BATS IN TRANSPORTATION STRUCTURES

GUIDANCE ON BAT EXCLUSION PRACTICES

July 2023

Prepared in Cooperation with the Florida Fish and Wildlife Conservation Commission.

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SECTION 1: INTRODUCTION

OVERVIEW OF THE BAT EXCLUSION HANDBOOK

PHOTO. 1 - Tricolored Bat. *Photo by FWC.*

Twenty species of bats are found in Florida. Thirteen are resident including an endemic bat species found nowhere else in the world. Seven species are accidental either from the Caribbean or from northern states. Several species are common across the state, while others have a more limited range. Florida has one candidate species proposed for listing under the Endangered Species Act (ESA), the tricolored bat (*Perimyotis subflavus* **- PHOTO 1**), as well as two species that are listed under ESA, the gray bat (*Myotis grisescens* – **PHOTO 2**) and the Florida bonneted bat (*Eumops floridanus* **- PHOTO 3** and **6***)*. In addition to those species protected under the ESA, there are numerous laws and regulations protecting all bat species. Several of these regulations are clearly defined, while others apply to bats under regulations addressing non-game wildlife (see **Section 3 – Regulation Designations**).

Transportation-related interactions with bats occur mainly when bats use infrastructure for shelter, protection, and breeding. These structure types include bridges, culverts, pipes, buildings (e.g., rest areas) and tolling facilities. Not all bat species are known to utilize structures, preferring instead to roost within natural habitat such as caves, trees, rocky crevices, etc. Although transportation features are not typically seen as supporting ecological function, they are increasingly considered as providing bats with roost sites where natural sites have been either eliminated or where they are naturally in short supply. Bats roosting in transportation structures can be susceptible to disturbance, injury, and mortality due to maintenance or construction activities such as pressure washing, waterproofing, deck replacement, road widening, and demolition.

The standard approach to minimize negative impacts to bats roosting within transportation structures when construction or maintenance activities need to be conducted is “exclusion". This process can take many different forms depending on the structure involved but includes installing materials that provide passive openings for bats to leave a roost unharmed, and then denies re-entry for an established period of time. This reduces the potential for interaction with the construction or maintenance activities that may harm bats. To conduct an exclusion, primary exit points are identified and marked on the engineering plans and on the structure itself with temporary markings (e.g., chalk). All other avenues for bat access are carefully sealed. This sealing activity is done cautiously to avoid trapping any bats. One-way devices (e.g., cone, tube or pipe) are placed over the primary exit points to prevent re-entry. Other bat removal methods such as ‘capture and relocation’ are prohibited by law.

WHAT IS A BAT EXCLUSION?

Bat Exclusion is a conservation-management activity that allows for bats to exit an existing structure unharmed, and denies re-entry for a pre-established period of time, while construction or maintenance work occurs.

Bat Exclusion (Figure 1) is a multi-step process in coordination with bat professionals which (1) seeks to identify the potential of bat roosting areas in transportation structures; (2) conducts inspections; (3) develops a *Bat Exclusion Management Plan*; (4) avoids maternity season and extreme temperatures; (5) implements exclusion in advance of proposed construction or maintenance impacts; and (6) re-establishes access (when feasible).

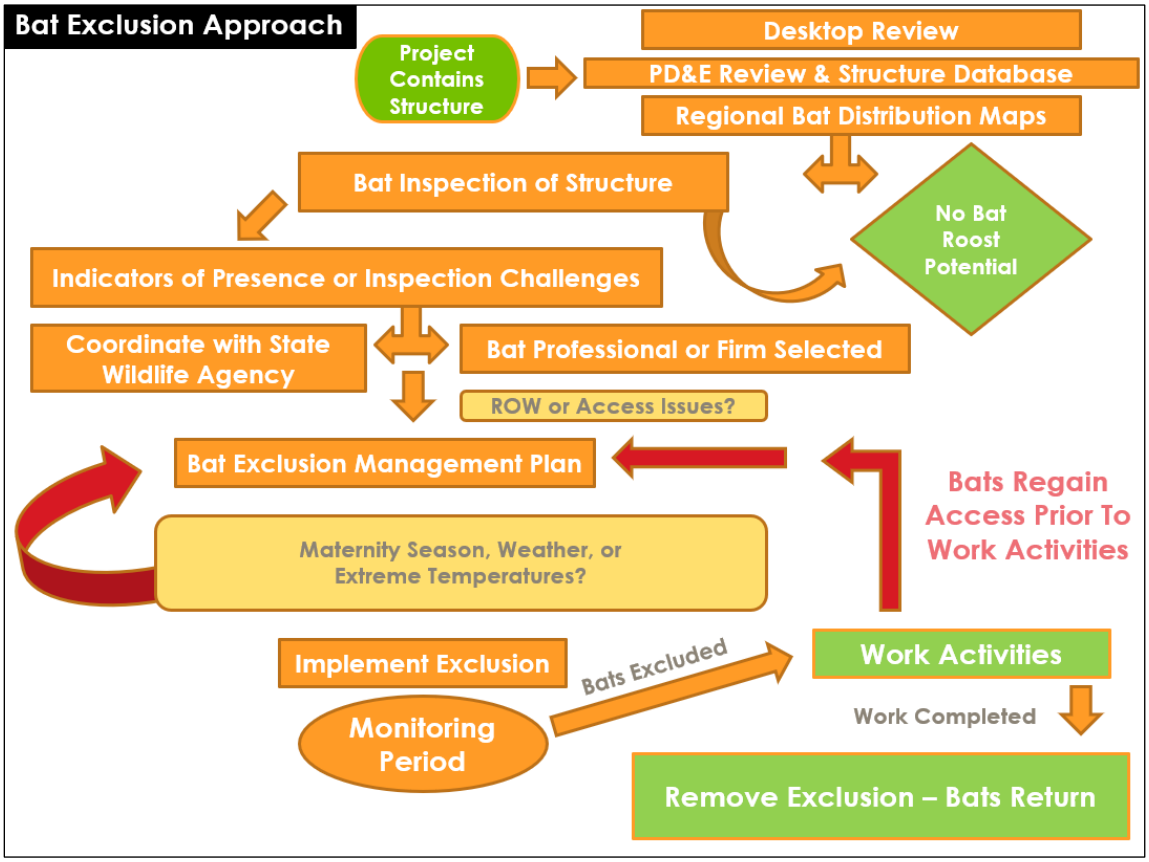


FIGURE 1 – Bat Exclusion Flowchart

If bats, other than those listed under the ESA, are present and may be affected by the proposed work activities, exclusion is an effective means to minimize impacts and meet regulatory requirements while providing a humane method to safely remove bats. The Florida Department of Transportation (FDOT), and its agents, are responsible for safely and effectively maintaining the function of its structures and roadway features, while understanding and following regulatory protection measures for bats. Bat exclusion measures can affect a project delivery schedule when not taken into consideration early and when exclusion methods are not fully planned and executed. However, in contrast to other protected species, bats possess a mobility and adaptability that allows

for flexibility when proposing structures maintenance and replacement activities if conducted in an informed manner.

PURPOSE AND INTENDED AUDIENCE

The Bat Exclusion Handbook is a "what to do" guide that addresses bat roost identification within structures and how to plan for their safe exclusion according to regulatory requirements.

The intended audience for this Handbook includes FDOT (Office of Environmental Management [OEM] staff, District Environmental Management Office [EMO] staff, Environmental Permit staff, structural engineers, project managers, construction managers, utility coordinators, and maintenance managers), consultants, and contractors. Interactions between transportation projects and environmental laws are outlined to explain the regulatory processes.

The Handbook is not meant to address federally protected species listed under the ESA, such as the Florida bonneted bat, gray bat, or the tricolored bat. If these protected species are encountered, coordination with the District EMO or OEM will be necessary. If non-environmental staff or agents are unsure of how to proceed, contact the District EMO or Environmental Permit Office for further guidance. Regulatory requirements are more rigorous under the ESA and consultation may need to occur with the U.S. Fish and Wildlife Service (USFWS). See species GIS Distribution Maps located in **Appendix A** to review the range of the Florida bonneted, gray, and tricolored bats. In addition, this document does not provide guidance regarding bat foraging habitat as this is primarily a concern for federally listed species under the ESA. To learn more, see the USFWS Species Profiles (fws.gov) for the gray bat and Florida bonneted bat. The tricolored bat is currently a candidate species that has been petitioned to be listed as endangered pending final approval by the end of 2023. Until that time, it receives no statutory protection under the ESA. However, cooperative conservation efforts are encouraged by the USFWS based on its recommendation that it receive future protection under the ESA. This Handbook focuses on those projects where bats are known to use, or have the potential to use, FDOT structures but does not address those species that are known to only utilize natural roosts.

PHOTO 2 - Endangered Gray Bat. *Photo by USFWS, Ann Froschauer* (Left).
PHOTO 3 - Endangered Florida Bonneted Bat. *Photo by Dustin Smith* (Right).

SECTION 2: DESCRIPTION

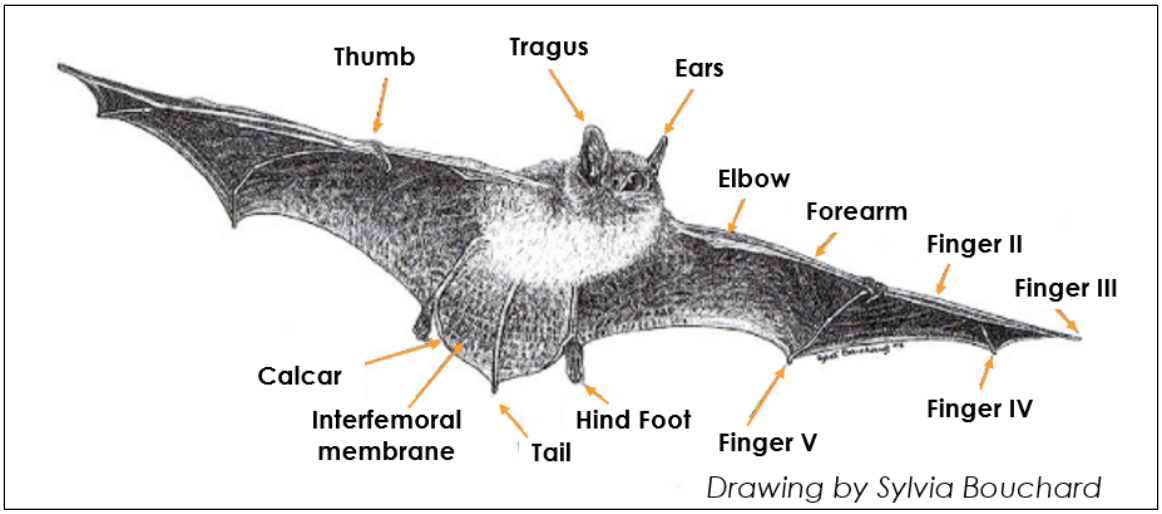
Bats as a group are one of the most diverse animals on the earth comprising one quarter of mammals. As the only mammal capable of true and sustained flight, they have spread widely across the globe - filling a variety of ecological niches. In addition, bats possess several unique qualities including being among the longest-lived mammals (10 - 30 + years) for their size; slowest-reproducing mammals for their size (typically only one young per year); and having developed one of the most sophisticated biological sonar systems, called echolocation, to navigate and hunt for food. This combination of a long-life span, low-fecundity, and feeding and roosting specializations means that bats are especially vulnerable to population loss. Impacts to bats, particularly during the maternity season, can have lasting impacts to regional populations (*Bats in American Bridges, Cite XIII*).

