 24 FEET



NORTH ELEVATION (2 / TR-2)
22x34 SCALE: 1"=10'-0"
11x17 SCALE: 1"=20'-0"

GRAPHIC SCALE
0 5 10 20 30 FEET

ARX WIRELESS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

CHECKED BY: DJR

APPROVED BY: DJR

SUBMITTALS

REV.	DATE	DESCRIPTION	BY
1	12/15/2020	ISSUED FOR REVIEW	KAM
0	12/09/2020	ISSUED FOR REVIEW	KAM

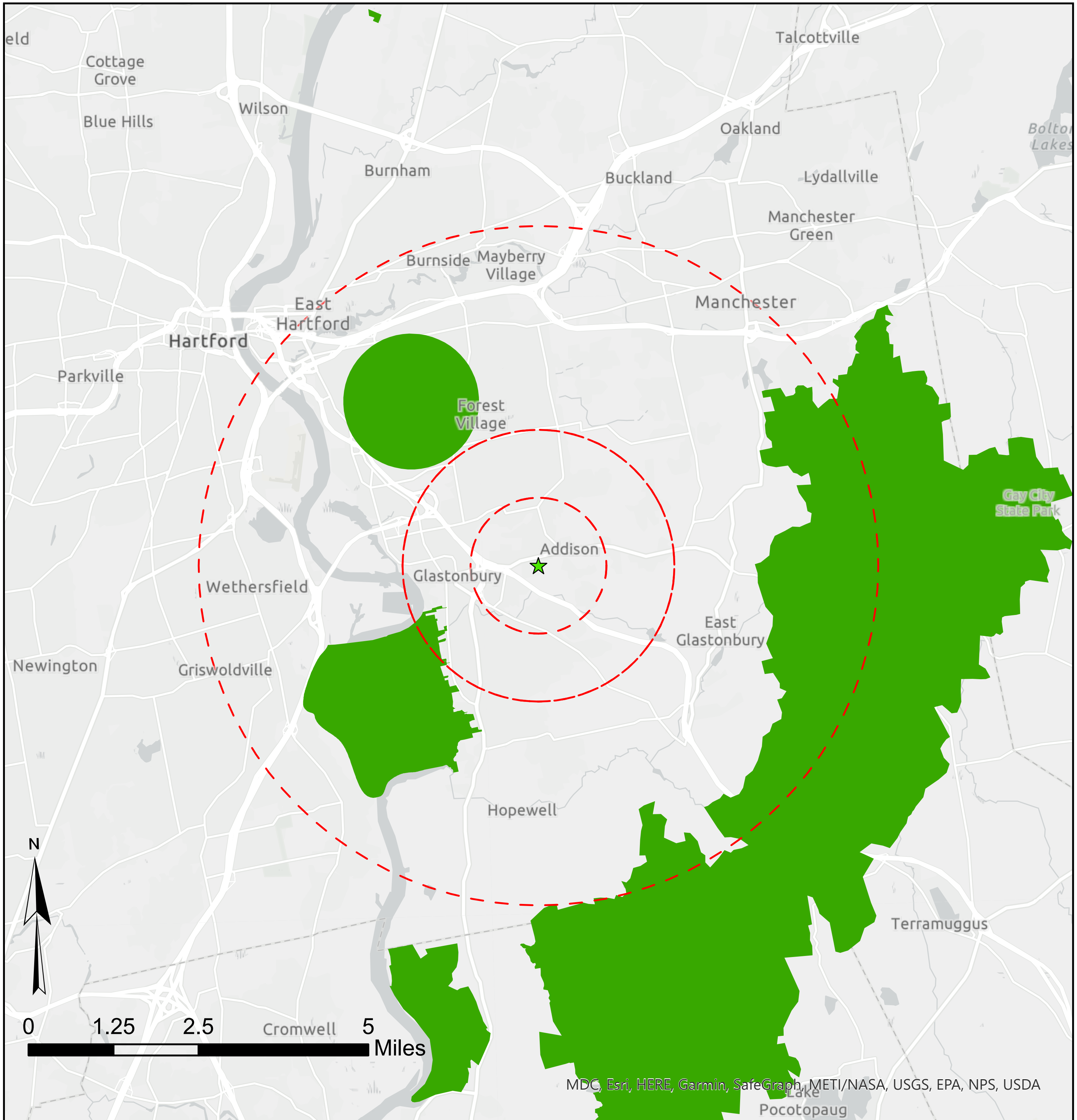
SITE NAME:
CT0114A
GLASTONBURY

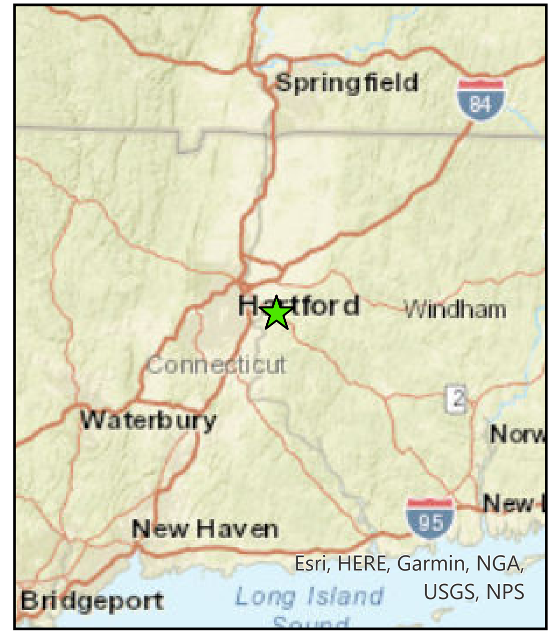
SITE ADDRESS:
LOT N-4 SEQUIN DRIVE
GLASTONBURY, CT 06033

SHEET TITLE
COMPOUND PLAN AND ELEVATION

SHEET NUMBER
TR-2

SUPPORTING DOCUMENTS





Legend

- Project Site
- Radius at 1, 2 & 5 Miles

Important Bird Area Type

- Continental
- Global
- State

Glastonbury/CT-0114
Sequin Drive
Glastonbury,Connecticut 06033

EBI Consulting
environmental | engineering | design

Source: Selected data from the Audubon, ESRI & EBI.

EBI PN#: 6120010499

Created by EBI GIS on: 2/26/2021

Annual Species Totals For Buckingham (18003)	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	199
Canada Goose	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	3
Wood Duck	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Mallard	3	0	-	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Hooded Merganser	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern Bobwhite	8	17	-	-	4	4	6	6	15	8	5	3	4	11	6	2	6	1	1	6	5	6	1	4	6	1	0	0	0
Ring-necked Pheasant	0	0	-	-	0	0	2	0	0	0	0	0	0	0	2	1	0	0	0	0	1	0	1	0	0	1	1	0	0
Wild Turkey	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Pigeon	0	0	-	-	0	0	10	0	0	38	20	19	4	0	0	5	0	0	2	0	0	4	25	0	0	0	0	0	0
Mourning Dove	5	10	-	-	10	15	23	14	25	27	28	39	25	29	41	59	47	39	37	44	51	39	32	23	30	29	25	37	42
Yellow-billed Cuckoo	2	0	-	-	0	5	14	3	0	0	0	0	0	1	0	4	0	1	0	1	0	0	1	0	0	0	0	0	0
Black-billed Cuckoo	2	1	-	-	1	1	11	2	0	0	0	0	0	1	3	3	1	0	0	2	1	0	0	0	0	0	0	1	0
Eastern Whip-poor-will	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Chimney Swift	6	5	-	-	3	0	15	0	0	0	0	0	1	2	1	1	1	1	2	0	17	1	4	3	9	10	3	6	7
Ruby-throated Hummingbird	0	1	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0
Killdeer	2	3	-	-	0	0	0	1	1	0	0	1	1	3	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0
Spotted Sandpiper	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Great Blue Heron	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Green Heron	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	0	1	0
Black-crowned Night-Heron	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Turkey Vulture	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0
Sharp-shinned Hawk	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Cooper's Hawk	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-shouldered Hawk	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Broad-winged Hawk	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Red-tailed Hawk	1	0	-	-	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0
Eastern Screech-Owl	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Great Horned Owl	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Barred Owl	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Belted Kingfisher	0	0	-	-	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-bellied Woodpecker	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	1	1	1	2	0	3	7
Downy Woodpecker	3	8	-	-	4	5	12	3	5	4	4	5	1	8	1	1	2	2	2	3	7	2	1	1	4	3	5	6	3
Hairy Woodpecker	1	1	-	-	2	1	1	0	1	0	0	1	1	4	1	3	0	1	3	0	1	1	0	0	2	2	0	1	0
(Yellow-shafted Flicker) Northern Flicker	7	14	-	-	4	5	8	7	5	3	2	6	3	4	2	1	3	2	2	1	6	0	1	3	5	0	3	0	3
Pileated Woodpecker	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Kestrel	0	0	-	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Crested Flycatcher	1	0	-	-	1	3	5	0	3	1	3	0	3	2	2	4	3	1	3	1	3	1	1	2	0	0	1	2	4
Eastern Kingbird	7	4	-	-	3	2	7	5	1	0	4	3	1	4	3	3	2	3	4	5	4	3	2	2	2	1	1	0	1
Eastern Wood-Pewee	7	9	-	-	6	7	3	4	6	4	7	3	4	4	3	3	2	4	6	6	3	3	7	1	3	4	3	5	0
Alder Flycatcher	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willow Flycatcher	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Least Flycatcher	7	7	-	-	1	7	6	4	2	3	6	2	1	3	5	3	7	2	4	2	2	4	0	0	1	1	2	2	1
Eastern Phoebe	5	4	-	-	1	6	4	0	5	4	3	2	7	6	2	7	0	6	4	4	6	10	2	5	7	4	5	4	3
White-eyed Vireo	0	0	-	-	1	0	0	0	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Yellow-throated Vireo	2	2	-	-	2	4	0	0	3	3	2	1	0	2	0	0	0	1	1	1	1	0	0	0	0	1	0	0	1
Blue-headed Vireo	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Warbling Vireo	0	1	-	-	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Red-eyed Vireo	20	11	-	-	9	16	14	15	21	6	9	20	7	12	9	7	4	10	10	5	10	5	4	9	7	2	5	2	9
Blue Jay	13	19	-	-	10	13	15	8	14	8	7	14	13	14	12	12	3	3	9	6	12	9	11	4	5	4	9	4	5
American Crow	8	7	-	-	8	14	41	17	21	17	17	19	31	36	25	37	23	19	40	45	63	37	26	29	39	36	38	39	36
Common Raven	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bank Swallow	0	0	-	-	0	0	50	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Tree Swallow	7	0	-	-	1	0	1	0	0	0	0	0	2	9	0	0	4	1	8	10	1	4	247	2	2	0	6	2	1
Northern Rough-winged Swallow	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1
Purple Martin	1	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barn Swallow	17	12	-	-	11	2	8	5	10	32	30	18	6	30	10	16	10	8	7	14	18	18	8	7	5	6	11	8	2
Black-capped Chickadee	5	2	-	-	20	7	11	9	10	8	15	6	4	16	11	3	9	9	15	12	12	11	18	12	9	6	5	7	13
Tufted Titmouse	0	2	-	-	1	2	6	1	5	1	1	5	8	7	11	3	9	7	22	10	19	5	12	14	27	11	9	16	10
White-breasted Nuthatch	0	5	-	-	5	5	1	3	2	4	3	1	2	5	1	5	4	2	6	9	3	5	13	1	1	3	1	1	4
Brown Creeper	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House Wren	8	4	-	-	11	10	8	12	10	14	5	9	9	5	8	11	8	8	3	8	13	9	8	5	3	10	7	11	10
Winter Wren	0	0	-	-	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh Wren	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carolina Wren	0	0	-	-	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	1
Blue-gray Gnatcatcher	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	4	0	0	0	0	0	0	0	0
Eastern Bluebird	0	0	-	-	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	1	2	1	1
Veery	14	20	-	-	4	13	1	7	12	9	13	15	5	1	7	6	7	4	4	5	12	5	2	2	1	7	2	3	4
Swainson's Thrush	1	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hermit Thrush	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood Thrush	20	32	-	-	21	18	29	22	25	18	16	19	12	20	9	9	13	23	12	14	17	15	20	6	24	13	19	14	16
American Robin	69	82	-	-	57	52	62	44	66	65	80	73	47	61	48	54	42	39	46	39	39	42	48	39	41	38	41	47	28
Gray Catbird	31	24	-	-	20	17	15	30	39	27	23	32	13	23	22	18	13	16	21	17	28	14	13	17	12	10	14	20	12
Brown Thrasher	6	8	-	-	4	6	4	3	8	3	3	3	0	2	1	2	0	1	1	0	2	1	0	0	2	0	0	0	0
Northern Mockingbird	0	0	-	-	1	1	1	1	3	7	8	11	10	10	11	4	9	4	2	10	11	10	9	5	10	9	12	9	11
European Starling	109	66	-	-	18	56	76	38	57	54	115	94	102	34	115	52	94	22	113	283	77	109	32	44	36	26	24	66	19
Cedar Waxwing	0	0	-	-	2	4	7	0	0	0	0	1	0	0	0	0	1	0	0	2	6	2	0	3	0	7	2	3	4
House Sparrow	45	35	-	-	33	22	56	33	25	24	28	16	66	46	24	18	16	16	57	43	68	55	57	7	7	11	14	19	13
House Finch	0	0	-	-	0	0	0	0	0	0	1	0	7	2	5	9	14	7	21	20	62	38	24	12	19	17	26	19	32
Purple Finch	2	1	-	-	1	0	1	0	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American Goldfinch	4	14	-	-	2	4	6	5	0	1	9	6	4	3	2	0	3	2	5	6	2	2	3	0	3	1	1	7	7
Grasshopper Sparrow	0	2	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chipping Sparrow	29	21	-	-	16	25	38	26	26	21	26	19	23	17	25	15	26	18	47	23	42	29	35	20	16	19	22	21	23
Field Sparrow	4	7	-	-	8	6	9	9	6	3	5	1	1	1	0	1	0	2	1	1	2	0	0	0	0	0	0	0	0
Savannah Sparrow	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Song Sparrow	33	33	-	-	24	33	47	33	44	37	31	29	29	34	31	31	17	25	25	19	26	27	18	20	24	22	22	21	14
Swamp Sparrow	0	0	-	-	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Towhee	31	54	-	-	34	28	24	9	17	22	17	10	15	14	10	3	8	2	2	4	5	5	6	4	5	4	3	3	3
Bobolink	1	1	-	-	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Eastern Meadowlark	8	10	-	-	2	3	5	4	1	5	0	1	4	1	3	0	1	0	0	0	3	0	0	1	0	0	0	0	0
Baltimore Oriole	12	20	-	-	9	33	48	8	19	16	12	5	17	4	15	8	15	14	4	0	4	3	4	5	1	4	7	5	3
Red-winged Blackbird	130	142	-	-	50	57	82	58	56	64	40	44	12	38	90	32	25	21	28	33	12	16	28	24	17	17	12	19	22
Brown-headed Cowbird	12	12	-	-	2	5	23	4	7	0	2	1	5	0	3	6	11	2	1	1	0	6	2	4	5	6	3	2	4
Common Grackle	48	44	-	-	21	24	49	9	12	16	14	21	33	31	85	19	11	39	26	39	31	27	33	17	13	19	32	28	20
Ovenbird	13	23	-	-	4	6	3	7	10	7	6	9	6	7	10	6	13	8	6	5	12	7	2	9	6	12	6	6	3
Worm-eating Warbler	0	0	-	-	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Louisiana Waterthrush	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Warbler	5	3	-	-	0	6	4	0	5	1	0	0	6	0	3	3	13	9	1	1	6	1	0	2	10	5	4	7	8
Black-and-white Warbler	5	5	-	-	0	2	2	4	6	0	3	2	6	2	3	6	4	2	0	3	2	5	0	3	4	7	3	1	1
Common Yellowthroat	14	6	-	-	11	16	16	15	21	27	20	21	17	22	20	24	9	10	9	24	15	13	7	5	8	10	10	7	10
American Redstart	1	4	-	-	0	5	6	3	3	5	3	7	4	2	3	0	5	1	3	0	4	3	0	2	5	3	8	2	2
Northern Parula	0	0	-	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	1
Magnolia Warbler	0	0	-	-	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow Warbler	0	3	-	-	0	4	6	3	2	2	0	1	7	9	9	11	20	10	9	3	7	6	9	15	18	20	22	12	17
Chestnut-sided Warbler	11	7	-	-	1	8	13	2	8	4	2	6	2	5	7	3	0	1	6	0	1	0	0	0	0	0	1	0	1
Pine Warbler	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prairie Warbler	1	0	-	-	2	4	5	1	0	2	2	1	2	2	0	2	1	3	1	0	1	0	1	1	0	0	0	0	1
Black-throated Green Warbler	0	0	-	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Canada Warbler	0	0	-	-	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarlet Tanager	13	3	-	-	5	10	17	6	6	10	4	13	0	2	0	1	0	0	0	0	1	0	0	1	0	0	0	2	0
Northern Cardinal	0	1	-	-	1	7	3	6	4	8	12	9	13	9	11	8	12	14	11	8	14	15	12	6	25	11	21	14	20
Rose-breasted Grosbeak	1	4	-	-	1	9	11	4	3	1	7	6	2	6	0	0	1	1	1	4	3	0	1	0	1	0	0	0	1
Indigo Bunting	3	5	-	-	7	6	9	5	6	5	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Species	**55**	**54**	**0**	**0**	**52**	**56**	**61**	**48**	**51**	**50**	**47**	**53**	**54**	**54**	**48**	**52**	**48**	**53**	**53**	**48**	**57**	**48**	**46**	**49**	**49**	**51**	**49**	**53**	**52**
Total individuals	**824**	**841**	**0**	**0**	**481**	**628**	**967**	**519**	**666**	**655**	**674**	**659**	**612**	**628**	**732**	**551**	**555**	**450**	**659**	**805**	**781**	**638**	**796**	**408**	**488**	**442**	**478**	**529**	**469**