DESCRIPTION

APPEARANCE

Bats range in color from black, brown, reddish tan, and gray. In general, they have short snouts, large ears, and fur covered bodies. Facial appearance for bats is dominated by the muzzle and ears, which varies between bat families and between genera. Wings are supported by the same bones that make up the human hand. The claw on the leading edge of the wing, their first digit, is equivalent to the human thumb. All bats present a similar appearance in flight, dominated by the expanse of the wings, but will vary in size. Florida bats range in size from the smallest (tricolored bat) weighing 4 to 8 grams (0.009-0.018 pound) with an approximately 9-inch wingspan to the largest (Florida bonneted bat) weighing between 34 and 47 grams (0.075-0.104 pound) with a wingspan of 20-inches. Physiology of the tail and membrane between the legs (uropatagium) also differs between species, based on specialization to feeding, flight, and roosting habits. Bats vary in their postures when roosting, particularly whether they hang suspended or cling to a wall - and in the manner in which the wings are folded and used. Additional differences between groups include the length of tail that extends past the tail membrane; variations in ears; and the length of tragus (a piece of skin in front of the ear canal used in directing sounds into the ear). See **FIGURE 2**.

FIGURE 2 - Bat Anatomical Features



BEHAVIOR

Understanding aspects of bat behavior is necessary to identify where to look on a structure, what species may be present, when it is suitable to perform exclusion efforts, and if necessary to determine what level of effort is required to exclude them.

A bat roost is any place that bats use for shelter, protection, and breeding. A roost could contain a single bat, or thousands of bats. Bat species differ on roost needs and this may vary seasonally. Some bats prefer roosting in caves, tree cavities, among leaves and under bark; however, some species have adapted to roosting in manufactured structures such as bridges, culverts, buildings, wooden telephone/power poles, pipes, and bat houses (see **TABLE 1**). Bats may also use transportation structures when natural roost locations are in short supply or regional habitat modifications have occurred. Characteristics of structures selected (i.e., size of expansion joints, materials, and design) vary and are later outlined. Other considerations include the structures position in the landscape, surrounding land use, availability of water, and level of protection from weather and disturbance.

Roosting behavior differs between species. Some prefer to live in groups (termed "colonial" bats), with numbers that range from several bats to large colonies of thousands. Other species prefer to roost alone or in small harems consisting of one male and one or more females. Colonial bats seek secure roosts sites that make it difficult for predators to reach them - either by being high off the ground or within protective crevices such as those that can be found on bridges and other structures. Solitary bats rely on camouflage and are often found on trees and in Spanish moss. Size of bat roosts (in combination with other characteristics) can be an indication of the species type. See **TABLE 1** for bat species roosting size.

Bat vocalizations differ between species through variations in frequency, pitch, and duration. Echolocation calls used for locating prey and navigating are typically too high in frequency to be heard by humans but can be detected with an acoustic detector, a tool commonly used to identify bat species (see **PHOTO 4**). These calls can be processed utilizing software systems designed to eliminate noise and identify bat calls. Social calls that occur when the bats are roosting can be heard by humans and used to determine roost presence; however, these types of calls cannot be used to identify species type. These socializing communications (e.g., finding mates and interactions between mother and infant) can be heard as squeaking or chirping and may help in identify where bats are roosting within a structure.

All of Florida's 13 resident bat species are insectivorous. Some bring insect prey back to their roost, leaving pieces of insects, usually wings and legs, scattered about (see **PHOTO 11**). Guano may sparkle in the light due to the insect pieces that are present. These physical observations can be used to identify roost presence. More often, guano and staining are the best indicators that bats are roosting in a structure.

PHOTO 4 – Example of an acoustic detector that can be used to monitor activity levels and identify species at a project site. *Photo by Titley Scientific.*

DISTRIBUTION

Another useful tool is the geographic distribution of the different bat species as defined by the resource agencies. GIS Distribution Layers/Maps have been developed which identify those species known to use FDOT structures (see **Appendix A**). Although bats do not recognize boundary lines, a graphical depiction is still useful to determine if a species is likely to occur in a given area.

Bats are not evenly distributed across the landscape, instead bat distribution will vary with some areas having greater concentrations than others. A bat species found on a particular structure is a result of the geographical location and habitat features available. Often, the lack of bat species records for a region is more a product of observational data gaps rather than species absence.

In Florida, Brazilian free-tailed bats (*Tadarida brasiliensis*), also called Mexican free-tailed, are the most common, both in number of bridges occupied and estimated number of individuals. Other common species observed in FDOT bridges include the southeastern myotis (*Myotis austroriparius*), big brown bats (*Eptesicus fuscus*), and evening bats (*Nyteceius humeralis*). In addition, Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) have been identified roosting in bridges. Myotis bat species, tricolored, Rafinesque's big-eared bat, and big brown bats can be found in culverts. Observations and coordination with Florida Fish and Wildlife Conservation Commission (FWC) have noted that occupied structures can support roosts of more than one species at the same time.

SEASONAL OCCURRENCE

Bats move between roosts to support their life cycle requirements. A few bats species have been found hibernating in north Florida caves, but most bats in southern latitudes are active year-round. Bats have the largest surface area to body mass of any mammal, which requires greater energy to maintain body temperatures. When temperatures dip below 50°F or even on cool rainy nights, bats may enter a state of torpor (reduced metabolic activity) to conserve energy until temperatures warm enough for insects to become available. During these times bats will seek warmer roost locations such as bridges and culverts/pipes that can sustain higher temperatures. Observers should avoid disturbing a bat roost during cold weather periods. Although bats can rouse themselves from torpor,

it takes time and energy to return their heart rate and breathing to normal levels to sustain flight. Disturbances can weaken bats and reduce fat stores making them susceptible to the elements, disease and predators.

LIFE CYCLE

PHOTO 5 - Brazilian free-tailed bat pup still dependent on its mother. *Photo by FWC.*

Bats mate in the fall and winter with a single "pup" born each spring (see **FIGURE 3**). In southern Florida, where it remains warm longer, females of some species such as the Florida bonneted bat may mate and have flightless juveniles potentially present in roost sites year-round. "Maternity colonies" gather in bridges, culverts, and buildings when they are ready to have pups. Most give birth from mid-April through July. Depending on the species, young (**PHOTO 5**) begin to fly within 3 to 6 weeks. The young are usually weaned from their mothers by mid-July, when the juveniles can fly and search for food on their own. Any roost disturbance during the maternity season may prove fatal to pups that have yet to develop the ability to fly. To avoid disturbance to maternity roosts, state law mandates bat exclusion measures can only be conducted outside of the maternity season which lasts from April 16th - August 14th (see **Section on Regulatory Designations**). The installation of an exclusion device, which allows bats to leave but not re-enter, prevents mothers from returning to care for her pup. Care should be taken in the weeks leading up to and just following the maternity season. If there are signs of maternity activities (e.g., large numbers of bats and young) earlier or later into the season contact the District EMO/Permit Office or seek guidance from FWC).

THREATS

More than half of bat species in the U.S. are in decline, with two species in Florida considered to be endangered and a third currently proposed for listing. Bat populations decline primarily due to the loss of natural habitat, disease, and direct disturbance to roosts. Habitat loss occurs when forests, wetlands, and roost habitats are converted for human development. Direct disturbance and vandalism occur in both natural and manufactured roosts, such as bridges and abandoned buildings. Bat roosts are destroyed out of fear and misunderstanding regarding the spread of disease and other cultural misconceptions. Rapid, unpredictable, and unusual changes in seasonal weather patterns can also cause populations to decrease. Over-application of insecticides can negatively impact bats by killing non-pest insects that would otherwise serve as bat food.

Another survival concern is white-nose syndrome (WNS), a fatal fungal disease spreading across the country causing steep declines in cave-dwelling bats. WNS has not been detected in Florida's caves, nor has the fungus (*Pseudogymnoascus destructans*) associated with the disease; however, experts believe the fungus could eventually reach Florida. WNS has been detected in manufactured structures outside of Florida, including bridges, culverts, and tunnels. A WNS Response Team, an organization of federal and state agencies, universities, and non-government organizations, is monitoring for the fungus.

FIGURE 3. Florida Bat Life Cycle, General Representation of Seasonal Bat Activity

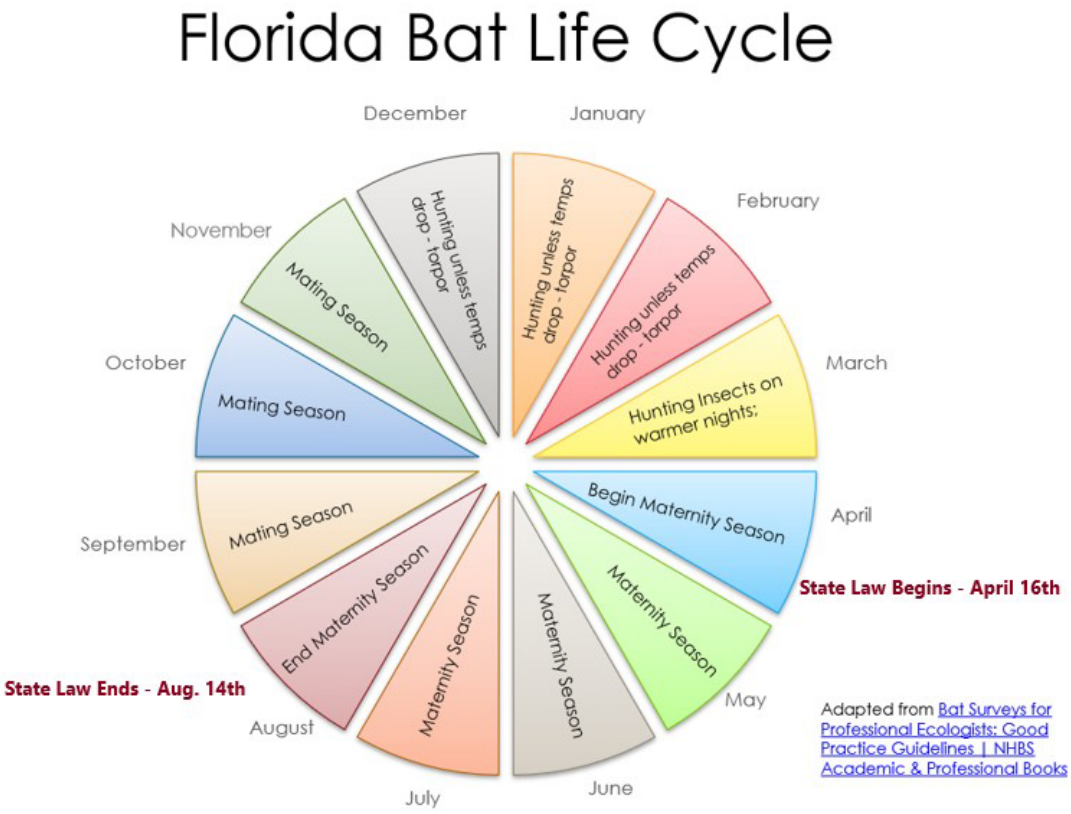


TABLE 1 – Florida Bat Species Roosting in Transportation Structures

SPECIES	COMMON NAME	FAMILY	RANGE	PROTECTION STATUS*	BRIDGE & CULVERT USE	ROOST TYPE	COLONY SIZE	REPRODUCTION
Eumops floridanus	Florida Bonneted Bat / Florida Mastiff Bat	Molossidae	Rare - Central and Southern Florida	Fed. & State **Endangered**; State - SGCN**	X	Tree cavities, palms, buildings, bridges & bat houses	Colonial - Small groups ranging from a few individuals to dozens. Males will roost alone	June – Oct.; pups have been found in roosts through Dec.
Molossus molossus	Velvety Free-tailed Bat / Pallas' Mastiff Bat	Molossidae	Uncommon –Key West to Key Largo	Not Listed	X	Buildings, tree hollows, and bat houses	Colonial	June – Sept.
Tadarida brasiliensis	Brazilian / Mexican Free-Tailed Bat	Molossidae	Common (most abundant FL bat) throughout FL, except the Keys	State	X	Manufactured structures, buildings & bridges	Colonial - large colonies ranging from a few hundred to several thousand	Early June
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	Vespertilionidae	Statewide except Keys and the Southeast	State - SGCN**	X	Trees with large cavities; caves; abandoned / seldom used buildings in wooded areas; bridges & bat houses	Colonial - pairs or small groups (fewer than 100)	May or early June
Eptesicus fuscus	Big Brown Bat	Vespertilionidae	Uncommon in north & central Florida; Rare - south FL	State	X	Dead tree cavities & royal palm leaf stem; buildings, bridges & bat houses	Colonial - several to seventy	May or June
Myotis austroriparius	Southern Myotis / Southeastern Bat	Vespertilionidae	North, panhandle, central, and northeastern FL. Not found in southern FL	State - SGCN**	X	Cave dwelling, but also roosts in hollow trees, buildings, bridges, culverts & bat houses	Colonial - small numbers to several thousand	May
Myotis grisescens	Gray (myotis) bat	Vespertilionidae	Only a few caves in the panhandle	Fed & State - **Endangered**; State - SGCN**	X	Cave dwelling, bridges and culverts	Colonial - small numbers	Late May or early June
Nycticeius humeralis	Evening bat	Vespertilionidae	Common throughout FL, except the Keys	Not Listed	X	Behind loose bark, crevices, & cavities of dead trees; Spanish moss; buildings, bridges, brackets on utility poles, & bat houses	Colonial - a few to around eighty	Late April or May
Perimyotis subflavus	Tricolored bat/ Eastern Pipistrelle	Vespertilionidae	Uncommon - found throughout FL, except the Keys	USFWS recommending Fed listing. State - SGCN**	X	Culvert, bridges, Caves, tree foliage, tree cavities, rock crevices, Spanish moss, & occasionally buildings	Colonial & Solitary – singly or in small groups	May or June

* **Protection Status** – Federal and State Protection Levels

** **SGCN** – The Florida Fish and Wildlife Conservation Commission (FWC) and partners develop Florida's list of Species of Greatest Conservation Need (SGCN) as part of a State Wildlife Action Plan.