HawkCount

Hawk Migration Association of North America's Raptor Migration Database

DONATE | SPONSOR

Hawkwatch Site Profile

Beelzebub Street

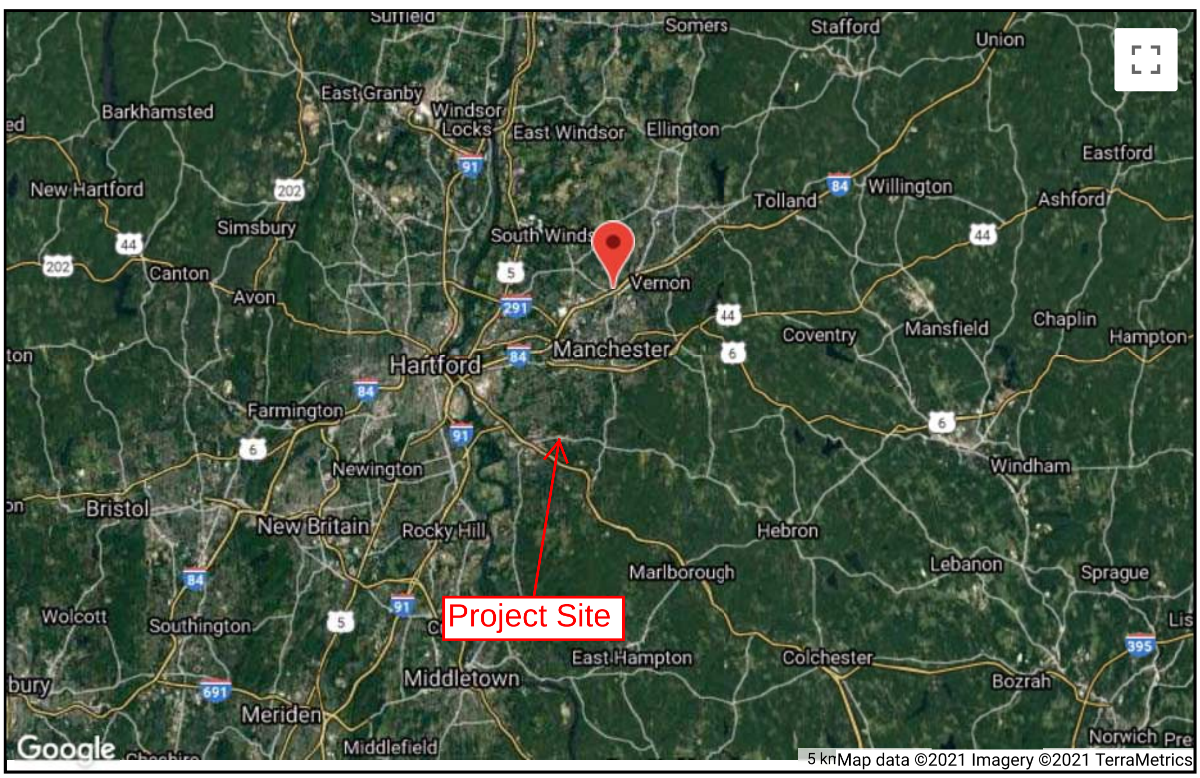
N 41° 48' 50.1",W -72° 31' 3.4"
(N 41.81392, W -72.51761)

South Windsor, Connecticut, USA

[Latest count data]

General | Data Inventory | Migration Timing | RPI Analysis

Map



Pan: Click and drag the map with the mouse pointer.
Zoom: Select the zoom level with the control at the left of the map.

General Site Information

Site Contacts

Name	Role	Email	Phone
Neil W. Currie		nwcurrie23@yahoo.com	

Count Season

Fall: Sep 10 to Sep 22

Procedures/Protocols

Site History

Site Topography

Directions to Site

Midwinter Bald Eagle Count

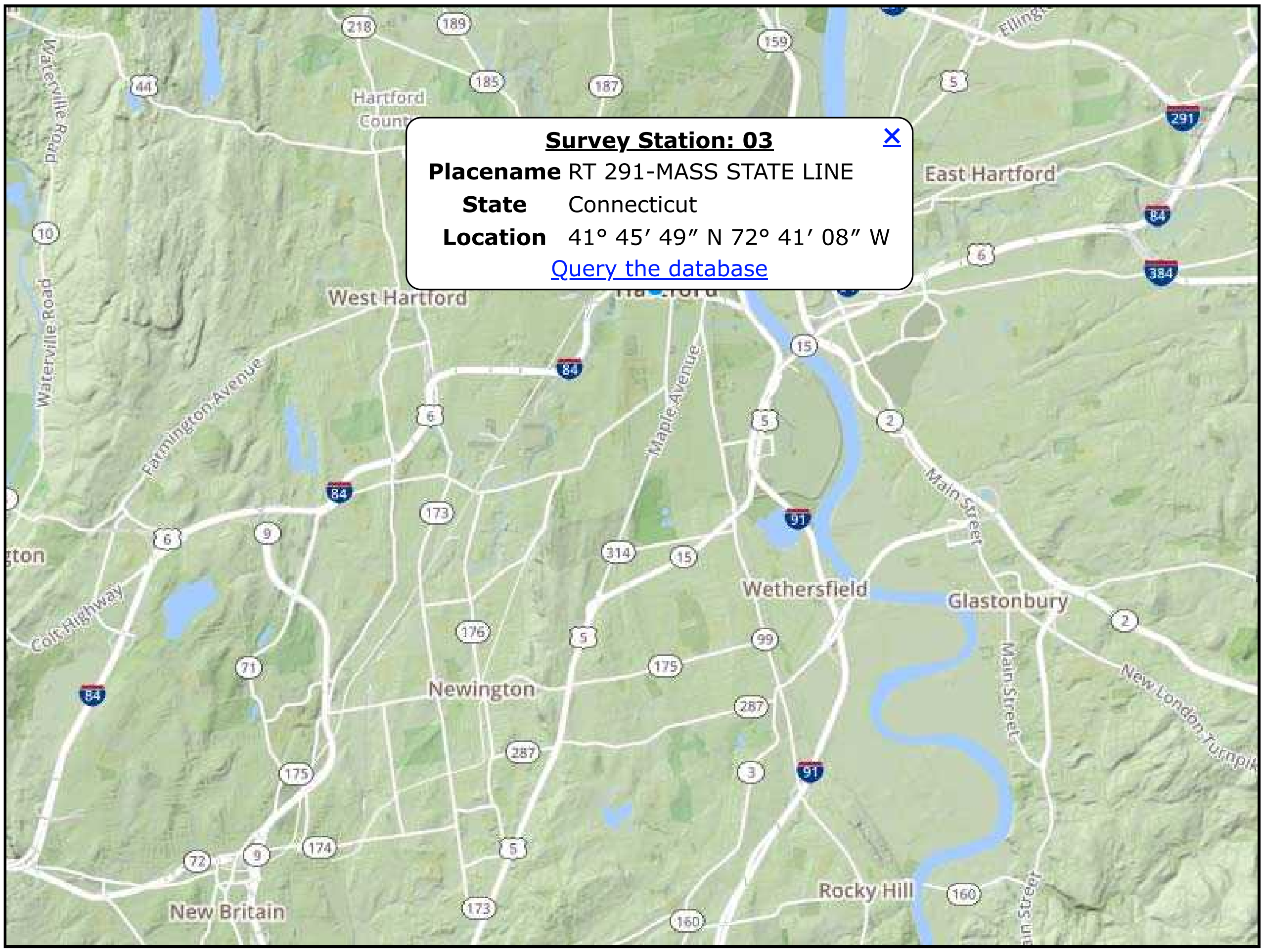
Background/ History of the Survey
Summary Trend Information
How to Use This Site
Forms/ Instructions for Upcoming Surveys
Metadata
Site Map

Query by Routes

This marker represents a cluster of sites in the general area. **Click** the marker to display a list of the sites contained within. **Zoom in** further to "break up" the cluster and display the individual yellow site markers within.

This marker indicates a survey site. **Click** the marker to display additional information, including a link that will allow you to query the database for records from that site.

NOTE: If you are experiencing loading or performance issues, please use another browser such as Firefox, Chrome, Edge, or Safari.



Midwinter **Bald Eagle** Count

Home | Query by State | Query by Route | Query by Name | Query by Lat/Long

Background/ History of the Survey
Summary Trend Information
How to Use This Site
Forms/ Instructions for Upcoming Surveys
Metadata
Site Map