SECTION 3: REGULATORY DESIGNATIONS

BAT REGULATIONS

Bats are protected by numerous laws and regulations. Several of these regulations are clearly defined, while others apply to bats under regulations addressing non-game wildlife. Projects that may impact bats require coordination and consultation with regulatory agencies based on the specific regulations described below.

STATE

All bat species are protected under Florida's wildlife laws. Below are excerpts from various laws at the time of this publication. Users should always confirm current version of the laws during project development.

According to the Florida Administrative Code (FAC) Section 68A-4.001 General Prohibitions:

> "*no wildlife or freshwater fish or their nests, eggs, young, homes or dens shall be taken, transported, stored, served, bought, sold, or possessed in any manner or quantity at any time except as specifically permitted by these rules nor shall anyone take, poison, store, buy, sell, possess or wantonly or willfully waste the same except as specifically permitted by these rules."*

Section 68A-29.002, *Regulations Relating to the Taking of Mammals,* specifically protects bats species from harm. These regulations prevent the poisoning and extermination of bats, as well as the disturbance of bat colonies; however, it does allow for exclusion provided that the exclusion is conducted in a manner consistent with the Nuisance Wildlife Rule Section 68A-9.010, which provides the following guidance:

(1) Wildlife that may not be taken as nuisance wildlife:
(b) The following mammals:
3. Bats – Except those bats may be taken either when:

a. The take is incidental to the use of an exclusion device, a device which allows escape from and blocks re-entry into a roost site located within a structure, or incidental to the use of a registered chemical repellant, at any time from August 15 to April 15, or

b. The take is incidental to permanent repairs which prohibit the egress of bats from a roost site located within a structure provided an exclusion device as described in sub-subparagraph a., above, is used for a minimum of four consecutive days/nights for which the low temperature is forecasted by the U.S. National Weather Service to remain above 50° F prior to repairs and during the time-period specified.

(2) Methods that may not be used to take nuisance wildlife:
e. Bat exclusion devices or any other intentional use of a device or material at a roost site which may prevent or inhibit the free ingress and/or egress of bats from April 16 through August 14.

In addition, FWC manages a listing of imperiled Florida Species. Section 68A-27 FAC, **Rules Relating to Endangered or Threatened Species**, states its purpose is to:

> "*conserve or improve the status of endangered and threatened species in Florida to effectively reduce the risk of extinction through the use of a science-informed process that*

> *is objective and quantifiable, that accurately identifies endangered and threatened species that are in need of special actions to prevent further imperilment, that identifies a framework for developing management strategies and interventions to reduce threats causing imperilment, and that will prevent species from being threatened to such an extent that they become regulated and managed under the federal Endangered Species Act of 1973, as amended, 16 U.S.C. §1531 et seq*".

The FAC defines the protections afforded each classification and process for adding and removing species from the list. The code specifies "take" as to kill, attempt to kill, wound, pursue, molest, harm, harass, capture, posses, or sell a species listed as endangered or threatened.

The FWC and its partners have also developed *Florida's List of Species of Greatest Conservation Need* (SGCN) as part of its State Wildlife Action Plan. The list directs limited resources to species with the greatest need, so FWC can better measure, monitor, and communicate the impact of conservation efforts. The following species are listed (see **TABLE 1**) – Florida bonneted bat, Brazilian free-tailed bat, Rafinesque's big-eared bat, southern myotis, gray bat, and the tricolored bat.

FEDERAL

The ESA provides the federal protection of listed bat species. The USFWS is the responsible agency. Under the ESA, there are two federally protected bat species found in Florida, and another species that is proposed for listing which requires consideration during consultation. Identification of a federally listed species within a project area requires coordination/consultation with the USFWS.

PHOTO 6 - Endangered Florida Bonneted Bat. *Photo by FWC.*

- Tricolored Bat, *Perimyotis subflavus,* (proposed for listing by USFWS as endangered) – Florida's smallest bat and is considered to be uncommon. Can occur throughout Florida, with the exception of the Keys. See **PHOTO 1**.
- Gray Bat, *Myotis grisescens,* (endangered) – Found in the Panhandle. See **PHOTO 2**.
- Florida Bonneted Bat, *Eumops floridanus*, (endangered) – Florida endemic (found nowhere else); occurs in central and southern Florida. See **PHOTO 3 & 6**.

See **Section 6 – When To Conduct Federal And State Agency Coordination** for guidance on coordination activities. If bats are identified on a structure, contact the District EMO or Environmental Permit Office.

SECTION 4: ROOST IDENTIFICATION & INSPECTION

BAT ROOST IDENTIFICATION

Recognizing where bats are roosting in a structure is the important first step towards reducing bat conflicts with transportation structures (see **Figure 4**). Roosting is the most common need in a bat's life history that has a direct relationship with transportation structures. Roosts provide essential functions, such as energy conservation; suitable conditions for social interactions and mating opportunities; shelter from weather;

protection against temperature extremes; and safety from predators and disturbance. Some species, such as the Brazilian Free-tailed bat roost in large colonies; however, in Florida the majority of colonial roosts have less than 1,000 individuals present. The why, how, and when bats use roadway features differ between structure type, location, and bat species.

FIGURE 4 – Common Bridge Terminology

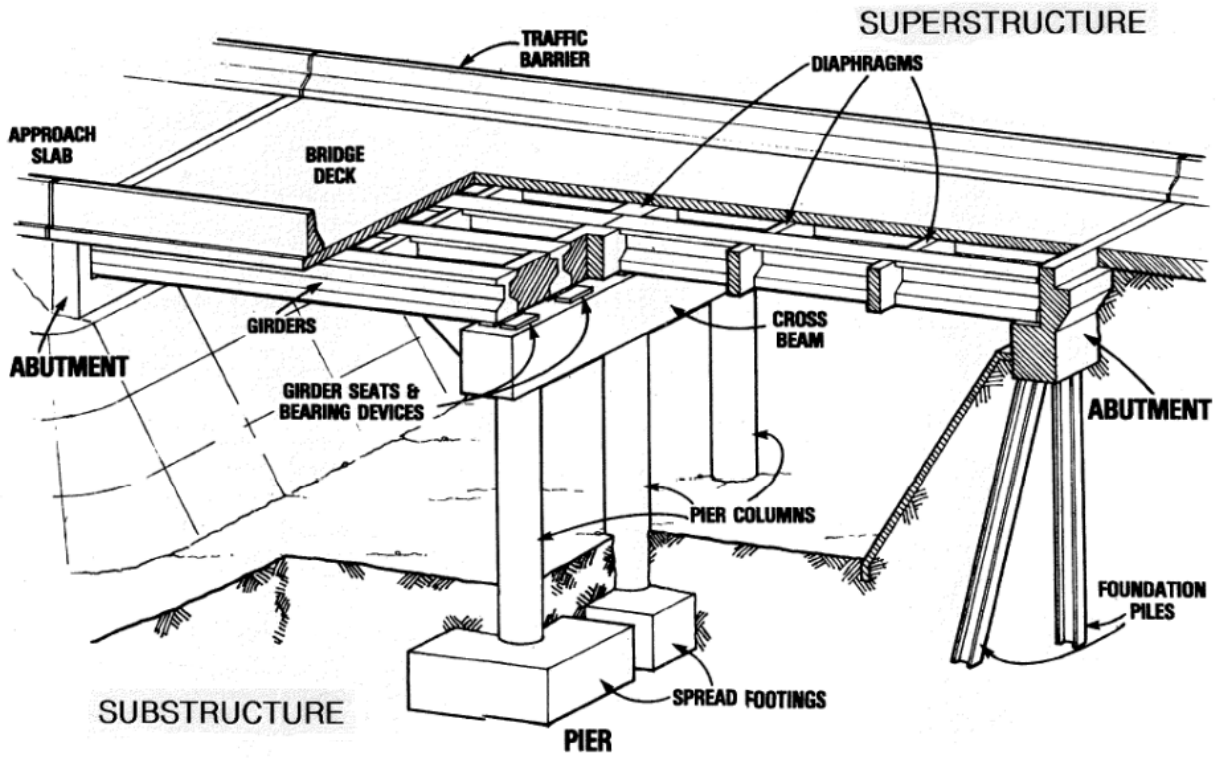


Figure Credit – Modified Skagit County Department of Works, 2017 Annual Bridge Report, Washington

BRIDGE, CULVERT, AND PIPE STRUCTURES

Transportation-related interactions with bats occur when bats use infrastructure for shelter, protection, and breeding. These structure types include bridges, culverts, pipes, buildings and tolling facilities. Brief descriptions of common transportation structure types are provided below to aid in communications with FDOT project managers, environmental staff, engineers, and contractors. Further information can be found within the FDOT's *Structures Design Guidelines*, *Turnpike Design Handbook*, and *Design Manual*.

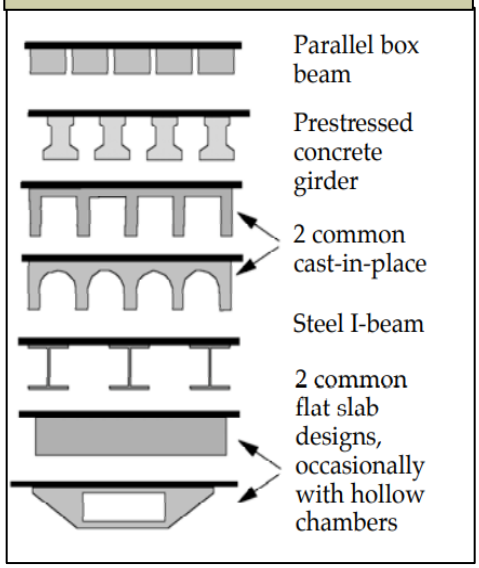
BRIDGES

A bridge is an elevated roadway, or railway, for carrying traffic or other moving loads. Bridges have a length, measured along the center of the roadway, of more than 20-feet between the inside faces of end supports. The vertical clearance of bridges over water is the minimum distance between the underside of the superstructure and the normal high water (NHW) for navigable water crossings or the mean high water (MHW) for coastal crossings. (FDOT *Structures Design Guidelines*, PG. 1-1). FDOT classifications of bridges are based on the following vertical clearances:

A. Low Level - less than 20-ft.
B. High Level - 45-ft. or greater
C. Medium Level - 20-ft. or greater but less than 45 ft.

Observations and research on bridges indicate bats are more likely to use bridge structures for roosting habitat when they are made of concrete and provide vertical crevices. See **FIGURE 5** – Cross-sections of Common Bridge Designs. The likelihood increases when these structures are located near/on river corridors, waterways, and/or in proximity to woodlands. These characteristics, combined with the bat distribution data, can indicate the probability of identifying a bat roost on a project. Vertical concrete surfaces located between beams provide ideal protection from wind and are especially used when they are heated by full sun exposure (see **FIGURE 6 & 7)**. Bats typically do not use bridges with flat bottom surfaces that lack inter-beam spaces.

FIGURE 5 – Cross-sections of Bridge Designs, *Bats in American Bridges, Cite XIII*



Characteristics that may increase the likelihood of bat roosts in bridges include:

- bridge structures made of concrete and concrete beams, and continuous steel girders that facilitate gaps, joints, drainage holes (e.g., weep holes, scuppers, downspouts), crevices, and hollows
- vertical crevices
- increased superstructure (see **FIGURE 4** for structure terms) height above ground (> 3 feet)
- increased superstructure depth for wind and predator protection, insultation from weather and temperatures, and increased area for crevices, gaps, and hallows (see **FIGURE 6 & 7**)
- structure located in proximity to wetlands or woodlands which provide feeding and drinking opportunities
- structure sealed at the top to provide protection from the weather
- structural components having full sun exposure

When determining bat presence on bridges it is important to check the entire structure – especially smaller crevices at least 0.5 inch, but it should also be noted that small bat species can navigate openings as small as 0.25 inch. Bats can be difficult or impossible to detect directly and therefore it is important to look for other signs of presence (see section on **Indicators of Bat Presence**). On concrete slab bridges, bats hang between the longitudinal slab joints; along the underside of the bridge between the individual slab unit joints hanging from or behind compressible construction material such as backer rod (see **PHOTO 15)**, Styrofoam, or rubber seals. On concrete bridges bats typically roost between the beam ends, diaphragms, and within the expansion joint hanging from or behind compressible construction material. On simple span bridges bats tend to hang within the expansion joint underside over the immediate pile bents; between the expansion joint headers/beam ends, and diaphragms; also seen are bats in tight spaces on top of steel beam bracing and between bracing and steel deck underside stay in place forms. On steel structures bats can be found at gaps between the concrete deck underside and steel stay in place forms, as well as on top of the steel lateral bracing and diaphragms between beams.

FIGURE 6 – Bridge Structure (Below Bridge Deck) Roost Characteristics

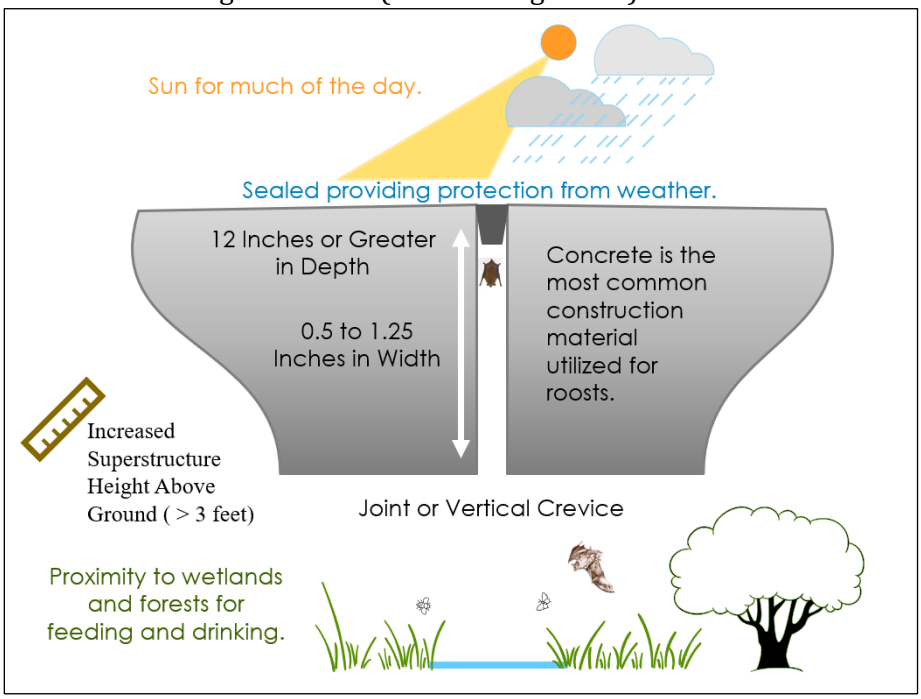


Figure Reference – Adapted from *Bats in American Bridges*, Cite XIII

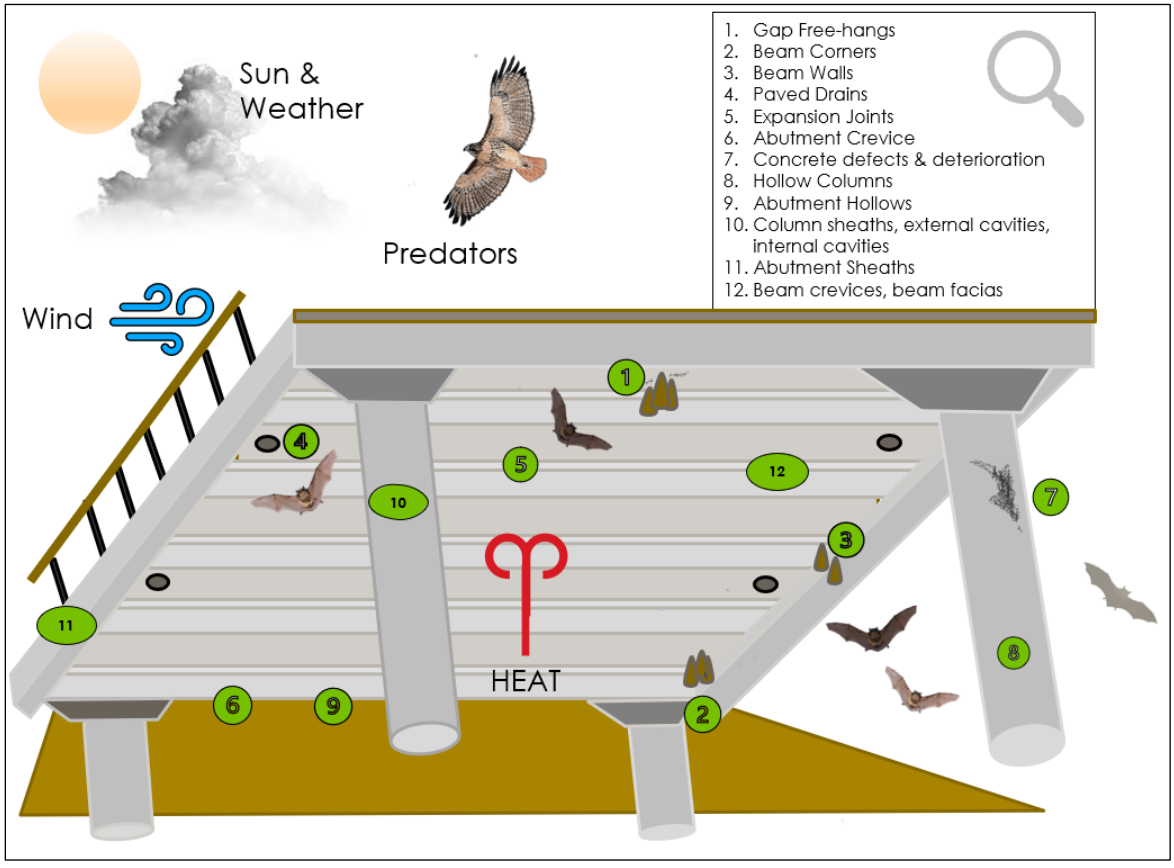


FIGURE 7 - Bridge Characteristics that Support Bat Roosts

CULVERTS

Culverts, are any structure not classified as a bridge that provides an opening under the roadway (PG. 4, *FDOT Standard Specifications for Roads and Bridge Construction,* Jan. 2020). Culverts can be single-span or multiple-span, with an interior width less than 20-feet when measured horizontally along the centerline of the roadway from face-to-face (inside) of the extreme abutments or sidewalls. There are a variety of types including: box, pipe, arch, and custom made culverts.

In culverts bats hang from or behind segment joints, weep holes, segment seal materials, and other connection points. Bats have been found in culverts as small as 3-feet in diameter, as well as short (2-lane roads) and larger concrete boxes (divided highways). In addition, bats have been identified in concrete pipe culvert and corrugated metal pipe culverts (coordination with FWC). Characteristics that increase the likelihood of culvert use include increased structure depth protection from wind and predators, insultation from weather and temperatures, increased area for crevices, gaps, overlapping features, and hollows. In addition, proximity to wetlands or woodlands which provide feeding and drinking.

PIPES

Pipes can also provide roosting habitat. These can include, but not limited, to bridge drainage pipes such as scuppers, weep holes, down spouts, etc.; abandoned utility piping attached to structures, and building pipes and vents (see **PHOTO 13**). Generally, bats can squeeze into openings as small as your thumb.

BUILDINGS AND TOLL FACILITIES

Types of structures included in this category include buildings located in rest areas and service plazas, toll facilities, weigh stations, welcome centers, office buildings and maintenance facilities. FDOT's toll facilities have moved to electronic gantries; however, some of these toll buildings remain. Bats in building facilities are typically in structural voids, the spaces between the exterior and interior envelopes of a building. Bats enter voids through openings on the exterior of buildings. Potential access areas for bats include structural penetrations as small as your thumb, which can include expansion joints, holes, cracks or crevices on the exterior of a structure.

PREPARING FOR PROJECT INSPECTION

Field inspections typically occur during a transportation project's environmental planning phase, design phase, or just prior to maintenance activities depending on the work proposed (see **Section 7 -** Project Phase Activities). Before conducting an inspection, first evaluate the type of structure involved. If working on a bridge, first identify the Structure Number. Structure numbers can be found facing the travel lanes of the bridge traffic barriers (see **FIGURE 8 –** Example of Structure ID Number). Some culverts have structure numbers which are located on the top of the headwall and also on the right side; however, not all culverts have numbers. Structure number can be searched through the Federal Highway Administration's National Bridge Inventory website which provides information such as structure materials, dimensions, year built, owner, and general status. In addition, FDOT's Structures Design Office can provide the latest bridge engineering inspection report and inventory pictures, which may identify areas of interest such as crevices, large cracks, voids, girders, hinges, expansion joints, and abutments. Note that District bridge inspectors may sometimes include notes on bats in their bridge engineering inspection reports. For questions on specific drainage structures, contact the District Drainage Office.

FIGURE 8 –Bridge ID Number Example; # 945260, District Four, Port St. Lucie Blvd., St. Lucie County

With the structure details, plans, drainage reports and any relevant bridge engineering inspection reports in-hand, consider the following:

- Are there features of the structure that provide suitable habitat for roosts such as gaps, joints, crevices, hollows, and voids?
- Are there special equipment needs, or Personal Protective Equipment (PPE) required to conduct the inspection?
- How many people would be required to conduct the inspection safely?
- Are there any access issues that require additional considerations (e.g., over, under, or on a railway, waterway, channel, highway, or forested area)?
- Will the inspection occur within the right-of-way (ROW) of another entity besides FDOT? Will permissions be required (see **Other Agency Considerations Section**)?

In addition to these considerations, it is helpful to review the bat species regional distribution maps (**Appendix A**) and species roosting preferences (**TABLE 1**). Questions to consider include:

- Which bat species have the potential to occur within the project area?
- Is there potential for a federally listed (or candidate) species to be located within the project area?
- For the species identified as potentially occurring within the project area, what roosting habitat do they prefer? Does the transportation structure support this type of roosting?