Query by Routes

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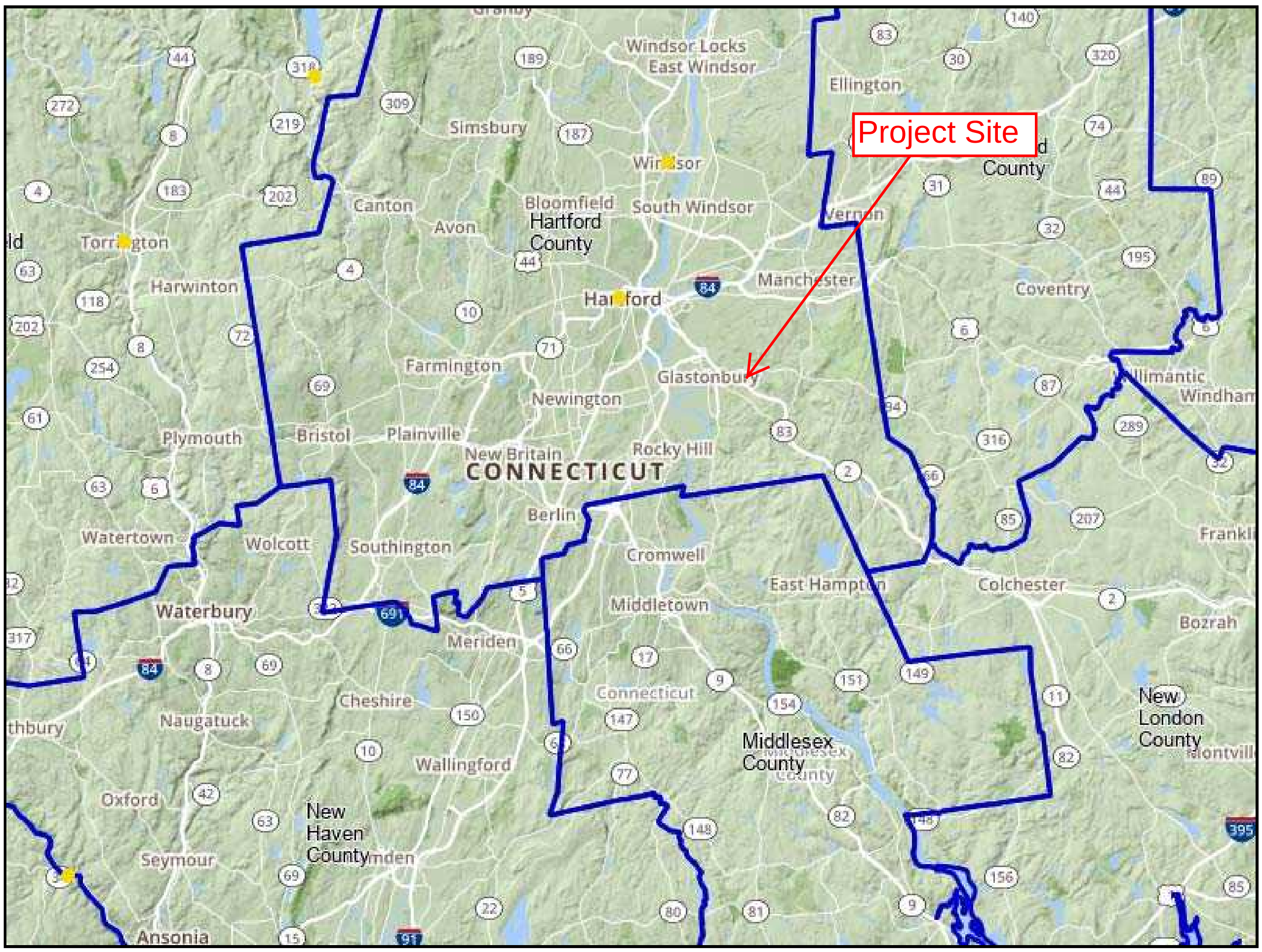
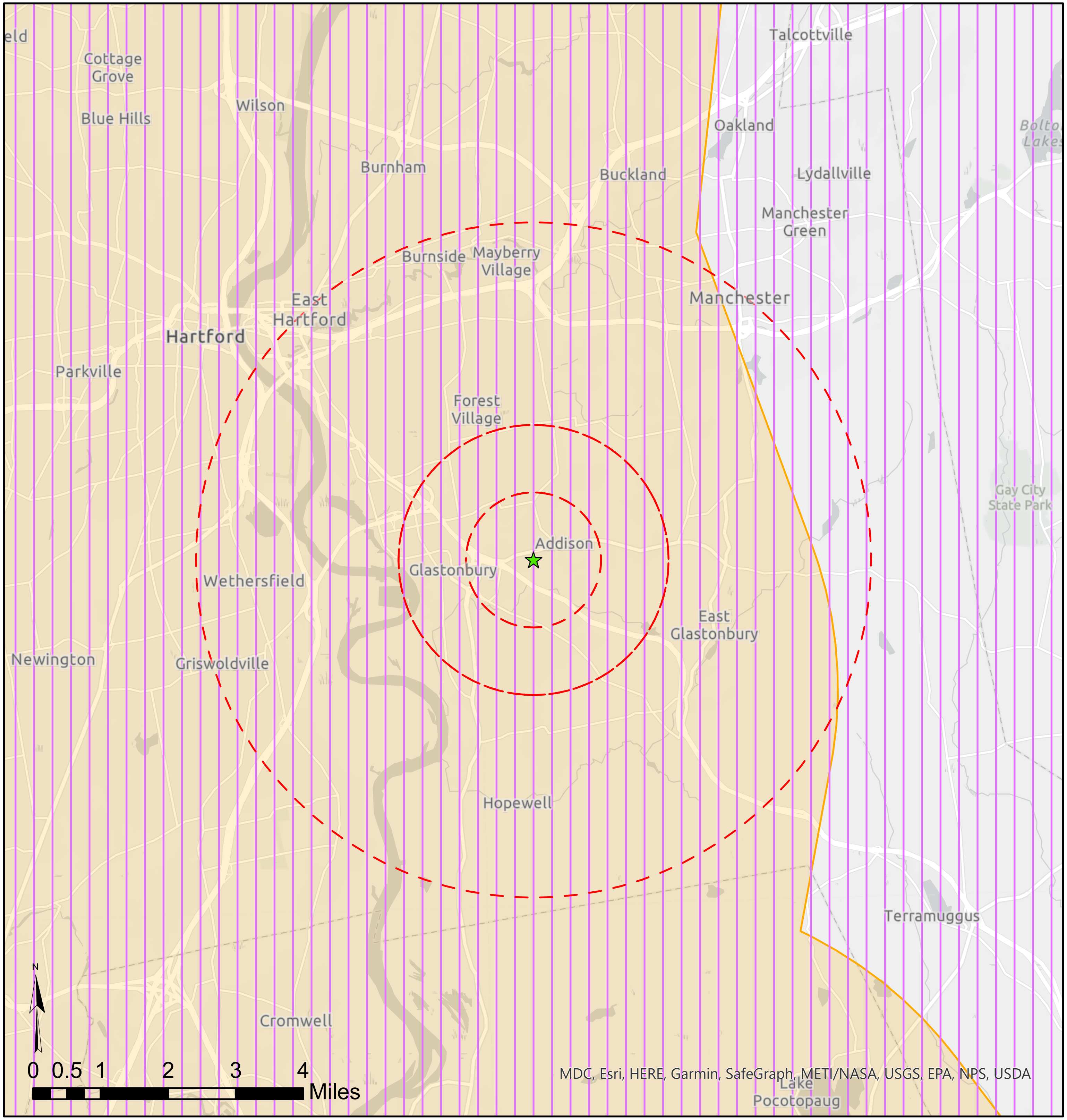
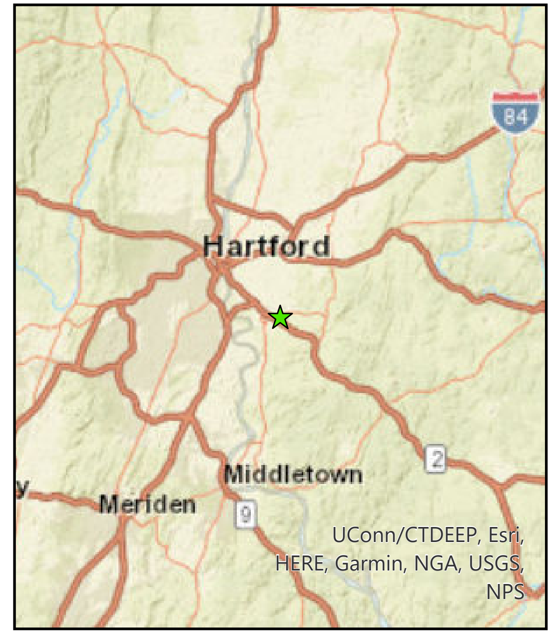






Legend

Project Site

Radius at 1, 2 & 5 Miles

Important Bird Area Type

Waterbirds Priority Area

Waterfowl Priority Area

Land Birds Priority Area

Glastonbury/CT-0114
Sequin Drive
Glastonbury,Connecticut 06033

EBI Consulting
environmental | engineering | design

Source: Selected data from the ACJV, ESRI & EBI.

EBI PN#: 6120010499

Created by EBI GIS on: 2/26/2021

Natural Diversity Data Base Areas

GLASTONBURY, CT

June 2020

State and Federal Listed Species

Critical Habitat

Town Boundary

NOTE: This map shows general locations of State and Federal Listed Species and Critical Habitats. Information on listed species is collected and compiled by the Natural Diversity Data Base (NDDB) from a variety of data sources . Exact locations of species have been buffered to produce the generalized locations.

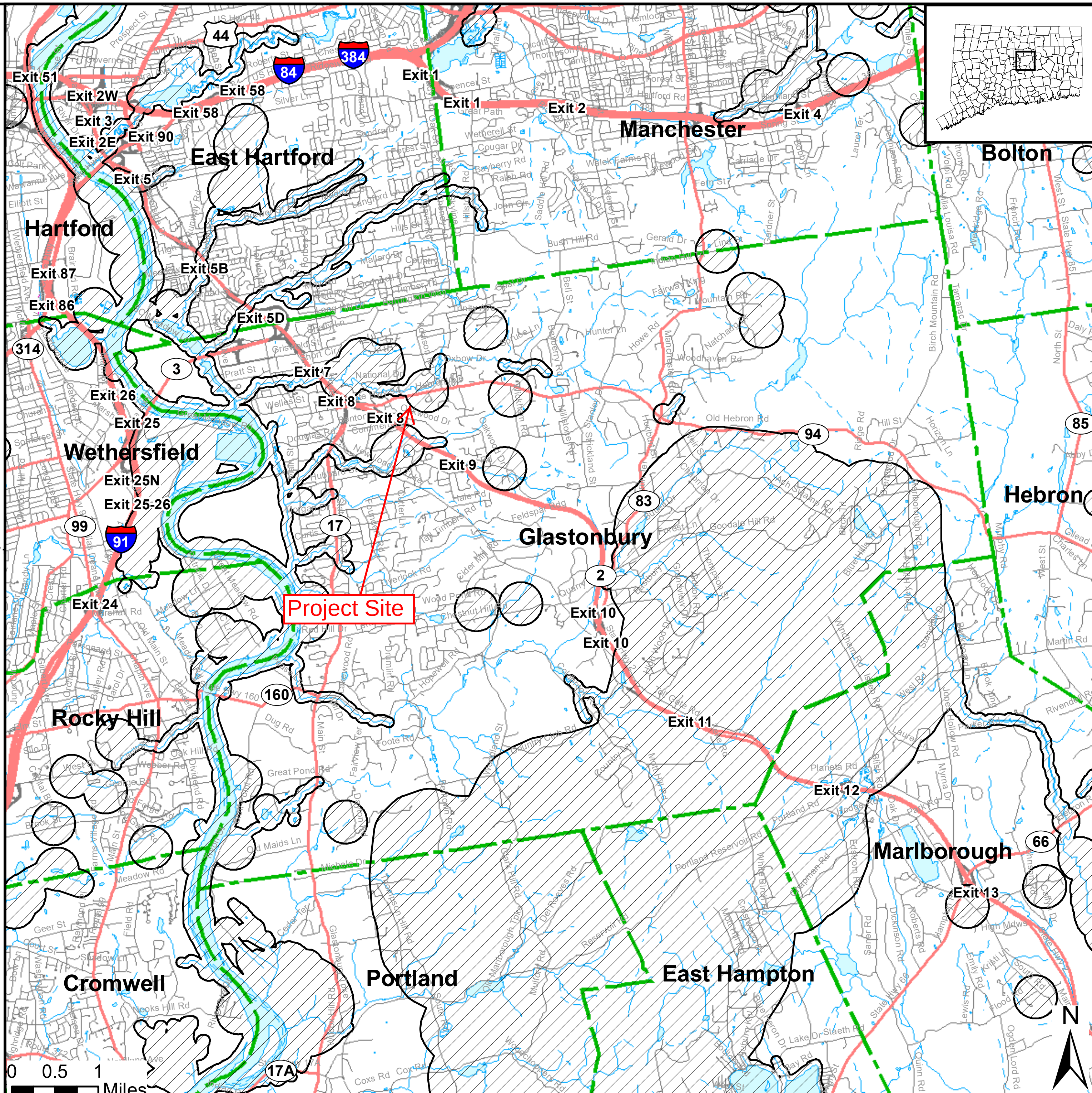
This map is intended for use as a preliminary screening tool for conducting a Natural Diversity Data Base Review Request. To use the map, locate the project boundaries and any additional affected areas. If the project is within a hatched area there may be a potential conflict with a listed species. For more information, complete a Request for Natural Diversity Data Base State Listed Species Review form (DEP-APP-007), and submit it to the NDDB along with the required maps and information. More detailed instructions are provided with the request form on our website.

www.ct.gov/deep/nddbrequest

Use the CTECO Interactive Map Viewers at http://cteco.uconn.edu to more precisely search for and locate a site and to view aerial imagery with NDDB Areas.

QUESTIONS: Department of Energy and Environmental Protection (DEEP)
79 Elm St, Hartford, CT 06106
email: deep.nddbrequest@ct.gov
Phone: (860) 424-3011

Connecticut Department of Energy & Environmental Protection
Bureau of Natural Resources
Wildlife Division



A County Report of Connecticut's Endangered, Threatened and Special Concern Species

Hartford County

Amphibians

Scientific Name	Common Name	Protection Status
Ambystoma jeffersonianum	Jefferson salamander "complex"	SC
Ambystoma laterale	Blue-spotted salamander	E/SC
Gyrinophilus porphyriticus	Northern spring salamander	T
Necturus maculosus	Mudpuppy	SC
Rana pipiens	Northern leopard frog	SC

Birds

Scientific Name	Common Name	Protection Status
Accipiter striatus	Sharp-shinned hawk	E
Aegolius acadicus	Northern saw-whet owl	SC
Ammodramus henslowii	Henslow's sparrow	SC*
Ammodramus savannarum	Grasshopper sparrow	E
Asio flammeus	Short-eared owl	T
Asio otus	Long-eared owl	E
Bartramia longicauda	Upland sandpiper	E
Botaurus lentiginosus	American bittern	E
Buteo platypterus	Broad-winged hawk	SC
Caprimulgus vociferus	Whip-poor-will	SC
Circus hudsonius	Northern harrier (Circus cyaneus)	E
Cistothorus platensis	Sedge wren	E
Dolichonyx oryzivorus	Bobolink	SC
Empidonax alnorum	Alder flycatcher	SC
Eremophila alpestris	Horned lark	E
Falco peregrinus	Peregrine falcon	T

Hartford County

Birds

Scientific Name	Common Name	Protection Status
Falco sparverius	American kestrel	SC
Gallinula galeata	Common moorhen (Gallinula chloropus)	E
Gavia immer	Common loon	SC
Haliaeetus leucocephalus	Bald eagle	T
Ixobrychus exilis	Least bittern	T
Melanerpes erythrocephalus	Red-headed woodpecker	E
Passerculus sandwichensis	Savannah sparrow	SC
Podilymbus podiceps	Pied-billed grebe	E
Pooecetes gramineus	Vesper sparrow	E
Progne subis	Purple martin	SC
Setophaga cerulea	Cerulean warbler	SC
Sturnella magna	Eastern meadowlark	T
Toxostoma rufum	Brown thrasher	SC
Tyto alba	Barn owl	E

Fish

Scientific Name	Common Name	Protection Status
Acipenser brevirostrum	Shortnose sturgeon	E
Alosa aestivalis	Blueback herring	SC
Cottus cognatus	Slimy sculpin	SC
Enneacanthus obesus	Banded sunfish	SC
Lethenteron appendix	American brook lamprey	E
Lota lota	Burbot	E
Notropis bifrenatus	Bridle shiner	SC

Invertebrates

Scientific Name	Common Name	Protection Status
Agonum darlingtoni	Ground beetle	SC
Agonum mutatum	Ground beetle	SC