NOTE - The greatest risk with bats is that they are simply overlooked. The unanticipated discovery of a bat roost during construction causes immediate work stoppage and the need to develop a *Bat Exclusion Management Plan*. This can delay project delivery and cause contractor claims. If bats are identified during construction, review *FDOT's Contractor Requirements For Unanticipated Interaction With Protected Species*, Specification 7-1.4. Coordination with your District EMO or Environmental Permit Office prior to inspection.

WHAT TO BRING

When conducting a field assessment, it is necessary to have the right tools.

- flashlight or headlamp, red light preferred to minimize disturbance
- handheld mirror or extendable rod for looking into cracks
- binoculars
- digital camera or phone camera
- writing utensil and paper for sketching out the areas where bat indicators have been identified
- personal protective equipment
- first aid kit
- a ladder may be necessary depending on the structure
- kayak/canoe if structure is over water

Individuals conducting inspections for bats may use FDOT's *Bat Roost Inspection Form* (**Appendix B**) as guidance and for project records.

BAT ROOST INSPECTION FORM

The *FDOT Bat Roost Inspection Form* (**Appendix B**) is a best practice for documenting inspections. It provides a breakdown of the items to consider when conducting an inspection of structures for bats. The FDOT office completing this form can vary in accordance with the normal function of each District and based on activity for which the inspection is being conducted. For large or complex projects, this form can be incorporated into a project specific *Bat Exclusion Management Plan*. Bat inspection should be conducted during the planning phase for large capacity projects and during design for minor projects. For maintenance activities, enough time must be scheduled to safely exclude bats in advance of work. Professional judgement is required as project specifics vary. See **Section 7 -** Project Phase Activities for discussion on the timing of inspections.

INDICATORS OF BAT PRESENCE

Although the most effective season to conduct an inspection is during the summer months when bats are most active, field inspection can be conducted year-round. Inspections during the maternity season should be conducted with care especially in confined spaces like culverts. If bats begin to take wing, reduce noise and leave structure. Inspections are driven by the project schedule and professional judgement is required on timing. Inspections conducted during the maternity season or during cool temperatures should be conducted in a manner that minimizes disturbance.

Preliminary indicators for determining presence of bats include:

STAINING - Bat body oil and urine stains can look like long, vertical lengths of browning. Stains can vary in size and may appear wet and are usually found in dark places. Look for dark stains located on concrete support beams and walls immediately below the ceiling of bridges, and beneath joints. In culverts, brown patches may occur on the roof or upper wall. See **PHOTO 7** and **8**.

GUANO - Bat droppings, also called guano, are small brown or black pellets. Older droppings may be gray in color. Bat droppings are dry and flakey. These droppings accumulate on the ground, floor of a covered bridge, or on structural components below roosts. Support beams and walls may collect guano, which is often spotted near or below vertical staining streaks. If guano is identified, take notes

of its locations. Check for guano under roosting spots such as cracks, hollows, and expansion joints. Scattered pellets indicate intermittent bat use, whereas large guano areas indicate regular use. See **PHOTOS 9** and **10**.

INSECT REMAINS - Some bat species bring their insect back to their roost to eat. Pieces of insects, such as wings, and legs can be found scattered below the roost. See **PHOTO 11**.

SMELL - Bat roost can produce a strong ammonia smell. The larger the colony, the stronger the smell becomes.

VISUAL - Depending on the temperature, bats may be found roosting low, high, clustered, spread out, or solitarily. If bats are able to be seen, try to obtain a quick estimate of their number and location. If the number of bats is large, make a partial count of a small area in the cluster and use that number to extrapolate a size for the entire cluster. For example, about 2,000 *Myotis* can fit in a square meter or 1,800 *Tadarida* (FWC). Photos may aid in estimating roost size. An estimate of roost size is not a requirement; however, it can be helpful in understanding the level of exclusion activities required.

NOISE - Listen for vocalizations of bats such as high-pitched squeaking or chirping. Take note of location(s) from where these vocalizations emanate. Unlike birds, these high-pitch noises will come from the darker areas of the structure. During cold weather events, when bats enter torpor (hibernation like state which allows bats to slow down body functions to conserve energy), bats may not make any noises. In addition, it can be difficult to hear bats over a busy highway.

Note that it is more common to see indicators of presence (such as staining or droppings) than to see bats. Therefore, each of these indicators should be considered on its own merits and the presence of even one of these on a structure is enough documentation to confirm bat usage. Species identification is not required to presume occupancy by bats.

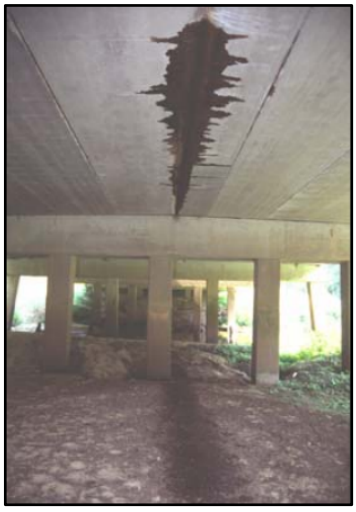


PHOTO 7 – (TOP LEFT) Staining on I-95 Bridge in Fort Pierce. *Photo by FWC.*
PHOTO 8- (TOP RIGHT) Staining along longitudinal joint and guano on ground.

PHOTO 9 - (TOP LEFT) Guano deposit on pier.
PHOTO 10 - (TOP RIGHT) Guano from bridge deck, on top of pier.

PHOTO 11 – (ABOVE) Example of insect remains.

SAFETY

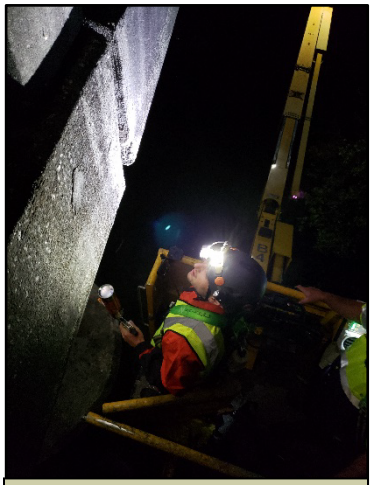


PHOTO 12 - Ocklawaha River Exclusion

It is important to recognize that working with wildlife in close proximity to active transportation facilities requires special safety considerations. Inspecting the varied transportation structures present unique personal safety concerns such as high elevations and fall protection; traffic control; enclosed and confined spaces; remote locations; wildlife; and sites where people may be unwelcoming. Transportation structures may traverse or parallel watercourses, roads, highways, railroad lines, and forests which increase the hazard potential. All inspections and work activities should commence by first evaluating safety parameters of the structure and the surrounding site, and then preparing accordingly. If a structure or site appear unsafe, pause and plan before proceeding.

In addition to the typical equipment required for working on a FDOT project, it is a good idea to have a mask, safety glasses and rubber gloves. Avoid entering enclosed and unventilated areas containing significant

amounts of bat guano. Histoplasmosis is an infection caused by breathing in spores of a fungus often found in bird and bat droppings. People usually get it from breathing in these spores when they become airborne during demolition or cleanup projects. Although most people who breathe in the spores do not get sick, those who do may have a fever, cough, and fatigue. Many people who get histoplasmosis get better on their own without medication, but in some people, such as those who have weakened immune systems, the infection can become severe.

Do not touch or pick up live, injured or sick bats. Bats can and do bite in self-defense. Should you be bitten by a bat, contact your County Health Department immediately. Rabies is fatal but preventable viral disease if treatment is sought immediately. It is not possible to tell if a bat has rabies by just looking at it. For more information about bat related health concerns contact the County Health Department, the Florida Department of Health, or the Centers for Disease Control and Prevention (CDC).

If a bat is identified as behaving unusually or injured **Do Not Handle It**. The best strategy is to leave the bat alone and it will usually fly away the upcoming evening. If the situation shows a clear injury, you may call FWC's Wildlife Alert Hotline at 1-888-404-3922 to speak directly to a FWC representative. In addition, wildlife rehabilitation contacts specifically for bats are provided by The Florida Bat Conservancy.

Asbestos and lead paint may be present in structures constructed before 2000. Before installing materials, or conducting activities that require scraping or drilling into a structure, check with the District Contamination Impact Coordinator (DCIC) to make sure the structures is clear of potential contamination issues. The DCIC may need to provide specific directions on worker safety.

SECTION 5: AVOIDANCE AND MINIMIZATION

When bat presence has been identified through an inspection, the next step is to consider how to avoid or minimize impacts. Coordination with engineers, biologists and FWC may help to identify potential impacts to the roost, based on the specific project characteristics and bat ecology. It is advisable to begin this coordination and planning early to avoid project delays (see **Section 7** - Project Phasing Section).

AVOIDANCE

If bats are present, exclusion is the usual path forward. Exclusion, as the primary focus of this guidance handbook, is the displacement of bats and therefore not considered to be avoidance. The only avoidance option is to conduct work when bats are absent (on their own volition) during migration or other seasonal movements. This option has limited applicability in Florida as bats use structures year-round. Seasonal movements of roost sites may have limited applicability to those Districts located in northern Florida. This option requires time and an intimate level of understanding of the roost's seasonal patterns. Specific guidance on regional bat seasonal patterns is beyond the scope of this handbook. For guidance contact FDOT's FWC Efficient Technical Advisory Team (ETAT) representative who can redirect you to appropriate experts. However, if bats are present, an exclusion plan is required.

MINIMIZATION

Bat exclusion from the structure is the standard method for minimization. The type of exclusion methods and devices required vary depending on the type of structure and where bats are roosting relative to the

location, scale, and type of work proposed. A review of the proposed project work activities and applicable exclusion approaches are required to minimize impacts to bats. There is no "one-size-fits-all" approach, rather time should be taken to develop a *Bat Exclusion Management Plan* (see **Bat Exclusion Management Section**).

SECTION 6: BAT EXCLUSION

BAT EXCLUSION MANAGEMENT PLAN

Depending on the work scope, structure type, and access challenges of the project, it is beneficial to develop a *Bat Exclusion Management Plan*. The plan can be developed by the FDOT District, its bat professional, and/or consultant firm, or it may be a responsibility of the construction or maintenance contractor. This plan can be used to document aspects of the roost; develop custom-tailored exclusion methodology; outline monitoring and maintenance requirements for exclusion devices/materials; provide for contingencies; implement potential mitigative measures; and outline the removal of exclusion devices/materials when the project is complete. For large projects or projects with challenging access issues (i.e., structures over rail or navigable waters) this management plan can be helpful in developing the project approach, identifying key process steps, outlining communication requirements with multiple parties, provide a means in which to seek input from different FDOT disciplines (e.g., environmental, structure engineers, Maintenance of Traffic [MOT], contractors, etc.), safety recommendations, and assist in understanding costs involved with the work effort.

ACTIVITIES THAT MAY REQUIRE EXCLUSION

The presence or absence of bats should be determined in advance of proposed work activities to ensure there is enough time for the necessary analysis of potential effects and the implementation of bat exclusionary efforts (see **Section 7** - Project Phasing Section).

Specific work types that may require bat exclusion when bats are determined to be present and are located within the proposed work area include, but are not limited to, the following:

- bridge structure repair
- bridge deck resurfacing* or water proofing
- filling gaps where mortar has fallen out
- removing or filling drainage holes and pipes
- filling, repairing, or replacing structure expansion joints
- filling other gaps, voids, and cracks between the various elements of a structure
- repairs under a bridge deck
- demolition of buildings and tolling facilities
- replacement, repair, and alterations of culverts
- concrete rehab

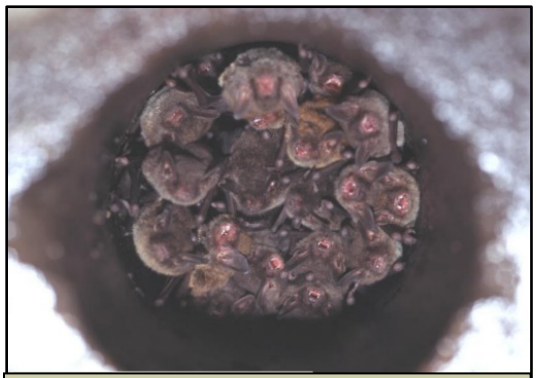


PHOTO 13 – Bats can be found in unanticipated locations (southeastern bats in pipe hole). *Photo by FWC.*

- beam connection and replacement
- bridge railing replace/repair
- painting or timber treatment
- pressure washing or sand blasting

*For bridge deck resurfacing, upfront coordination with FWC may allow for bats to remain during this work activity.

In addition to direct impacts, activities directly adjacent to transportation structures with known bat roosts should be reviewed. Even if work is not on the structure with bats, activities such as pile driving can create vibrations and/or noise sufficient to cause roost abandonment. Distance from the existing structure, duration, and time of day of the proposed activities should be considered when reviewing potential impacts. As structures and work activities can vary, coordinate with FDOT's ETAT FWC representative for technical guidance and exclusion plan.

BAT EMERGENCE/RE-ENTRY ASSESSMENT

If bats, or indicators of bat presence, are detected further assessment work may be recommended. This is typically conducted in the form of emergence/ re-entry assessment. The purpose of this assessment includes (1) observe and record bats emerging and/or re-entering from a structure identified during the preliminary inspection, and (2) to mark those areas where bats are emerging or re-entering for the purpose of informing the exclusion approach. For structures with multiple features suitable for roosting bats, more than one survey or surveyor may be necessary. Where structures are complex or challenging to access, tools such as thermal imagery and acoustic detectors can be evaluated. Note that the levels of bat activity are highly dependent on weather, temperature, and types of roost.

Emergence/ re-entry assessments should be conducted 30 minutes before sunset or 30 minutes before sunrise and observe through sunrise (FWC guidance). The observers should position themselves so emerging bats are silhouetted against the sky as they exit the roost. Observers may choose to take counts of emerging bats at set intervals. The observers should be close enough to the roost to observe exiting bats, but not so close as to influence the emergence (i.e., do not stand directly beneath the roost and do not make unnecessary noise and minimize use of lights or use red light). Do not shine light on the roost as it may prevent or delay bats emerging. An acoustic detector (**PHOTO 4**) and/or cameras (thermal or night vision) can be used to increase the detectability of emerging bats; however, this is not required.

Once the survey has been completed, a report should be provided that contains the assessment's findings, analysis and photos/graphics of the locations of emergent and re-entry points.

Emergence surveys should be used with caution and the following should be considered.

1) Nightly bat emergence may be delayed due to a variety of reasons (and use of thermal imagery is not always practical).
2) Bats may have preferred exit points, but that does not limit them from being able to exit from other points in the structure.
3) If bats are present in a bridge, multiple exit points need to be provided (at minimum one per expansion gap along each crossbeam and on the end caps and abutments)
4) Nightly bat presence can fluctuate in a structure.

Visual assessments of bridges are a more reliable way to determine what needs to be done with an exclusion. Emergence surveys are most valuable to confirm (1) bats are in a structure - if unable to previously confirm, and (2) bats are able to successfully leave the structure after installation of exclusion devices (and that there are no gaps in the exclusion).

METHODS OF BAT EXCLUSION

PHOTO 14 – Use care when applying adhesives or compounds where bats might come in contact with it. *Photo by FWC.*

Bat exclusion methods vary considerably and there is no, one size fits all method. Certain screening, mesh, netting, tubes and other materials can work well and be customized based upon the varied transportation structure types. In addition, there are professional bat exclusion products available for purchase. With so many exclusion materials and project specific aspects to be taken into consideration, it is beyond the scope of this Handbook to describe every possible exclusion method, rather this section provides some general approaches, materials, and common practices. Note that the exclusion methods below can be used in different structure types and scenarios based on similar features and are not intended to be limited to those specific structure examples listed below. Complete exclusion installation typically takes several consecutive days based on weather, temperature, access, and structural aspects. Seek professional assistance on custom-tailored approaches, materials, and installation. A *Bat Exclusion Management Plan* should be developed with input from an experienced professional (see section on **Professional Assistance for Bat Exclusion**).

EXCLUSIONS FOR NARROW GAPS

Narrow gaps, such as expansion joints, hinges and abutments, can provide suitable conditions for bat roosts. Exclusion consists of inserting one way exit cones, tubes, or pipes into the gap and surrounding them with a rigid mesh, netting, or wood (e.g., wood lath strips). An adhesive or compound is then used to anchor the exit device(s) and completely seal any remaining gaps that could allow bats to regain access. As a general rule, if you can get your thumb into a hole, a bat can get through. The most commonly used exit device is PVC pipe with a diameter of at least 2 inches and a length of at least 10 inches to ensure bats can properly exit the structure. It works by allowing bats to safely exit the roost, but prevent them from reentering as the pipe is too small for them to fly through and too slippery to be able to crawl their way back up. For large bat roosts the use of multiple exit devices is recommended. For entry/exit points that are larger than a cone, tube, or pipe opening, use more than one, putting them side by side. When attaching the exit device or covering access points, it is important to not allow the adhesive or compound into the gap itself where a bat might come into contact with it and get stuck (see **PHOTO 14**). The installer must "bat proof" all inactive areas of the structure before installing one-way cones, tubes, and pipes into the gap to prevent bats from relocating to another area of the structure. Once the bats have been excluded, wood blocks or backer rod can be used to seal gaps. See **FIGURE 9 & 10**.

FIGURE 9 – Bridge Cross-Section, Exclusion Device Diagram for Narrow Gaps

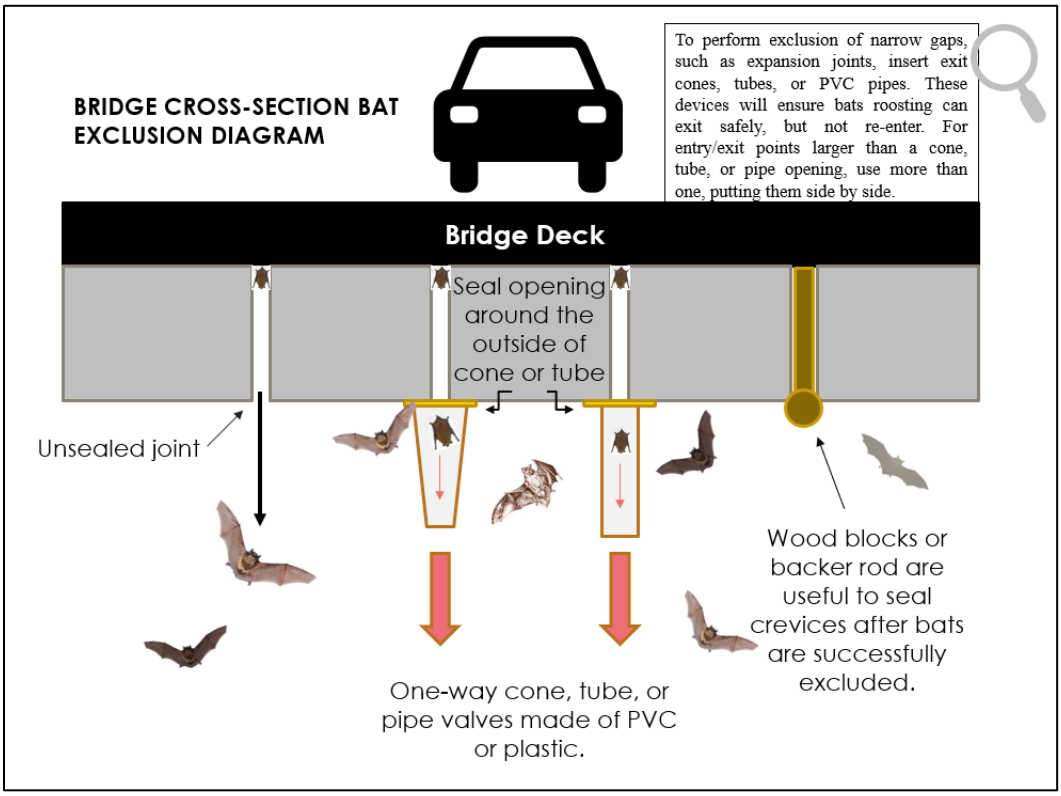
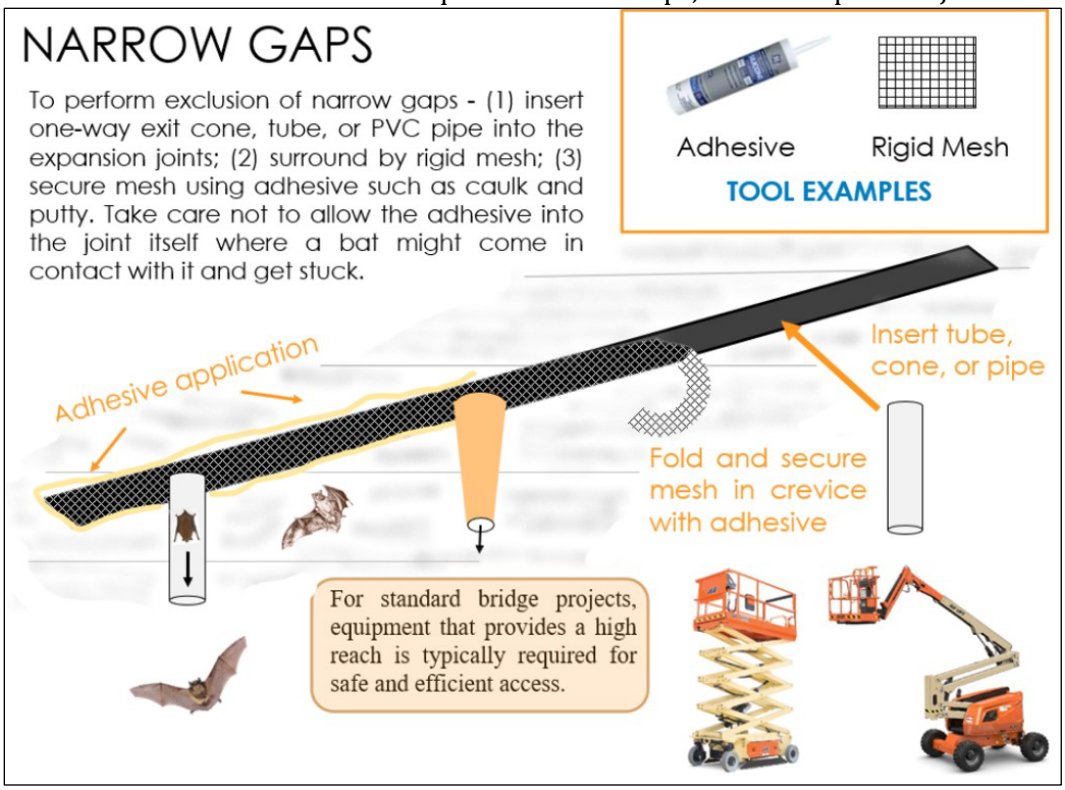