Hartford County

Invertebrates

Scientific Name	Common Name	Protection Status
Alasmidonta heterodon	Dwarf wedgemussel	E
Alasmidonta varicosa	Brook floater	E
Amara chalcea	Ground beetle	SC
Apodrepanulatrix liberaria	New Jersey tea inchworm	E
Bembidion carinula	Ground beetle	SC
Bombus terricola	Yellow-banded bumble bee	T
Brachinus cyanipennis	Bombardier beetle	SC
Brachinus medius	Bombardier beetle	SC
Callophrys irus	Frosted elfin	T
Cambarus bartonii	Common crayfish	SC
Chytonix sensilis	Barrens Chytonix	E
Cicindela formosa generosa	Big sand tiger beetle	SC
Cicindela lepida	Dune ghost tiger beetle	E
Cicindela puritana	Puritan tiger beetle	E
Cicindela purpurea	Purple tiger beetle	SC*
Cicindela tranquebarica	Dark-bellied tiger beetle	T
Cordulegaster erronea	Tiger spiketail	T
Erynnis horatius	Horace's duskywing	SC
Erynnis lucilius	Columbine duskywing	E
Euchlaena madusaria	Scrub euchlaena	T
Eumacaria latiferrugata	Brown-bordered geometer	T
Euxoa pleuritica	Fawn brown dart moth	SC
Euxoa violaris	Violet dart moth	SC
Exyra fax	Pitcher plant moth	T
Geopinus incrassatus	Ground beetle	SC
Gomphus descriptus	Harpoon clubtail	T
Gomphus fraternus	Midland clubtail	T
Gomphus quadricolor	Rapids clubtail	T

Hartford County

Invertebrates

Scientific Name	Common Name	Protection Status
Gomphus vastus	Cobra clubtail	SC
Gomphus ventricosus	Skillet clubtail	SC
Grammia phyllira	Phyllira tiger moth	E
Gyraulus circumstriatus	Disc gyro	SC
Harpalus erraticus	Ground beetle	SC
Hemileuca maia maia	Barrens buck moth	E
Hetaerina americana	American rubyspot	T
Hybomitra typhus	Horse fly	T
Lampsilis cariosa	Yellow lampmussel	E
Lapara coniferarum	Southern pine sphinx	T
Leptodea ochracea	Tidewater mucket	SC
Lethe eurydice	Eyed brown	SC
Leucorrhinia glacialis	Crimson-ringed whiteface	T
Ligumia nasuta	Eastern pondmussel	SC
Lycaena epixanthe	Bog copper	SC
Margaritifera margaritifera	Eastern pearlshell	SC
Scaphinotus viduus	Ground beetle	SC
Schinia spinosae	Spinose flower moth	SC
Speranza exonerata	Barrens itame	T
Speyeria atlantis	Atlantis fritillary butterfly	E
Stylurus amnicola	Riverine clubtail	T
Sympistis perscripta	Scribbled sallow moth	SC
Zale curema	Black-eyed zale	E
Zale obliqua	Oblique zale	SC
Zanclognatha martha	Pine barrens zanclognatha	T

Mammals

Scientific Name	Common Name	Protection Status

Hartford County

Mammals

Scientific Name	Common Name	Protection Status
Lasionycteris noctivagans	Silver-haired bat	SC
Lasiurus borealis	Red bat	SC
Lasiurus cinereus	Hoary bat	SC
Myotis lucifugus	Little brown bat	E
Myotis septentrionalis	Northern long-eared bat	E
Perimyotis subflavus	Tri-colored bat	E

Plants

Scientific Name	Common Name	Protection Status
Acalypha virginica	Virginia copperleaf	SC
Agalinis acuta	Sandplain agalinis	E
Agastache nepetoides	Yellow giant hyssop	E
Agastache scrophulariifolia	Purple giant hyssop	E
Alopecurus aequalis	Short-awned meadow foxtail	T
Andromeda polifolia var. glaucophylla	Bog rosemary	T
Angelica venenosa	Hairy angelica	SC*
Aplectrum hyemale	Puttyroot	SC*
Arethusa bulbosa	Dragon's-mouth	SC*
Aristida longespica var. geniculata	Needlegrass	SC
Aristida purpurascens	Arrowfeather	E
Asclepias purpurascens	Purple milkweed	SC
Asplenium ruta-muraria	Wallrue spleenwort	T
Bidens beckii	Beck's water-marigold	SC
Blephilia ciliata	Downy wood-mint	SC*
Blephilia hirsuta	Hairy wood-mint	SC*
Calystegia silvatica	Short-stalked false bindweed	SC*
Calystegia spithamaea	Low bindweed	SC*
Carex aestivalis	Summer sedge	SC

Hartford County

Plants

Scientific Name	Common Name	Protection Status
Carex alata	Broadwing sedge	E
Carex barrattii	Barratt's sedge	E
Carex bushii	Bush's sedge	SC
Carex buxbaumii	Brown bog sedge	E
Carex collinsii	Collins' sedge	SC*
Carex cumulata	Clustered sedge	T
Carex davisii	Davis' sedge	T
Carex foenea	Bronze sedge	SC
Carex hitchcockiana	Hitchcock's sedge	SC
Carex limosa	Mud sedge	T
Carex oligocarpa	Eastern few-fruit sedge	SC
Carex oligosperma	Few-seeded sedge	SC*
Carex polymorpha	Variable sedge	E
Carex pseudocyperus	Cyperus-like sedge	E
Carex tuckermanii	Tuckerman's sedge	SC
Carex typhina	Cattail sedge	SC
Carex willdenowii	Willdenow's sedge	E
Celastrus scandens	American bittersweet	SC
Chamaelirium luteum	Devil's-bit	E
Coeloglossum viride	Long-bracted green orchid	E
Corallorhiza trifida	Early coral root	SC
Corydalis flavula	Yellow corydalis	T
Crocanthemum propinquum	Low frostweed	SC
Cuphea viscosissima	Blue waxweed	SC*
Cypripedium parviflorum	Yellow lady's-slipper	SC
Deschampsia cespitosa	Tufted hairgrass	SC
Desmodium glabellum	Dillenius' tick-trefoil	SC
Dicentra canadensis	Squirrel corn	SC

Hartford County

Plants

Scientific Name	Common Name	Protection Status
Dichanthelium ovale ssp. pseudopubescens	Stiff-leaved rosette-panicgrass	SC*
Dichanthelium scabriusculum	Tall swamp rosette-panicgrass	E
Dichanthelium xanthophysum	Pale-leaved rosette-panicgrass	SC*
Diplazium pycnocarpon	Narrow-leaved glade fern	E
Drymocallis arguta	Tall cinquefoil	SC
Dryopteris goldiana	Goldie's fern	SC
Echinodorus tenellus	Bur-head	E
Elymus wiegandii	Wiegand's wild rye	SC
Equisetum palustre	Marsh horsetail	SC*
Equisetum pratense	Meadow horsetail	E
Eriophorum vaginatum var. spissum	Hare's tail	T
Eurybia radula	Rough aster	E
Gaultheria hispidula	Creeping snowberry	SC
Gaylussacia bigeloviana	Dwarf huckleberry	T
Gentianella quinquefolia	Stiff gentian	E
Geranium bicknellii	Bicknell's northern crane's-bill	SC*
Goodyera repens var. ophioides	Dwarf rattlesnake plantain	SC*
Hottonia inflata	Featherfoil	SC
Houstonia longifolia	Longleaf bluet	T
Hydrastis canadensis	Goldenseal	E
Hydrophyllum virginianum	Virginia waterleaf	SC
Hypericum ascyron	Great St. John's-wort	SC
Isotria medeoloides	Small whorled pogonia	E
Liatris novae-angliae	New England blazing-star	SC
Linnaea borealis ssp. americana	Twinflower	E
Linum intercursum	Sandplain flax	SC*
Linum sulcatum	Yellow flax	E

Hartford County

Plants

Scientific Name	Common Name	Protection Status
Liparis liliifolia	Lily-leaved twayblade	E
Lipocarpha micrantha	Dwarf bulrush	T
Lygodium palmatum	Climbing fern	SC
Maianthemum trifolium	Three-leaved false Solomon's-seal	T
Malaxis unifolia	Green adder's-mouth	E
Milium effusum	Tall millet-grass	E
Moneses uniflora	One-flower wintergreen	E
Onosmodium virginianum	Gravel-weed	E
Opuntia humifusa	Eastern prickly pear	SC
Orontium aquaticum	Golden club	SC
Orthilia secunda	One-sided pyrola	SC*
Oxalis violacea	Violet wood-sorrel	SC
Packera anonyma	Small's ragwort	E
Packera paupercula	Balsam groundsel	E
Panax quinquefolius	American ginseng	SC
Paronychia fastigiata	Hairy forked chickweed	SC*
Pedicularis lanceolata	Swamp lousewort	T
Pinus resinosa	Red pine	E
Piptatherum pungens	Slender mountain ricegrass	E
Plantago virginica	Hoary plantain	SC
Platanthera blephariglottis	White-fringed orchid	E
Platanthera ciliaris	Yellow-fringed orchid	E
Platanthera dilatata	Tall white bog orchid	SC*
Platanthera hookeri	Hooker's orchid	SC*
Platanthera orbiculata	Large round-leaved orchid	SC*
Polygala nuttallii	Nuttall's milkwort	T
Populus heterophylla	Swamp cottonwood	T
Prunus alleghaniensis	Alleghany plum	SC*

Hartford County

Plants

Scientific Name	Common Name	Protection Status
Ranunculus ambigens	Water-plantain spearwort	E
Ranunculus pensylvanicus	Bristly buttercup	SC
Rhododendron groenlandicum	Labrador tea	T
Rhynchospora scirpoides	Long-beaked beaksedge	E
Ribes glandulosum	Skunk currant	SC
Ribes triste	Swamp red currant	E
Rotala ramosior	Toothcup	T
Sagittaria cuneata	Northern arrowhead	E
Salix exigua	Sandbar willow	E
Salix pedicellaris	Bog willow	E
Salix petiolaris	Slender willow	SC
Scheuchzeria palustris ssp. americana	Pod grass	E
Schoenoplectus torreyi	Torrey bulrush	T
Scirpus longii	Long's bulrush	SC*
Scleria pauciflora var. caroliniana	Few-flowered nutrush	E
Scleria triglomerata	Whip nutrush	E
Scutellaria integrifolia	Hyssop skullcap	E
Senna hebecarpa	Wild senna	T
Silene stellata	Starry campion	T
Solidago latissimifolia	Elliott's goldenrod	SC*
Stachys hispida	Hispid hedge-nettle	T
Stachys hyssopifolia	Hyssop-leaf hedge-nettle	E
Stellaria borealis	Northern stitchwort	SC
Streptopus amplexifolius	White mandarin	T
Thuja occidentalis	Northern white cedar	T
Trichomanes intricatum	Appalachian gametophyte	SC
Trichostema brachiatum	False pennyroyal	E

Hartford County

Plants

Scientific Name	Common Name	Protection Status
Triosteum angustifolium	Narrow-leaved horse gentian	E
Triphora trianthophora	Nodding pogonia	E
Trisetum spicatum	Narrow false oats	E
Uvularia grandiflora	Large-flowered bellwort	E
Vaccinium vitis-idaea ssp. minus	Mountain cranberry	SC*
Valerianella radiata	Beaked corn-salad	SC*
Verbena simplex	Narrow-leaved vervain	SC*
Viola canadensis	Canada violet	SC
Viola selkirkii	Great-spurred violet	SC
Waldsteinia fragarioides	Barren strawberry	E
Xyris montana	Northern yellow-eyed grass	T

Reptiles

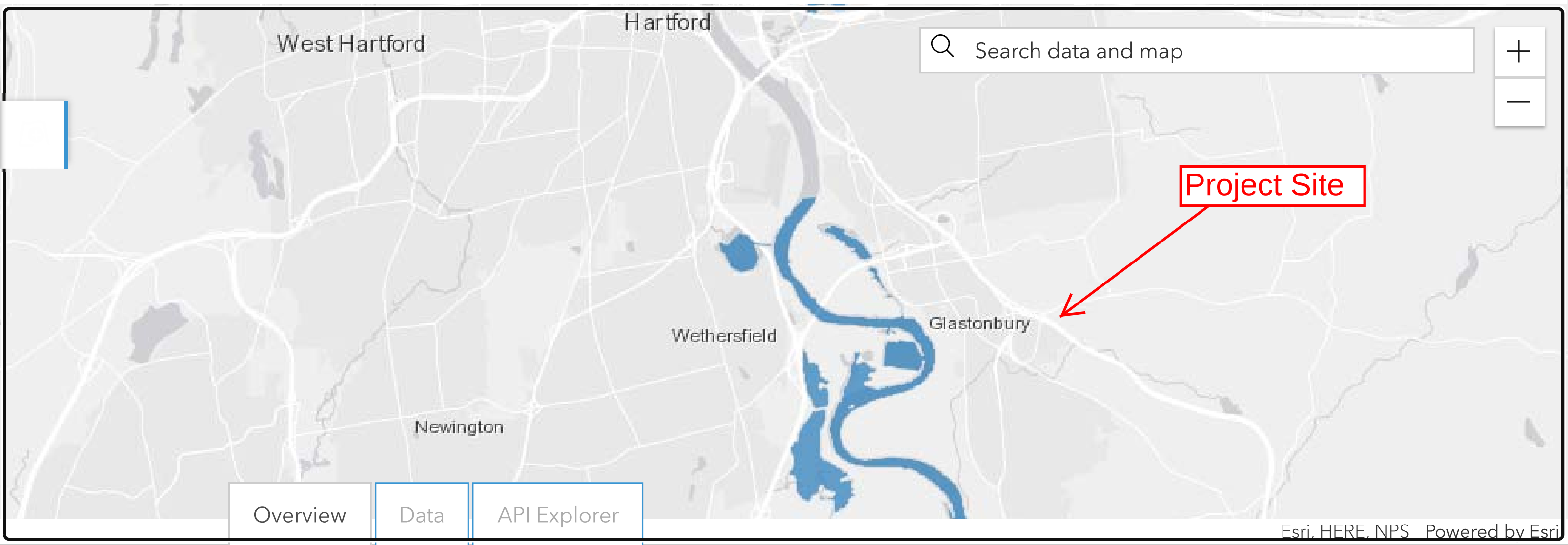
Scientific Name	Common Name	Protection Status
Clemmys guttata	Spotted turtle	SC
Crotalus horridus	Timber rattlesnake	E
Glyptemys insculpta	Wood turtle	SC
Heterodon platirhinos	Eastern hognose snake	SC
Opheodrys vernalis	Smooth green snake	SC
Plestiodon fasciatus	Five-lined skink	T
Terrapene carolina carolina	Eastern box turtle	SC
Thamnophis sauritus	Eastern ribbon snake	SC

E = Endangered, T = Threatened, SC = Special Concern, * Believed Extirpated

State of Connecticut
Department of Energy and Environmental Protection
Bureau of Natural Resources, Wildlife Division
79 Elm St., Hartford, CT 06106

Migratory Waterfowl

Last updated last year | 165 Records



Overview Data API Explorer

10/30/2019 Feature Layer

Download APIs

Migratory Waterfowl is a 1:24,000-scale, polygon feature-based layer that depicts the concentration areas of migratory waterfowl at specific locations within Connecticut. Paul Merola, former DEP Wildlife Biologist,