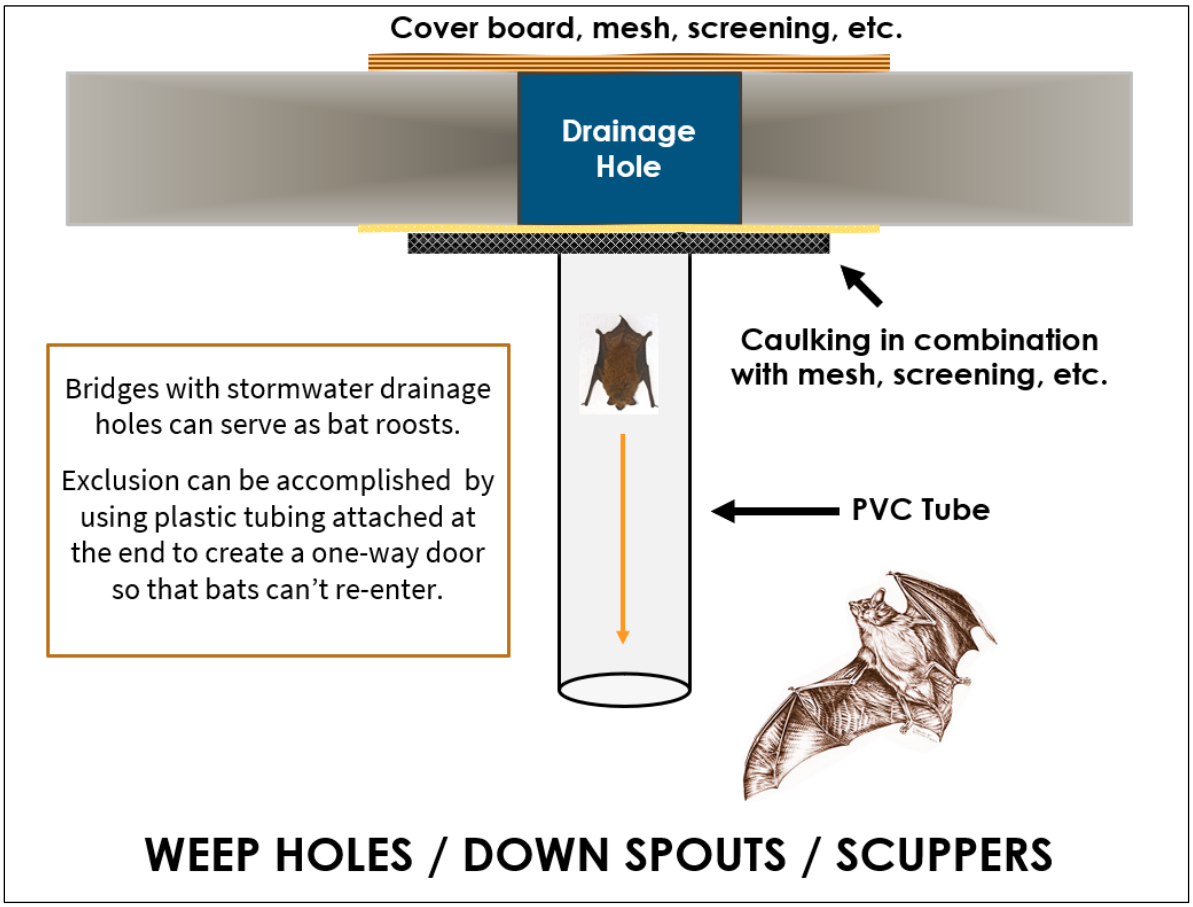
FIGURE 10 – Exclusion Technique for Narrow Gaps, such as Expansion Joints.



EXCLUSION FOR PIPES

Bats can squeeze through small openings and have been found in pipes such as structure weep holes, down spouts, scuppers, ducts, vents, and other drainage/stormwater features. Exclusion can be accomplished through the use of a one-way device secured with an adhesive compound (see **FIGURE 11**). Take care not to allow the adhesive into the pipe where a bat might come in contact with it and get stuck. For larger pipes, use more than one exit device in combination with mesh, screening, etc.

FIGURE 11 – Exclusion Technique for Pipes.

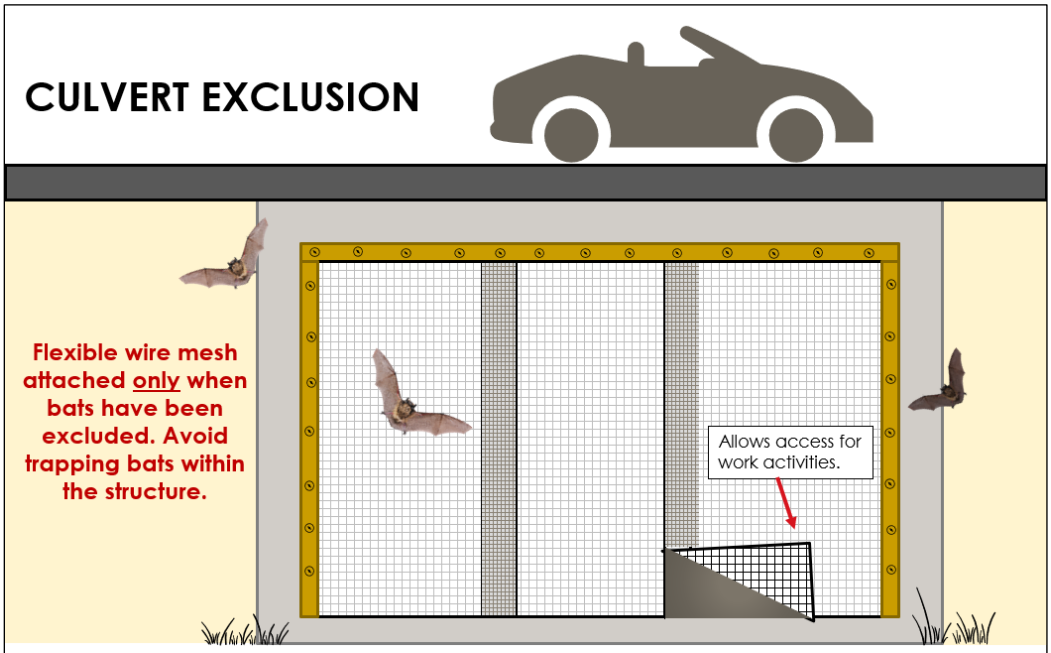


CULVERT EXCLUSIONS

Bats can and do use culverts to roost. For culverts that contain gaps, cracks, joints, or crevices, exclusion begins with following the installation process as described above in the **Exclusions for Narrow Gaps section**. Once the bats are excluded, a flexible wire mesh "curtain" can be installed to keep bats out and to facilitate work activities within the culvert. Curtains are to be installed at both sides of the culvert. Care should be taken not to trap bats within the culvert during curtain installation. See **FIGURE 12.**

Culverts can present a number of site specific challenges, including varying sizes and water movement scenarios; therefore, consult with bat professionals and District EMO staff. **Curtain exclusion is only to be used for culverts, it is not to be used for bridges or other structures.**

FIGURE 12 – Culvert "Curtain" Exclusion



Cover both sides with wire mesh to exclude bats. Fasten along the top and side edges. For wide culverts, split mesh for easier access for work activities. Not for use on bridges or other structures.

EXCLUSION NETTING

Exclusion netting to be used only in specific circumstances, most applicable for culverts when bats roost in areas that are not easily excludable otherwise (e.g., where the ceiling meets the wall) and if recommended and installed by a bat professional. Netting can present issues even when installed to manufacturer specifications including inadvertently entangling bats. If exclusion netting is to be used on a project, additional monitoring should be provided to ensure bats do not become entangled.

METHODS

For larger vertical surfaces and voids in structures, the basic design is to attach the netting over the roost access area and secure it around the perimeter, except for the exit device(s) at the bottom where bats will escape. In some cases, the combination of netting and exit devices (tubes, cones, and pipes) can be used. Exclusion netting should be lightweight; however, specifications must be discussed with a bat professional. In addition, netting should be durable and not fray or become misshapen under hot temperatures. Note that netting over an entire structure is inappropriate and may cause unanticipated problems, instead netting should be targeted with the roosting area in mind. Netting should be cut/trimmed as needed to fit the appropriate application.

All identified roost entry and exit points, as well as areas of potential access (those areas not being utilized by bats for roost entry and exit points but could provide access) should be blocked. Exit devices may require attachment to girders, piers, or other structures for support. The one-way exit devices should be located below the actual roost opening so bats do not become disorientated by trying to locate exit points that are not near their existing routes.

PHOTO 15 – Foam Backer Rod

For net installation use putty, staples, nail/screws (if approved by FDOT Structures Office), and/or wooden lath strips to attach the netting to metal, concrete, wood, or other surfaces. Caulk-type adhesives and spray foams can also be used to attach netting as long as bats will not come into contact with the adhesive before it is cured and is no longer sticky. To prevent bats from coming in contact with adhesive, always install a protective barrier (e.g., foam pipe insulation or backer rod – **PHOTO 15**) first. This material is also a much less abrasive surface to come in contact with for the bats as opposed to wire mesh or other materials. Using the sealant to hold the backer rod/insulation in place also prevents issues with it becoming dislodged due to storms or other unforeseen circumstances. Note that any sealing materials selected to attach the netting needs to be able to handle Florida's high temperature and water exposure, to remain securely attached for the entire time the exclusion materials are in place. This may require scraping/removal of grit and grime located on the necessary attachment joints. Do not use solvent-based sealer/adhesive as they may structurally impair certain exclusion netting. Duct tape or similar types of tapes are not appropriate to secure netting for a bat exclusion. Installer is to avoid damaging the existing bridge during installation of sealant material if bridge is to remain.

The use of netting applications over roadways, navigable waterways, and rail should be thoroughly reviewed by FDOT EMO and Structures Office staff, bat professional, or contractor to avoid any potential conflicts and/or potentially hazardous conditions. The installer should perform daily inspections of the netting to identify any observable issues (e.g., poor attachment, tears, entanglement, etc.) until bats are excluded. See section on **Bat Monitoring After Exclusion Installation**.

BUILDINGS AND TOLLING STRUCTURES

For exclusion of transportation related buildings (rest areas, service areas, welcome centers, weight stations, office buildings, and maintenance buildings) and tolling structures, all potential entry and exit points (holes in eaves, soffit, etc.) should be identified. This can be done by observing bat emergence to determine the location of the exit points (see section on **Bat Emergence/Re-entry Assessment**). Before excluding the exterior exit points, the installer should review the interior of the building for small openings through which bats could enter. All openings connecting the building attic/crawl spaces or other potential roosting areas within the structure should be sealed, while entry points on the outside of the building are left open. This prevents bats from entering into internal rooms or become trapped within the building. Caulking, flashing, screening or insulation can be used to seal most openings on the inside. Draft guards should be placed beneath doors to attics; electrical and plumbing holes should be filled with steel wool, caulking or weather stripping. If the interior is not reviewed bats may seek exits through the interior of the building.

Once the interior is addressed, one-way exit devices (e.g., tubes, cones, and piping) should be added to those exterior points identified in the emergence/re-entry assessment and all potential points of entry covered with netting, mesh, caulking, flashing, foam backer rod (see **PHOTO 15**.), wood, etc. to block bats from regaining access to the structure. If using adhesive compounds, caulking or expanding foam, care should be used to avoid entrapping bats. Consider applying adhesive early enough in the day so it has time to dry before bats emerge in the evening. See building exclusion examples - **FIGURES 13** and **14**. Note that in general it is difficult to inspect every potential roost area within a building or tolling facility, so

excluding of the entire structure may be easier and more successful. See University of Florida Natural Resources and/or Bats in Buildings | FWC (myfwc.com) for additional information.

For smaller vertical holes and crevices, use two pieces of netting, one secured to each side of the crevice can be used (termed hanging door, see **FIGURE 13**). The netting should extend about a foot below the bottom of the hole or crevice. The sides of the netting are attached in a way the puffs the netting out and creates an open space over the hole or crevice, allowing the bats to drop out and fly underneath the netting. Your hand should easily slide under the netting to confirm that sufficient space is provided for bats to exit freely. When the bats return, they will attempt to fly directly to the hole or crevice, but it will be blocked by the netting. They will not land below the netting and climb up behind it to reach the hole, nor will they fly vertically up the narrow space between the structure and netting.

FIGURE 13 – Exclusion Techniques for Buildings.