More

About

CT DEEP GIS Open Data Website Content - Bioscience
Shared By: deepgis
Data Source: services1.arcgis.com

View Metadata
Create Webmap
Create a Story Map

Attributes

Chart • Map Visualization

AM_WIGEON Number	BLACKDUCK Number	BRANT Number	BUFFLEHD Number	BW_TEAL Number
CAGO Number	CANVASBK Number	COMMENTS Text	GADWALL Number	GOLDEYE Number
GW_TEAL Number	HOOD_MERG Number	MALLARD Number	MERG_COM Number	
MIGRATION Text	OLDSQUAW Number	RB_MERG Number	SCAUP Number	SCOTER_CM Number

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104
http://www.fws.gov/newengland

In Reply Refer To: December 17, 2020
Consultation Code: 05E1NE00-2021-SLI-0757
Event Code: 05E1NE00-2021-E-02282
Project Name: Glastonbury

Subject: 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(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

Project Summary

Consultation Code: 05E1NE00-2021-SLI-0757

Event Code: 05E1NE00-2021-E-02282

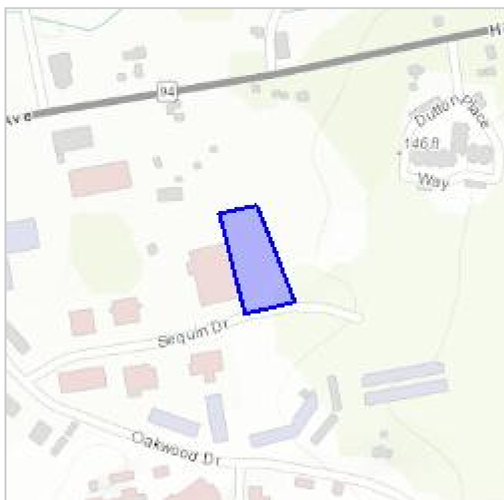
Project Name: Glastonbury

Project Type: COMMUNICATIONS TOWER

Project Description: Construction of a 115-foot (including appurtenance) monopole tower and associated support equipment located within fenced 50-foot by 50-foot lease area.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/41.714032463316975N72.58164156295327W



Counties: Hartford, CT

Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this 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.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Critical Habitat for Threatened & Endangered Species [USFWS]

Final Linear Features

Final Polygon Features

Proposed Linear Features

Proposed Polygon Features

A specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

U.S. Fish and Wildlife Service | The data found in this file were developed by the U.S. Fish & Wildlife Service field offices. For more information please refer to the species level metadata found with the individual shapefiles. The ECOS Joint Development Team is responsible for creating and serving this conglomerate file. No data alterations are made by ECOS. | Maxar, Microsoft

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PMCID: PMC3338802
PMID: 22558082

An Estimate of Avian Mortality at Communication Towers in the United States and Canada

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Martin Krkosek, Editor

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Conceived and designed the experiments: TL CR PM DGB BM SAG. Performed the experiments: TL PM DGB BM LMS EM. Analyzed the data: TL PM DGB BM LMS EM. Contributed reagents/materials/analysis tools: TL PM DGB BM LMS EM ERT DD. Wrote the paper: TL CR PM DGB BM SAG MLA RLC AMM ERT.

Received 2011 Jul 28; Accepted 2012 Feb 20.

Abstract

Go to:

Avian mortality at communication towers in the continental United States and Canada is an issue of pressing conservation concern. Previous estimates of this mortality have been based on limited data and have not included Canada. We compiled a database of communication towers in the continental United States and Canada and estimated avian mortality by tower with a regression relating avian mortality to tower height. This equation was derived from 38 tower studies for which mortality data were available and corrected for sampling effort, search efficiency, and scavenging where appropriate. Although most studies document mortality at guyed towers with steady-burning lights, we accounted for lower mortality at towers without guy wires or steady-burning lights by adjusting estimates based on published studies. The resulting estimate of mortality at towers is 6.8 million birds per year in the United States and Canada. Bootstrapped subsampling indicated that the regression was robust to the choice of studies included and a comparison of multiple regression models showed that incorporating sampling, scavenging, and search efficiency adjustments improved model fit. Estimating total avian mortality is only a first step in developing an assessment of the biological significance of mortality at communication towers for individual species or groups of species. Nevertheless, our estimate can be used to evaluate this source of mortality, develop subsequent per-species mortality estimates, and motivate policy action.

Introduction

Go to:

On the morning of September 11, 1948, "a good number of dead, dying, and exhausted birds" were found at the base of the WBAL radio tower in Baltimore, Maryland [1]. Reports of such avian mortality at communication towers in North America became common in the 1950s [2]–[7]. These observations were consistent with the long documented mortality of birds at lights, including lighthouses [8], light towers [9], buildings [1], [10], and ceilometers [1], [11]. Although initially dismissed as being of minor consequence [12], the ongoing and chronic mortality of nocturnally migrating birds at lighted structures has become a recognized conservation issue [7], [13]–[15]. Bats are also killed in collisions with tall towers in unknown numbers [16]–[18]. An estimate of the total number of birds killed at communication towers in the United States and Canada is particularly relevant because the current transition from analog to exclusively digital broadcasting in the United States is expected to lead to the construction of more tall towers and a similar trend will likely follow in Canada.

In 1979, Banks [13] developed a widely circulated estimate of avian mortality at television towers, which revised upward a previous estimate by Mayfield [12]. In Banks's assessment of various sources of human-caused avian mortality, he extrapolated the results of three studies at tall towers – two in Florida [19], [20] and one in North Dakota (for which he did not provide a citation but which was almost certainly [21]) – to all television towers. He calculated the average mortality at these three sites to be roughly 2,500 birds per year, and multiplied it by the number of television towers (1,010 in 1979). He then assumed that half of all television towers would cause a hazard to migrating birds. The resulting estimate of annual mortality was 1,250,000 [13]. Also in 1979, Avery [22] applied bird mortality results from seven towers that had been monitored for at least 10 years and derived an overall mortality estimate of 940,000/year for the United States. More recent estimates of total avian mortality at towers in the United States by the U.S. Fish and Wildlife Service (USFWS) in 2001 [14], [23] adjusted the Banks estimate by accounting for the increased number of towers since 1979. Application of Banks's method today results in an estimate of 4–5 million birds killed annually by tall towers, with Manville [15], [24] indicating a possibility of mortality an order of magnitude higher.

No estimate of avian mortality at communication towers has been made for the United States and Canada as a whole, and the only estimate for Canada was presented in a preliminary unpublished report preceding this paper. The bulk of species killed at towers in the United States and Canada are Neotropical migrants, i.e., birds that breed in Canada and the United States and spend the non-breeding period south of the U.S. border [13], [25]. Because the ranges of these species extend into Canada, mortality in both the United States and Canada contribute to their population dynamics.

In this paper we develop a new estimate of avian mortality at communication towers in the United States and Canada. This estimate derives from a review and re-analysis of tower mortality studies (following [26]). We improve on Longcore et al. [26] by adjusting mortality records at towers for sampling effort, search efficiency, and scavenging, and by incorporating additional studies. We produced a regression for avian mortality by tower height and then applied this regression to a geographic database of communication towers for the United States and Canada. This approach recognizes that taller towers kill more birds on average than do shorter towers [26]–[28], but also incorporates mortality estimates for lighted towers that are less than 600 ft (~180 m) above ground level (AGL), which have previously been left out of estimates of total avian mortality. These "shorter" (60–180 m) lighted towers, which constitute >95% of lighted towers, do regularly kill birds [28]–[30] and their sheer number argues against ignoring them. We do not, however, estimate mortality from collisions with other lighted structures. Attraction to light at night leads to avian mortality at buildings, monuments, cooling towers, bridges, offshore platforms, ships, lighthouses, and wind turbines [24], [31], [32], and the same group of species (Neotropical migrants) are especially susceptible.

Our goal is to improve upon past estimates, which relied on a very limited set of data and did not reflect current understanding of the tower height–mortality relationship. Because of the nature of the existing data on avian mortality at towers and the lack of a systematic continent-wide survey effort, additional field studies will be required to refine further our approach. Our results do, however, increase both the transparency and accuracy associated with the estimate of this source of avian mortality.

Methods

Go to:

We assigned average mortality values to tower height classes (every 30 m) using a regression of tower height by annual mortality (following [26]). Longcore et al. [26] identified reports of birds killed at 26 communication towers over at least two migratory seasons (e.g., spring and fall, two falls), consisting of a minimum of 10 total carcass-searching visits per site. We added figures from additional studies [33], [34], tested the sensitivity of the regression to inclusion of studies, and developed adjustments for sampling effort, search efficiency, and scavenging to produce estimates of mortality.

Sensitivity of Tower Height–mortality Regression

We collected as many studies of bird mortality at communication towers as possible from the literature and, when necessary, obtained raw data from study authors. Some studies had to be dropped from our analysis (e.g., [28]) because we were unable to obtain data from study authors and published reports did not allow us to assign mortality to specific towers. Because the number of tower studies available to us was finite, and because the choice of studies may have influenced our results, we tested the extent to which the regression was robust to sampling variation among the towers available for analysis. We used a randomization and resampling procedure to select random subsets of the 38 towers included in the analysis. To explore a range of plausible tower subsets that could produce a regression, we resampled subsets that included just under half of the available towers (18) up to those with one fewer than the complete dataset (37 towers) and re-iterated the sampling procedure 5,000 times. We used the natural logarithm of both the dependent and independent variables to normalize their distributions.

Adjustment for Scavenging and Search Efficiency

Loss of birds to scavengers and failure to detect all dead birds (search efficiency) are sources of error and variation in tower studies. Some authors have opted to apply searching and scavenging factors to final kill estimates (e.g., [28], [35]). Recognizing that search efficiency and scavenging losses are likely tower-specific, we opted to correct the number of kills at each tower before regressing these estimated losses against tower height.

We assumed that scavenging would be lower at a small tower that sporadically generates only a few mortalities compared with a well-established tall tower that kills birds reliably and therefore maintains scavenger interest [36]–[39]. This assumption is supported by high scavenging rates documented at tall towers such as WCTV in Florida [20], [36], [38] and rapid increases in scavenging when researchers provide carcasses [33]. Even with extensive scavenger control efforts, Stoddard estimated that he was losing at least 10% of bird carcasses to scavengers daily [40]. Therefore, we adjusted our scavenging rate by tower height.

We assumed that it is easier to find carcasses under a short tower because carcasses are likely to be less dispersed under shorter guy wires or in the absence of guy wires. Whether the area around the tower is bare or heavily vegetated will affect both scavenging and search rates [41]. Open habitats with little concealing vegetation are, predictably, more conducive to efficient searching for carcasses [41]. Scavengers detecting prey by sight can find the carcasses more easily as well. Notwithstanding the use of smell by some carnivores to find prey, dense cover makes it more difficult in general for both scavengers and searchers to find carcasses [42]. Support for our assumptions about the effect of cover on these rates is found in research on avian mortality caused by pesticides, power lines, and wind turbines [41]–[45]. We avoided attempts to calculate probability of detection by searchers that involved the "life expectancy" of carcasses because these methods are biased [46]. If a carcass was not found on the first search day, the probability that it will be found on subsequent days is considerably less than the average search rate would suggest. Therefore, for the purpose of this analysis, the likelihood that a carcass was found more than one day after it was generated is considered negligible. Removal of dead birds by scavengers at sites with regular mortality also follows an exponential decay model such that the probability of small dead birds remaining to be found falls quickly following the mortality event [45], [47].

We divided towers into height classes to which we could assign differential search and scavenging rates. Based on breaks in the raw tower mortality data, we chose to divide the towers into three height classes: 0–200 m, 201–400 m, and ≥401 m. To assign search and scavenging rates we relied on our published summaries of available rates from a range of carcass searching contexts (Table 1) [41], [42], other existing studies and reviews [37], [43], [44], [46], [48], and values reported at the towers in our dataset where these rates were measured [28], [33], [34], [49]. Taking into account patterns from these data, we used tower height as well as any information about cover as a way to assign search and scavenging corrections by height and cover class to the towers for which these rates had not been measured and reported by the authors (Table 2). All search and scavenging rates, both measured and assigned, are reported in Table 3.

Table 1

Average search and scavenging rates taken from pesticide impact studies [42].

Habitat	Body size	Search rate (# study plots)	Percentage lost to scavenging	Detection rates (studies combining search and scavenging rates)
Shrub/wood edge	Small-medium	41.0% (301)	20.9%	22.8% (94)
Shrub/wood edge	Large	67.6% (29)	-	-
Bare/open	Small-medium	64.6% (359)	28.4%	18.6% (56)
Bare/open	Large	88.1% (17)	-	-

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Search and detection rates are based on daily averages weighted by the number of study plots. Search rates represent the proportion of carcasses found over the total number still present at the time of search. Scavenging rates represent daily measurements averaged over all plots without regard for the number of placed carcasses.

Search rates are undoubtedly at the high end of that which is possible because the search procedures were optimized, always including trained lines of searchers spaced optimally for the habitat as well as the use of search dogs in some studies.

Table 2

Assumed rates for search efficiency and scavenger removal by tower height and habitat type when not provided by investigator.

Tower type and mortalityprofile	Habitat	Assumed proportion of small birds located by searcher	Assumed proportion ofsmall birds remainingafter scavenging	Combined rate of detection
Height class 1 (0–200 m), sporadic mortality, more localized	Open habitat	75%	80%	60%
	Brush and other visual obstructions	50%	85%	42%
Height class 2 (201–400 m), regular mortality, more dispersed	Open habitat	65%	55%	36%
	Brush and other visual obstructions	40%	70%	28%
Height class 3 (≥401 m),dependable mortality, carcasseswidely dispersed	Open habitat	55%	30%	16%
	Brush and other visual obstructions	30%	55%	16%

Table 3

Summary of factors used to develop the search and scavenging correction for bird mortality at communication towers.

Reference	Cover	Daily	Tower height (m)	Scavenger control	Scavenging measured	Search efficiency measured	Measured or assumed search rate	Measured or assumed scavenging rate	Ov det rat
[69]	burned spring, hayed fall	No	30.5	no	no	no	0.750	0.200	0.6
[49]	cleared periodically	No	60	yes	yes	yes	0.406	0.392	0.2
[34]	mowed at least once per season	Yes	60	no	yes	yes	0.294	0.076	0.2
[34]	mowed at least once per season	Yes	60	no	yes	yes	0.294	0.076	0.2
[34]	mowed regularly	Yes	79	no	yes	yes	0.294	0.076	0.2
[40]	Mowed	Yes	90	yes	no	no	0.750	0.100	0.6
[34]	mowed at	Yes	97.5	no	yes	yes	0.290	0.113	0.2

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We investigated the sensitivity of our final results to these assumptions about search efficiency and scavenging by recalculating our total mortality estimates while assigning the average search efficiency and scavenging rates reported from those studies that did estimate these rates. This approach tested the alternative assumption that studies from all towers where search efficiency or scavenging were not measured had the same search efficiency, scavenging rate, or both, as did studies at the towers where they were measured, regardless of the physical conditions at the tower or the height of the tower.

Adjustment for Sampling Effort and Design

Studies included in the tower height–mortality regression varied in sampling design and duration. Following Longcore et al. [26], we required a minimum of 10 searches for a study to be included. Authors of most of the studies used in the regression assumed that most birds would be found by sampling during peak migration, on bad weather days preceding or following the passing of a cold front (e.g., J. Herron, pers. comm.), or both (Table 4). The logic behind this approach is that many high avian mortality days are correlated with these factors [31]. Nevertheless, "trickle kills" on fair weather days even outside the typical migration period can contribute substantially to overall mortality [40]. Substantial mortality during clear and calm weather during the migration season has also been documented [30], [50] (Figure 1). For these reasons we used raw data from two studies that carried out daily carcass searches – WCTV Florida tower data from 1956–1967 initiated by Herbert L. Stoddard and Tall Timbers Research Station [40] and North Dakota "Omega" tower [21], [51], [52] – as a baseline to develop estimates of the effectiveness of the various sampling designs for the 38 tower studies included in our dataset. The Florida estimates were averaged over the 10 years of sampling during which height of tower and predator control were the same; the North Dakota estimates are for two years of sampling. When the estimate was (partially) based on sampling outside the migratory period (as defined), we used the Florida dataset, which had continuous, year-round sampling. We did not, however, correct upward all kill estimates to account for the trickle of kills recorded in the non-migratory seasons. We believe, therefore, that our estimates are conservative. To control for differences between spring and fall migration we developed estimates for both spring and fall separately.

Table 4

Summary data with sampling efficiency correction for the 38 studies used to develop an estimate of bird mortality at communication towers.

Reference	Tower height (m)	Start year	End Year	Sampling days	Sampling correction	Sampling strategy	No. of years	Average correction sampling (spring)	Average correction sampling (fall)	Birds collect
[69]	30.5	1998	1999	25/year	yes	bad weather	1	0.44	0.36	0
[49]	60	2000	2004	average >70/year	yes	bad weather	4	0.50	0.50	15
[34]	60	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	3
[34]	60	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	1
[34]	79	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	8
[40]	90	1998.5	2000	>330/year	no	n/a	1.5	1.00	1.00	21
[34]	109	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	7
[34]	110	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	6
[34]	110	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	3
[70]	133	1958	1960	<60/year	no	n/a	2	1.00	1.00	267
[34]	142	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	14
[34]	142	2007	2008	45 spring, 45 fall	no	n/a	2	1.00	1.00	5
[33]	152	2004	2006	>52/year	yes	bad weather + weekly	2	0.90	0.58	11
[71]	161	1980	1986	15.25/year average	yes	bad weather	6	0.44	0.36	700

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Number of years in each study may differ from the calendar years encompassed by the study because of the assumption that each fall constitutes 0.75 years of surveying and each spring constitutes 0.25 years of surveying. Studies in which surveys were conducted only during the fall or only sporadically during the spring will appear to be shorter than their calendar duration.

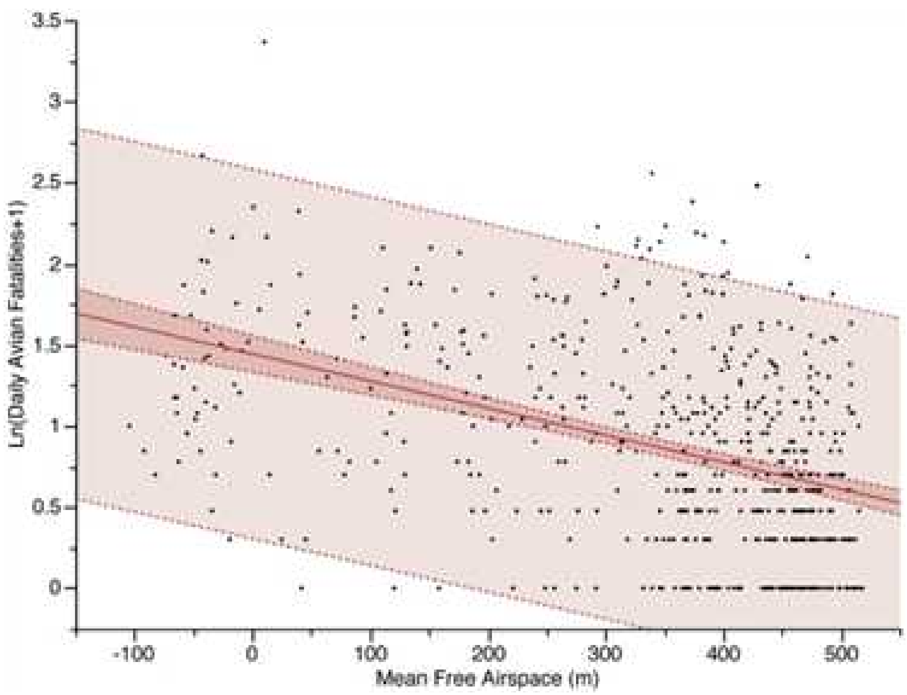

Figure 1

Relationship of bird fatalities to free airspace at WCTV Tower, 1956–1967.

Raw data from Crawford and Engstrom (2001) were used to plot daily bird fatalities against the mean free airspace between the top of the tower and the cloud ceiling each day. Days with maximum ceiling were excluded. Daily avian mortality increases significantly as free airspace decreases (Ln(Bird Fatalities +1)= 1.443928 – 0.0016667 · Mean Free Airspace (m), R^2=0.17, p<0.001).

To adjust for the kills between sampling days during the migratory seasons we resampled (with replacement) daily mortality data from the Florida and North Dakota datasets within each of the spring and fall migration periods by randomly selecting a subset of days and summing avian mortality for the selected days. We calculated average bird mortality for 5,000 iterations and then used the ratio of the average bird mortality from the 5,000 iterations to the total number of birds killed during either spring or fall migration or outside of the migration period to adjust mortality estimates for studies without daily sampling. We averaged estimates between the Florida and North Dakota datasets. This adjustment was applied to studies where researchers sampled on bad weather days (see below) and to those with weekly sampling outside the migration period.

For studies that did not provide complete details on their sampling design, we made simplifying assumptions (see below). If more than one sampling strategy was used, we developed estimates for each and used the sum as our overall estimate. For example, sampling may have been done weekly (regular sampling) outside of the migration period and also on “bad weather days” during the migration period.

We defined the spring and fall migration periods as a 60-day window before and after the migration peak for both spring and fall for each dataset, recognizing that for some recent studies (e.g., [28]) monitoring only occurred during the three-week peak of migration. We determined the peak for the Florida and North Dakota datasets by plotting the number of birds killed (from the raw data) against Julian date for all years of data combined and using negative exponential smoothing.

Some investigators reported the total number of days sampled during one or both migration periods and sometimes outside the migration periods. When the sampling interval (e.g., weekly) was identified in the study design, we constrained the resampling procedure to randomly select a day within that sampling interval. If no sampling interval was defined, selection was random.

Some investigators sampled on so-called “bad weather days” or following bad weather nights, i.e., overcast, often associated with advancing cold fronts and potentially including precipitation. Usually no other information was provided to define bad weather or the number of days when bad weather occurred. High bird mortality at communication towers is correlated with bad weather days [40], [50], [53]. This is shown by plotting ln(n+1)-transformed daily mortality data from the Florida tower dataset for the 1956–1967 fall migrations against the mean free airspace (distance between the top of the tower and the bottom of the cloud cover). Days where maximum free airspace was recorded were excluded from analysis because measurements did not vary for total ceiling greater than 610 m (2,000 ft). Mortality for days with mean ceiling at the maximum was 4.0–8.0 birds per day (95% C.I., n=871), while mortality for all days with less than the maximum ceiling was 16.0–33.5 birds per day (95% C.I., n=569). Considering these remaining points, a linear regression reveals a highly significant effect of mean free airspace, but also low explanatory power (Figure 1). Based on these data, we used days with mean free airspace equal to or below 335 m (1,100 ft) as an index of bad weather days because mortality was significantly lower on days with airspace greater than 335 m (10.3–17.8 birds per day, 95% C.I., n=387) compared with days with airspace below this threshold (21.5–73.3 birds per day, 95% C.I., n=182).

For some studies, the only information provided was the number of days sampled and the timing of sampling (during migration or all year). For these studies we assumed that researchers sampled on bad weather days during migration when large bird kills at communication towers were expected, given that this was the response obtained when we were able to contact researchers to ask about papers where this detail was not provided (e.g., J. Herron, pers. comm.).

Several researchers sampled only on days when so called “big kills” were reported. The definitions of “big kill” were not included. The typical daily trickle of dead birds for the Florida dataset over the 1956 –1967 period was five. We therefore defined big kills as six or more birds located after any given night.

We investigated the sensitivity of our results to our assumptions about sampling effort by varying these assumptions for the 13 studies in our dataset that either did not indicate the number of days sampled or did not provide a definition of sampling design, or did neither. Some researchers had indicated that they had sampled on overcast or bad weather days or following bad weather days. For all of these studies and for those that did not mention anything specific, we made the conservative assumption that towers were sampled on bad weather days. We then recalculated the sampling adjustment and total mortality using three different scenarios: 1) researchers sampled on bad weather days and weekly during migration (e.g., [49]); 2) researchers sampled on bad weather days and weekly all year (e.g., [33]; excludes 5 of the 13 studies that clearly indicated they only sampled during migration); and 3) researchers sampled only following big kill days, about which they were notified by personnel at the tower (e.g., [5]).

Evaluation of Model Correction Factors

We plotted either raw carcass counts or mortality estimates corrected for either sampling effort or search efficiency and scavenging, or both, against tower height and looked for improvements in the regression coefficient as an indication that the corrections improved the model.

Description of Communication Towers and their Characteristics

We used a Geographic Information System (GIS) to extract the locations and characteristics of towers in the Antenna Structure Registration (ASR) database maintained by the U.S. Federal Communications Commission (FCC) and the NAV CANADA obstruction database. The FCC data are freely available and we purchased a license for the Canadian obstruction data for the limited purpose of this study. We compared and crosschecked these with the FCC's microwave tower database and the commercial TowerMaps database (also purchased, see http://www.towermaps.com/), which provides locations of cellular towers to potential lessees and incorporates both data for shorter towers and information that was not included in the FCC databases. We did considerable quality control on the tower data, confirming from independent sources that all towers greater than 300 m existed. This was necessary because the data were prone to multiple types of errors; for example, the FCC database included a record claiming to be located in the "Land of Oz" in Kansas, associated with geographic coordinates in Minnesota. Full details of the quality assurance are available from the authors.

The NAV CANADA database did not contain comprehensive information about either the presence of guy wires or the presence and type of lighting. We therefore relied on data from the FCC and TowerMaps datasets and assumed that lighting and guy wire use was similar in both countries for towers of the same height class, an assumption supported by the similarity in marking and lighting standards between the two countries. The U.S. Federal Aviation Administration requirements are found in the advisory circular AC 70/7460-1K. Those of Canada are found in Standard 621 of the Canadian Aviation Regulations.

Calculation of Annual Mortality

Avian mortality was estimated with the antilogarithm of the regression of the log transformed variables, which was adjusted for transformation bias using the smearing estimator after testing to confirm homoscedasticity of variance in the regression [54], [55]. Most recorded tower kill events take place at guyed towers, and steady-burning lights increase the probability of large tower kills [26], [28]. We assumed that unguyed towers caused 85% less mortality than guyed towers (midpoint of 69–100% estimate in [56]) and that towers without steady-burning lights caused 60% less mortality than towers with such lights (midpoint of 50–71% estimate in [28]). Following Longcore et al. [26], all estimates were calculated assuming that when both seasons were not measured, 75% of annual mortality occurred during the fall and 25% during the spring [40].

We overlaid locations of towers within each Bird Conservation Region (BCR) in the study area and calculated the number of towers in each 30 m height class for all towers ≥60 m. Bird Conservation Regions are divisions defined by habitat and topography that have been delineated for the purpose of bird conservation by the North American Bird Conservation Initiative and are endorsed by a range of bird conservation organizations and government agencies. BCRs are based on the North American ecoregions developed to promote international conservation efforts [57]. For each height class within each BCR we calculated the average number of birds killed per year, using the tower height–mortality regression adjusted for sampling effort, search efficiency, and scavenging as described above. For purposes of calculating total mortality we included all towers in the continental portions of the United States and Canada. Although most literature on tower mortality in North America describes studies from east of the Rocky Mountains, we included the West as well for purposes of estimating total mortality, a decision supported by records of tower mortality in Colorado [33], New Mexico [58], and Alaska [59], in addition to documented kills at lighthouses in California and British Columbia [60], [61]. We did not attempt to assign differential mortality for so-called flyways because radar studies and other observations strongly support the existence of "broad front" migration [62], [63]. To investigate this assumption, we plotted the residuals of the tower height–mortality regression by their geographic coordinates and calculated Moran's I as a measure of spatial autocorrelation. We acknowledge that local habitat factors may influence mortality at particular towers, but because only 18.4% of towers were originally selected for monitoring on the basis of knowledge of prior mortality (see below), it is unlikely that these variations would result in a systematic bias in the resulting mortality estimates.

To illustrate the contribution of each part of our adjustment to the final estimate of mortality, we calculated the extrapolated mortality estimates for the unadjusted mortality data, with the sampling correction only, with the search efficiency and scavenging corrections only, and corrected for all factors.

We do not report estimates of bird mortality at short (<60 m) towers in this paper because they contribute negligibly to overall annual bird mortality and are not usually illuminated unless located near an airport. We note, however, that single-night mortality events with several hundred identified dead birds at unlit <60 m towers have been reported, often related to lighting at adjacent infrastructure [30], which is consistent with reports from turbines and towers monitored at industrial wind facilities [64]. Our analysis therefore applies to towers ≥60 m.

Results

Go to:

Tower Height–mortality Regression

Towers used in the height–mortality regression were located throughout the eastern United States (Figure 2). We were able to confirm from original sources and personal communications that 68.4% of the towers were chosen for study with no prior knowledge of avian mortality; status is unknown for 13.2% of towers; and only 18.4% of towers were chosen with any knowledge of prior avian mortality. Log-transformed annual avian mortality, when adjusted for sampling effort, search efficiency, and scavenging, was significantly explained by log-transformed tower height in a linear regression (R^2= 0.84, $F_{1,36}$=191.62, $p<0.0001$) (Table 5; Figure 3).

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Figure 2

Bird Conservation Regions and locations of towers used for tower height–mortality regression.

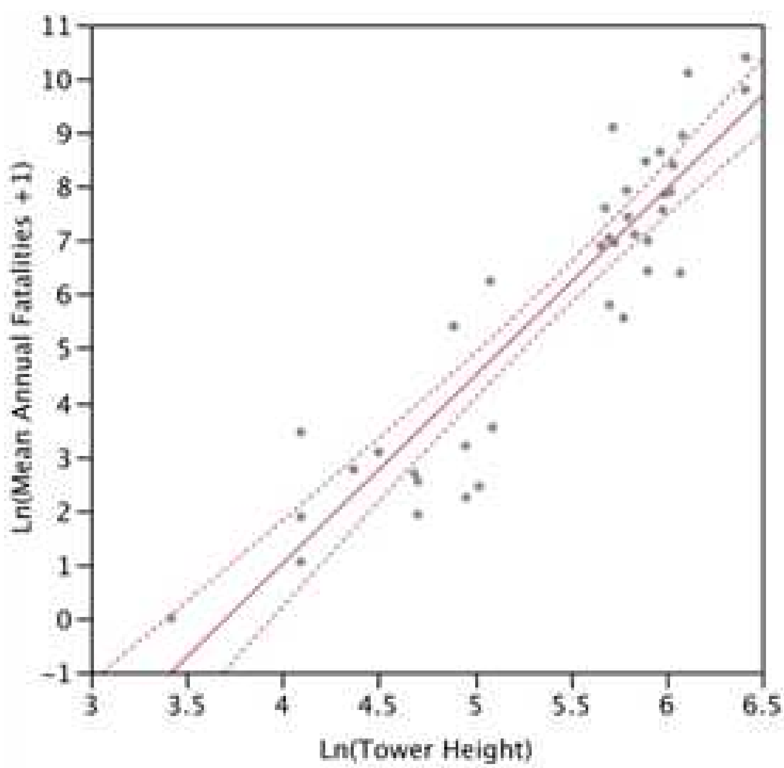

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Figure 3

Regression and 95% confidence intervals of annual avian fatalities by tower height.

Annual avian fatalities were adjusted for sampling effort, search efficiency, and scavenging and regressed by log-transformed tower height (Ln(Mean Annual Fatalities +1)=3.4684 · Ln(Tower Height) – 12.86, R^2 =0.84, p<0.0001).

Table 5

Regression results for mean annual fatalities by tower height, when unadjusted, corrected for sampling only, corrected for search efficiency and scavenging only, and corrected for both sampling and search efficiency/scavenging, with estimated annual fatalities after back transformation, adjustment for bias, and application to all towers in the United States and Canada.

	Slope	Intercept	R^2_{adj}	RMSE	F	P	Estimated annual fatalities (million)
No corrections	2.8257	–10.8626	0.78	1.110	133.5046	<0.0001	1.38
Sampling correction	3.0962	–11.9490	0.80	1.151	148.8302	<0.0001	2.06
Searcher/scavenging correction	3.2024	–11.8012	0.82	1.110	171.2329	<0.0001	4.31
Both corrections	3.4684	–12.8600	0.84	1.137	191.6163	<0.0001	6.80

Tower Height–mortality Regression Sensitivity to Study Inclusion

The median R^2 values of the resampled distributions are similar to those obtained from using all of the available studies (Figure 4, Table 6) and are not sensitive to the addition or elimination of a few or a set of studies. The results of the resampling procedure for subsets of 18 studies (a little under half of the studies) and for 37 studies (1 fewer than the total) show the range of influence that study inclusion could have on the regression line (Table 6).

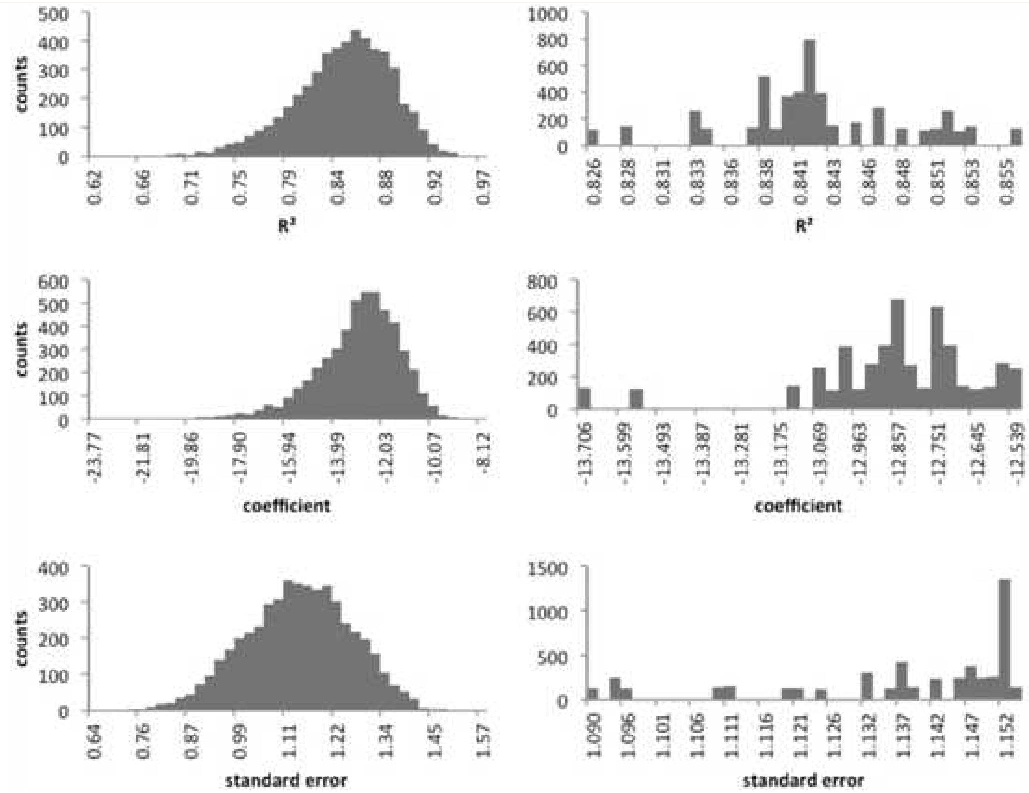

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Figure 4

Influence of study choice on tower height–mortality regression.

Distribution of counts for R^2 (adjusted), standard error, and coefficient for 5,000 iterations (subset=18 studies, left; subset=37 studies, right) for a linear regression between the natural logarithms of tower height (m) and mean annual fatalities.

Table 6

Confidence intervals and median values for model parameters using randomized subsets of 18 or 37 studies (5,000 iterations).

Subset	Parameter	5%	95%	Median
18 studies	R^2	0.765	0.906	0.847
	slope	3.087	4.061	3.474
	intercept	–16.205	–10.775	–12.882
	standard error	0.919	1.331	1.345
37 studies	R^2	0.828	0.853	0.841
	slope	3.414	3.591	3.465
	intercept	–13.556	–12.556	–12.845
	standard error	1.093	1.153	1.146

Evaluation of Model Adjustment Factors

Models using either sampling correction alone or the combination of sampling correction with the combined search efficiency and scavenging correction were found to be superior to the model using tower height alone at explaining annual kills (R^2=0.84 vs. R^2=0.79; Table 5). Correcting for search efficiency and scavenging losses appeared to provide the best improvement to the overall model (Table 5).

Tower Characteristics

Our database of ≥60 m towers included 70,414 towers in the continental United States and Canada after all quality assurance and quality control was done (Figure 5). Most towers in the United States dataset (31,486; 50.3%) were freestanding with steady-burning lights at night, while the fewest towers (4,898; 7.8%) were guyed with strobe lights at night. Some towers had strobe lights during the day but red flashing and red solid lights at night so these were included as having solid lights.

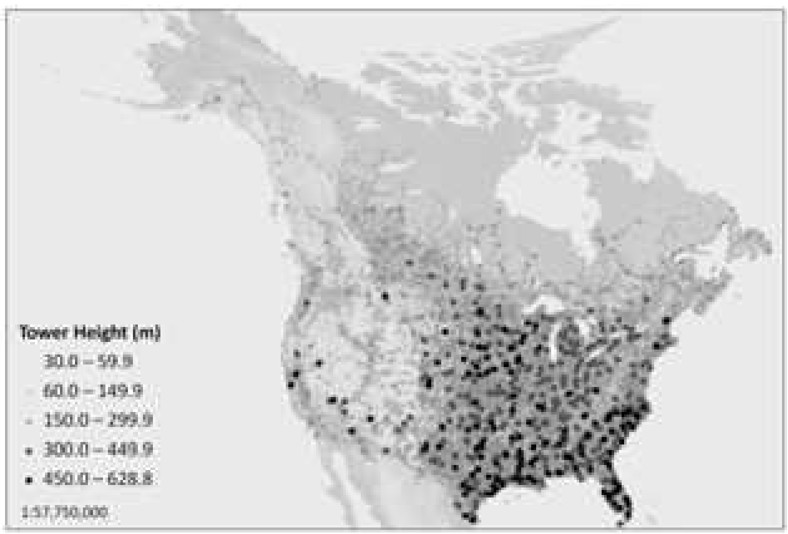

Figure 5

Map of communication towers in the United States and Canada by height class.

Data acquired from Federal Communications Commission, Towermaps.com, and NAV CANADA.

Total Mortality and Estimates by Bird Conservation Region

Combination of the tower height–mortality regression with estimates of reduced mortality at towers without guy wires or steady-burning lights produced a matrix of mortality by height class and tower characteristics. These estimates, already adjusted for sampling effort, search efficiency, and scavenging, ranged from zero for short unguyed towers to over 20,000 birds per year for the tallest guyed towers with steady-burning lights.

The back-transformed tower height–mortality regression, adjusted for bias (smearing estimator) and applied to towers in the continental United States and Canada, produced an annual mortality estimate of

6.8 million birds per year (Table 5). Extrapolation from the unadjusted data yielded an estimate of 1.4 million birds per year, meaning that our cumulative assumption is that searchers find only around 20% of the birds that are killed, because of search efficiency, scavenging, and incomplete sampling (Table 5).

These results are sensitive to the assumptions that were made about these factors. As an illustration, we calculated total mortality while assuming a constant search efficiency equal to the average of the measured search efficiency from those towers where this was measured (36.4%), which resulted in a total mortality estimate of 9.4 million birds per year. Applying the average scavenging rate (15.8%) to all towers resulted in a mortality estimate of 4.7 million birds per year. Using both averages (for scavenging and search efficiency) yielded an estimate of 6.4 million birds per year. For the sampling effort adjustments, recalculated mortality estimates for the three scenarios applied to studies with unknown sampling schemes were: 5.4 million birds per year for sampling only on big kill days, 5.7 million birds per year for sampling on bad weather days and weekly year round, and 6.2 million birds per year for sampling on bad weather days and weekly during migration only. Finally, if we recalculate mortality after omitting all towers selected with prior knowledge of any mortality on site (18.4% of our sample of towers), the estimate of total mortality declines to 5.5 million birds per year.

Over two-thirds of the estimated mortality is attributed to towers ≥300 m, of which only 1,040 were found in our database (1.6% of towers ≥60 m; Table 7). Fully 71% of mortality is attributed to the tallest 1.9% of towers. Shorter towers (60–150 m) contribute approximately 17% of all mortality because of their sheer numbers (Table 7).

Table 7

Number of communication towers ≥60 m by type and associated avian mortality estimates for Canada and the continental United States.

Country	Height class (m)	Guyed towers with steady-burning lights	Guyed towers with strobe lights	Unguyed towers with steady-burning lights	Unguyed towers with strobe lights	Annual fatalities	Percent of fatalities
United States	60–90	5,901	863	17,693	2,575	115,524	1.76%
	90–120	10,023	1,696	10,004	1,683	531,411	8.07%
	120–150	2,938	505	2,922	488	377,542	5.74%
	150–180	1,992	311	661	101	468,600	7.12%
	180–210	343	46	107	12	142,679	2.17%
	210–240	174	54	51	11	126,507	1.92%
	240–270	109	57	29	16	131,379	2.00%
	270–300	76	61	18	14	146,530	2.23%
	300–330	271	128	0	0	642,858	9.77%
	330–360	115	28	0	0	345,255	5.25%
	360–390	78	22	0	0	317,130	4.82%
	390–420	47	16	0	0	254,809	3.87%
	420–450	35	10	0	0	238,450	3.62%

Country	Height class (m)	Guyed towers with steady-burning lights	Guyed towers with strobe lights	Unguyed towers with steady-burning lights	Unguyed towers with strobe lights	Annual fatalities	Percent of fatalities
	450–480	66	23	0	0	579,458	8.80%
	480–510	25	10	0	0	277,580	4.22%
	510–540	24	8	0	0	319,300	4.85%
	540–570	8	9	0	0	165,120	2.51%
	570–600	18	15	0	0	410,068	6.23%
	600–630	38	27	0	0	991,745	15.07%
	Subtotal	*22,282*	*3,888*	*31,486*	*4,898*	*6,581,945*	*100.00%*
Canada [1]	60–90	627	323	1,880	968	13,980	6.34%
	90–120	1,295	284	1,295	284	69,981	31.72%
	120–150	251	55	251	55	32,797	14.86%

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[1]Tower attributes (guy wires, lighting type) for Canada are extrapolated from proportions in the United States because these attributes are not found in the NAV CANADA database.

Our estimates of mortality vary by region, influenced both by the size of the region and the number and height distribution of towers (Figure 6; Table 8). The number of towers in each BCR does not directly correlate with estimated annual mortality because of differing numbers and heights of towers. As a result, Peninsular Florida is associated with more mortality than all of Canada; even though fewer towers are reported in Peninsular Florida, they are on average much taller. The concentration of migrants resulting from Florida's geographic position would increase mortality even more, but this factor is not considered in our method because mortality rates for any given tower height are assumed to be constant across the continent. The Southeastern Coastal Plain BCR accounts for greater mortality than other BCRs, followed by Eastern Tallgrass Prairie, Oaks and Prairies, and Piedmont (Table 8). Canadian mortality accounts for only a fraction of the total (approximately 3.2%), because Canada has far fewer, and generally shorter, towers.

Figure 6

Estimated annual avian mortality from communication towers by Bird Conservation Region.

High mortality estimates in Peninsular Florida and Southeastern Coastal Plain reflect the more numerous and taller communication towers in these regions.

Table 8

Total estimated annual avian mortality at towers ≥60 m in the United States and Canada by Bird Conservation Region (BCR).

BCR	USA (lower 48 states)	Canada	Alaska	Total
1–Aleutian Bering Sea			0	0
2–Western Alaska			155	155
3–Arctic Plains and Mountains		542	83	625
4–Northwestern Interior Forest		288	2,228	2,516
5–Northern Pacific Rainforest	21,170	2,411	333	23,914
6–Boreal Taiga Plains		24,591		24,591
7–Taiga Shield and Hudson Plains		2,754		2,754
8–Boreal Softwood Shield		20,650		20,650
9–Great Basin	20,744	339		21,083
10–Northern Rockies	8,653	1,925		10,578
11–Prairie Potholes	265,244	63,032		328,276
12–Boreal Hardwood Transition	139,535	34,564		174,099
13–Lower Great Lakes/St. Lawrence Plain	83,185	51,175		134,360
14–Atlantic Northern Forest	36,469	18,378		54,847
15–Sierra Nevada	343			343

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Although we extended mortality estimates to all towers in Canada and the continental United States, few studies are available from the West (Figure 2). This may be a function of a higher number of nocturnal migrants in the East, different patterns of migration, different weather patterns, or it may simply reflect the fewer and shorter towers in the West as a whole. We investigated the effect of location on annual mortality by regressing the residuals of our height regression against longitude and also by testing the residuals for spatial autocorrelation. The resulting plot showed slightly higher mortality in the East, but the relationship was not significant and was largely driven by a single data point in Colorado. Residuals were not spatially autocorrelated using inverse Euclidean distance weighting (Figure 7; Moran's I=0.09, z=0.23, p=0.816). More comprehensive surveys of towers in the West are needed to see if the lower mortality at the site in Colorado represents an anomaly or a different pattern of mortality in the West. Pending such further analysis, extrapolation of mortality at towers in the western portions of the United States and Canada should be regarded as provisional.

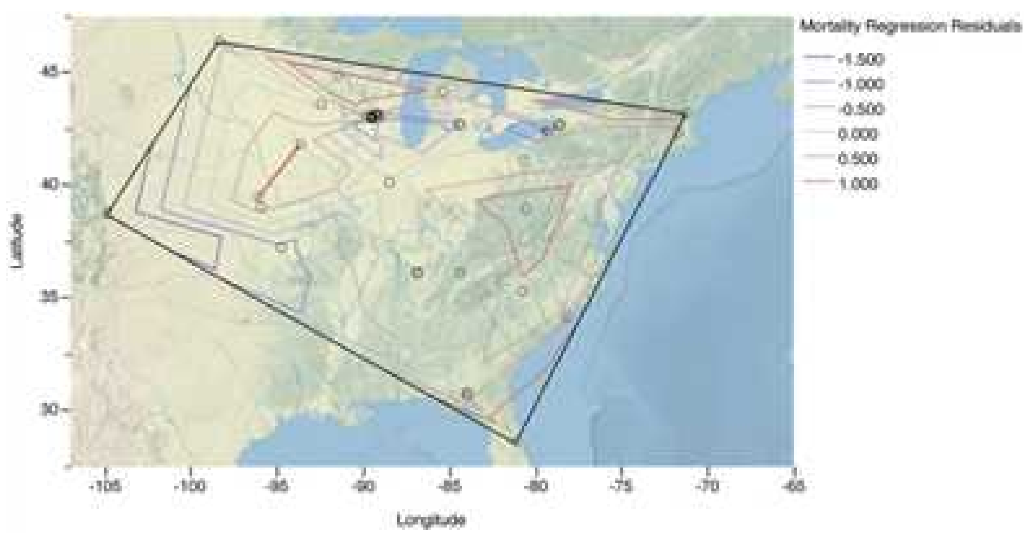

Figure 7

Distribution of residuals of tower height–mortality regression for 38 towers in the United States as adjusted for sampling effort, search efficiency, and scavenging.

Contour lines indicate regions above and below the regression line. Although exhibiting a geographically variable pattern, the residuals are not significantly spatially autocorrelated.

Discussion

Go to:

Our total mortality estimate of 6.8 million birds per year is ~50% greater than the current USFWS estimate of 4–5 million birds per year [14], [15], [23], [24]. Our results do not support the suggestion that mortality might be an order of magnitude higher [14], [15], which had been made before this type of synthetic analysis had been attempted. Our approach to estimating total avian mortality at towers uses far more data than previous efforts. For example, Banks's [13] estimate was based on mortality rates from only three tower studies and assumed that all towers caused the same rate of mortality, regardless of tower height. Our method incorporates evidence from 38 towers to establish the relationship between tower height and avian mortality. We accounted for the height distribution and physical characteristics of ~84,000 towers across the United States and Canada (including towers <60 m, which we mapped but did not include in our mortality estimates). Notwithstanding the sources of uncertainty in our estimate, the method improves previous efforts, is transparent, and can be revised in conjunction with additional field studies.

Although mortality at some towers has apparently declined over time [31], the influence of any such trend (if a true decline in mortality and not the result of increased scavenging) is offset by the large portion (>50%) of towers in the regression having survey end dates after 1990. If only these studies ending after 1990 are used in the regression, the total mortality estimate decreases to 4.8 million birds per year. The residuals of the tower height–mortality regression, however, are not significantly explained by the ending year of the survey (results not shown) so we did not exclude the older studies from our final regression. Even if the decline in number of birds killed at towers is a real phenomenon, the effect of these kills on sensitive species could still be substantial if populations have declined by a greater proportion.

Estimated tower mortality increases exponentially with tower height [26], which makes our results sensitive to the use of the height classes. For example, if we used the top of each height class rather than the middle to calculate total mortality, the estimate would increase by 25%. The use of the height classifications was necessary for ease of calculation and because attributes of the Canadian towers that were not known had to be assigned probabilistically. We used log transformations of both variables to normalize the distributions and because the total volume of airspace occupied by guy wires increases far more rapidly than does height. The increasing length of guy wires provides a mechanistic explanation for the exponentially increasing probability of avian collisions as tower height increases. Extremely tall towers also extend into the “normal” flight altitudes of many migrants so that mortality events can occur under clear skies and favorable migration conditions; this provides another plausible mechanism for the exponential increase in mortality rates observed by height. We also considered using separate regressions for towers less than and greater than 200 m, given the break in the data, but found that doing so had little effect on the overall estimate and we could not formulate a functional explanation why the tower height–mortality relationship should change in this manner.

Further research is needed on the mortality rates at the tallest towers (i.e., >500 m). These data are needed to confirm that the tower height–mortality relationship is exponential [26]. The nature of this relationship is important because it leads directly to a policy recommendation of focusing on the tallest towers first for mitigation. If more extensive tower datasets show a different relationship (e.g., logistic) then mitigation actions would be much different, requiring treatment of many more towers to address the same proportion of mortality.

Producing this estimate of avian mortality at towers required many assumptions, the implications of which we have explored to the degree possible with the data available. By undertaking this exercise, we have reaffirmed what elements should be included in tower studies going forward – explicit measurement of search efficiency, scavenging rates, and the effect of sampling schemes for any study, as well as investigation of geographic variation in mortality and inclusion of towers representative of the extremes of the height distribution. Such research will help refine our regionalized mortality estimates.

In 1989, the Exxon Valdez oil spill killed approximately 250,000 birds in what has become the benchmark for a major environmental disaster [65]. Our estimates show that communication towers are responsible for bird deaths equivalent to more than 27 Exxon Valdez disasters each year. Our estimate of the number of birds killed annually by communication towers is 2–4 times greater than the estimate for annual fatalities from lead poisoning before lead shot was phased out for hunting waterfowl [66].

Previous efforts (e.g., [25]) and our compiled database illustrate that most of the birds killed at communication towers are Neotropical migrants, which have suffered population declines and many of which are formally recognized as “Birds of Conservation Concern” [67], [68]. Data on per species mortality would provide even more clarity about the biological significance of avian mortality at communication towers. In a companion manuscript, we estimate species-specific losses based on total losses estimated here and species-specific casualty reports for Bird Conservation Regions following methods we developed previously [35]. But even without such estimates, the aggregate mortality numbers developed here should lead policymakers to pursue mitigation measures to reduce this source of chronic mortality.

Mitigation of avian mortality at communication towers could most practicably be achieved by implementing several measures: 1) concomitant with permission from aviation authorities, remove steady-burning red lights from towers, leaving only flashing (not slow pulsing) red, red strobe, or white strobe lights [24], [26], [28], [31]; 2) avoid floodlights and other light sources at the bases of towers, especially those left on all night [64]; 3) avoid guy wires where practicable [26], [28]; 4) minimize the number of new towers by encouraging collocation of equipment owned by competing companies; and 5) limit height of new towers when possible. Concentrating on removing steady-burning lights from the roughly 4,500 towers ≥150 m tall in the United States and Canada with such lights should be a top priority because, according to our model, it would reduce overall mortality by approximately 45% through remedial action at only 6% of lighted towers.

Acknowledgments Go to:

The authors acknowledge the outstanding contribution of Herbert L. Stoddard and Tall Timbers Research Station in executing the long-term study of avian mortality at the WCTV tower. We thank Charles Francis for his help in extracting weather records used in Figure 1 and Martin Raillard for his support. We thank several anonymous reviewers for constructive criticisms and Gerald Winegrad, Caroline Kennedy, and Eugene A. Young for productive discussions about this research and access to unpublished reports.

Footnotes Go to:

Competing Interests: The authors have declared that no competing interests exist.

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QUALIFICATIONS

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SUMMARY OF EXPERIENCE

Mr. Stayer received his BS in the Management of Information Systems from the University of Texas at Arlington with an emphasis in database managment. Mr. Stayer also received a MS in Wildlife Ecology from Texas State University with an emphasis on avian species, specifically a Master's Thesis on raptor species. He has spent 5 years working for the U.S. Fish and Wildlife Service (USFWS) responsible for conducting numerous wildlife and habitat assessments, understanding and implementing all sections of the Endangered Species Act (ESA), responsible for reviewing National Environmental Policy Act (NEPA) documents, writing and reviewing grant proposals, writing and reviewing biological reports, and publication of numerous documents related to the Endangered Species Act.

RELEVANT PROJECT EXPERIENCE

Mr. Stayer has worked with EBI Consulting as a Biologist II since January of 2014. Prior to working with EBI, Mr. Stayer worked as a wildlife biologist for the USFWS Carlsbad Field Office. Mr. Stayer worked closely with the U.S. Navy and National Park Service to establish a habitat monitoring program for the Federally threatened island night lizard. He has also worked with numerous water districts to assess project impacts, develop project alternatives, and propose mitigation for numerous Federally listed threatened and endangered species in complice with the ESA and NEPA. As a USFWS fish and wildlife biologist Jason has conducted numerous species and habitat assessments and developed ESA Section 4 documents for the Cocachella Valley Fringe-toed Lizard, Island Night Lizard, Coastal California Gnatcatcher, Santa Ana Sucker, and Southwestern Willow Flycatcher. Jason has also drafted Section 7 Consultation documents for 30 different state and federally listed species.

EDUCATION

Bachelor of Science, Management of Information Systems, December 2002
University of Texas at Arlington, Arlington, TX

Master of Science, Wildlife Ecology, August 2008
Texas State University, San Marcos, TX

PROFESSIONAL REGISTRATIONS

Seabird Assessment Oil Spill Response, March 2009
Carlsbad Fish and Wildlife Office, Carlsbad, CA

Listing and Candidate Assessment (Section 4 - ESA), March 2010
Lakewood Fish and Wildlife Office, Lakewood, CO

Habitat Conservation Plan Development (Section 10 - ESA), March 2011
Carlsbad Fish and Wildlife Office, Carlsbad, CA

Recovery Planning Implementation (Section 4 - ESA), April 2011
National Convention Training Center, Shepherdstown, WV

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Interagency Consultation (Section 7 - ESA), April 2012
Carlsbad Fish and Wildlife Office, Carlsbad, CA

Critical Writing and Critical Thinking, June 2012
National Convention Training Center, Shepherdstown, WV

24 hour HAZWOPER Certification, March 2013
Carlsbad Fish and Wildlife Office, Carlsbad, CA

PUBLICATIONS

USFWS Publication	5-year review on the Coachella Valley fringe-toed lizard (August 10, 2010)
Federal Register	Proposed revised critical habitat for the southwestern willow flycatcher – assist Arizona Fish and Wildlife Office (Carlsbad Field Office lead) (August 15, 2011)
Federal Register	90-day finding on the coastal California gnatcatcher (October 26, 2011)
USFWS Publication	5-year review on the island night lizard (October 10, 2012)
Federal Register	Final revised critical habitat for the southwestern willow flycatcher – assist Arizona Fish and Wildlife Office (Carlsbad Field Office lead) (January 03, 2013)
Federal Register	Island night lizard proposed delisting rule (February 04, 2013)
Federal Register	Draft post-delisting monitoring plan for the night lizard (February 04, 2013)
Federal Register	Island night lizard final delisting rule (April, 01 2014)
Federal Register	Final post-delisting monitoring plan for the night lizard (April, 01 2014)

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Summary of Experience

Patrick Tilley, Biologist II, has extensive experience as a biologist and environmental scientist in the environmental consulting and regulatory environmental science industry since 2015 specializing in the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), natural resource surveys and management, and project management. His experience and knowledge includes ecological processes throughout the United States, and working within the regulatory framework of the California Endangered Species Act (CESA), Endangered Species Act (ESA), California Department of Fish and Game Code, Migratory Bird Treaty Act (MBTA), and Bald and Golden Eagle Protection Act (BGEPA).

At EBI Consulting, Mr. Tilley serves as a Biologist II within the Midwest Telecom Environmental group. His primary responsibilities in this role include Biological and Natural Resource Assessments for FCC NEPA Compliance Reviews.

Relevant Project Experience

Mr. Tilley has conducted and completed various natural resource surveys, assessments, and United States Fish and Wildlife Service protocol species surveys throughout the southwest United States. Habitats have included but are not limited to: coastal sage scrub, chaparral, riparian forest, annual grassland, and oak woodland. Mr. Tilley has conducted numerous avian nesting surveys for a variety of bird species. Also, he has experience with wildlife species identification; notable species that Mr. Tilley has experience surveying and identifying are arroyo toad, burrowing owl, coastal cactus wren, California gnatcatcher, least Bell's vireo, Otay tarplant, Ridgway's rail, Stephens' kangaroo rat, and thread-leaved brodiaea.

Education

BS, Biology, California State University - Long Beach
Certificate, Project Management, University of San Diego

Professional Affiliations

San Diego Management and Monitoring Program
The Wildlife Society

Professional Registrations

Arroyo Toad: Presence/Absence Survey Techniques, The Wildlife Society
Cactus Wren Conservation, Restoration & Survey Techniques, California Department of Fish and Wildlife
Flat-tailed horned lizard: Handling permit and survey techniques, Southwestern Partners in Amphibian and Reptile Conservation