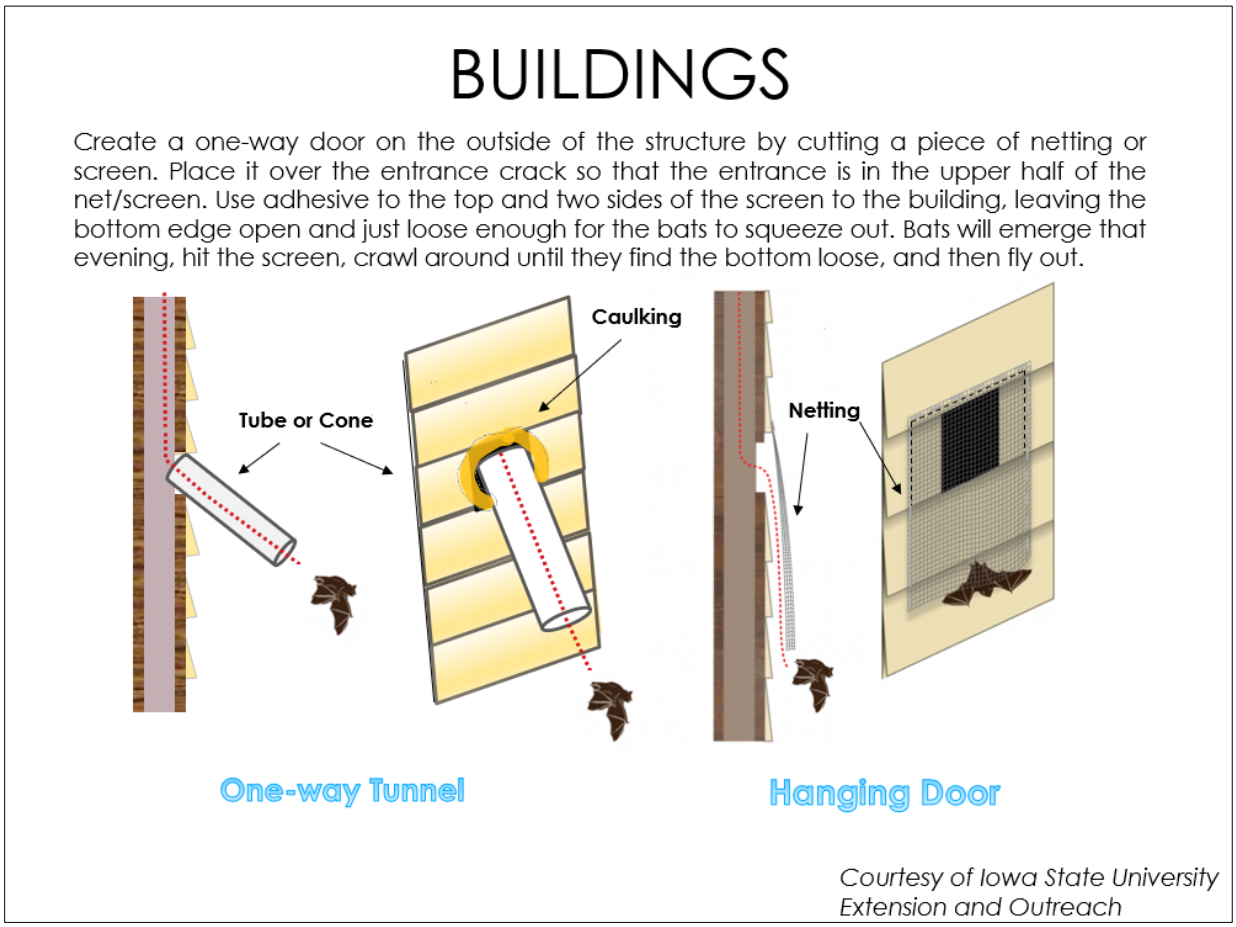
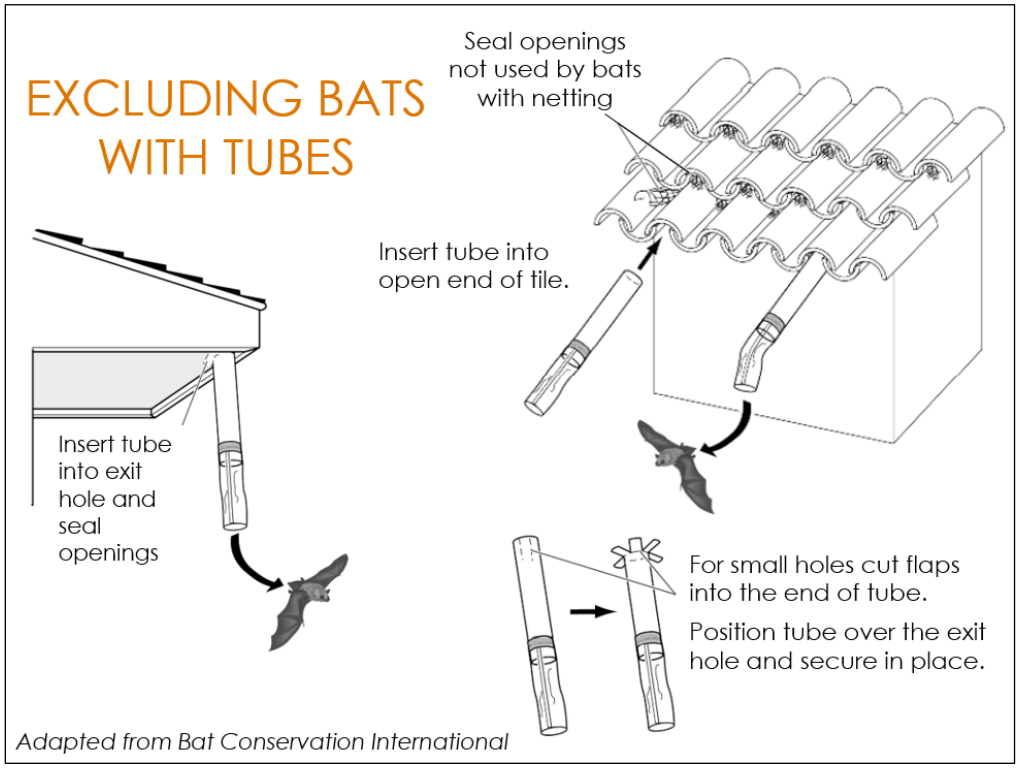


FIGURE 14 – Exclusion Technique /Tubes for Buildings.



WHEN EXCLUDING BATS FROM ONLY A PORTION OF A STRUCTURE

Partial exclusions may be conducted to minimize disturbance to roosts located in other parts of a structure where maintenance/construction activities are not conducted. Bats in areas without work may remain if work can be done in a manner that does not cause harm (see definition of "take" in **Regulatory Designations** section). This may include, but not limited to:

- flagging used to delineate active work areas from non-active work areas, thus limiting personnel presence and steering them away from remaining roost(s) during the evening and night
- minimize clearing and grubbing near the structure(s) where bat roost(s) remain
- avoid night work
- if not able to avoid night work, lights should be directed only in those portions of the structure under active construction (see **PHOTO 16 – Refer to Night-Time Activities Section**) and avoid light trespass into areas occupied by bats
- combustion equipment, such as generators or pumps, should not be parked, nor operated, in proximity to bat roost(s)
- no storage of chemicals or applications near roost(s) that create toxic or noxious fumes
- bat education conducted with work crews, especially those working at night; education to include, but not limited to, the following: 1) bats may be attracted to insects drawn towards work zone lights; 2) bats present are not interested in people; 3) bats are excellent flyers and may come close to people if insects are in the work zone area; 4) if bats are near people, the bats will not try to land on, bite, or harm people; and, 5) work crews or individuals in that type of situation should not

attempt to hit or harm bats because it is unnecessary and would be considered a "take" under regulations FAC 68A (as listed in **Section 3 – Regulatory Designations**).

- use of noise and visual barriers to avoid disturbance (see **PHOTO 17**)

NIGHT-TIME ACTIVITIES

Night-time activities can adversely affect bats. Light, odors and noise can delay or discourage bats from emergence, or potentially cause site abandonment. If night operations are necessary, consider installation of very localized lighting in the work zone and avoiding surrounding areas (see **PHOTO 16**). Consider the development of a Modified Special Provision (see **Section on Special Provisions and Modified Special Provisions)**, using the Limitations of Operations – *Night Work Along Coastal Roads, 8-4.1.1* - as a starting point. The temporary erection of noise barriers and/or light screens (see **PHOTO 17**) may also be considered. Temporary infrastructure (e.g., stockpile areas, roads for construction traffic) should be constructed at a distance from roosts when possible.

PHOTO 16 – Light Shielding Examples **(below)**. Direct construction lighting by using shielding where it is needed to avoid light trespass on bat roosts.

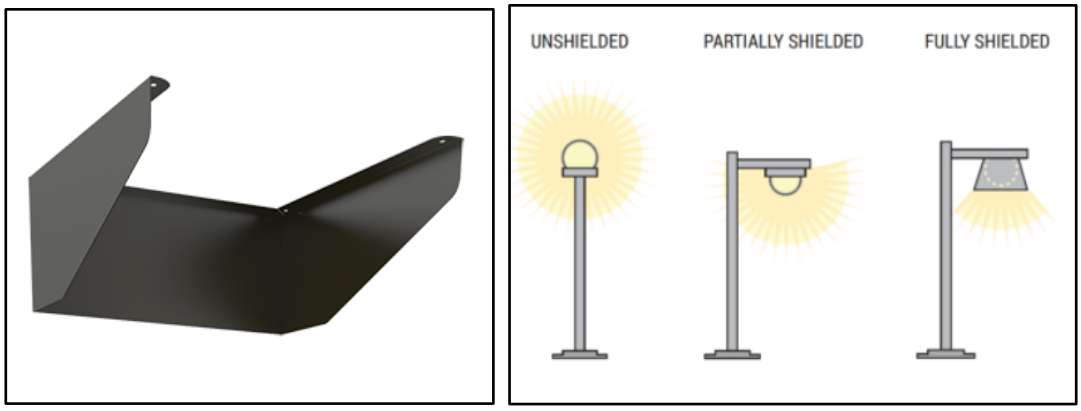


PHOTO 17 – Sound blanket fences **(below)** are an option to help control noise and provide a visual and light barrier.

EDUCATION

Before working near known roosts, construction or maintenance crews should be instructed to not handle bats, as well as how to avoid disturbing them. Educational materials can be obtained through FWC or Bat Conservation International, Inc. FDOT specifications require contractors to notify the FDOT Engineer if bats, or evidence of bat activity, are observed in the structure during work activities. If evidence of bat activity is observed during construction, follow requirements in Section 7-1.4, *FDOT Contractor Requirements For Unanticipated Interaction With Protected Species, Standard Specifications for Road and Bridge Construction.*

If a bat is identified as behaving unusually or injured **Do Not Handle It**. The best strategy is to leave the bat alone and it will usually fly away the upcoming evening. If the situation shows a clear injury, you may call FWC's Wildlife Alert Hotline at 1-888-404-3922 to speak directly to a FWC representative. In addition, wildlife rehabilitation contacts specifically for bats are provided by The Florida Bat Conservancy.

SPECIAL PROVISIONS AND MODIFIED SPECIAL PROVISIONS

Special Provisions (SP), or Modified Special Provisions (MSP), are specific clauses adding to or revising FDOT's *Standard Specifications*. If the existing SPs do not adequately address project needs, coordination can occur with the project's Engineer of Record (EOR) to develop MSPs to ensure project specific exclusion requirements are included in the construction contract. The use of MSPs should be coordinated with the District Permit Coordinator, EMO, or District Specifications Office before final plans are developed. SPs have been created for bats and bat exclusion measures to be used to guide the construction contractor. See FDOT's Standard Specifications Library for the most recent version of SPs for bat exclusion.

SAFETY OF BATS

COLD WEATHER RESTRICTIONS

A critical time for bats is when the temperatures are low, and the bats enter hibernation or deep torpor. The metabolic cost of waking a bat can be high and enough to reduce their energy supply to the point where survival is not possible. Per state rule exclusion can only occur when there are four consecutive days/nights for which the low temperature is forecasted by the U.S. National Weather Service to remain above 50°F.

MONITORING AFTER EXCLUSION INSTALLATION

After the exclusion devices are installed, they should be monitored to make sure they are working properly. As exclusion methods and structures vary, professional judgement should be used on frequency of monitoring; however, the installer should perform inspections to ensure secure attachment, as well as identify tears and gaps from weather, wildlife, or equipment; material failure; and identify modification needs (see **FIGURE 15**). Monitoring frequency of exclusion devices after installation should be considered a part of a project's *Bat Exclusion Management Plan.*

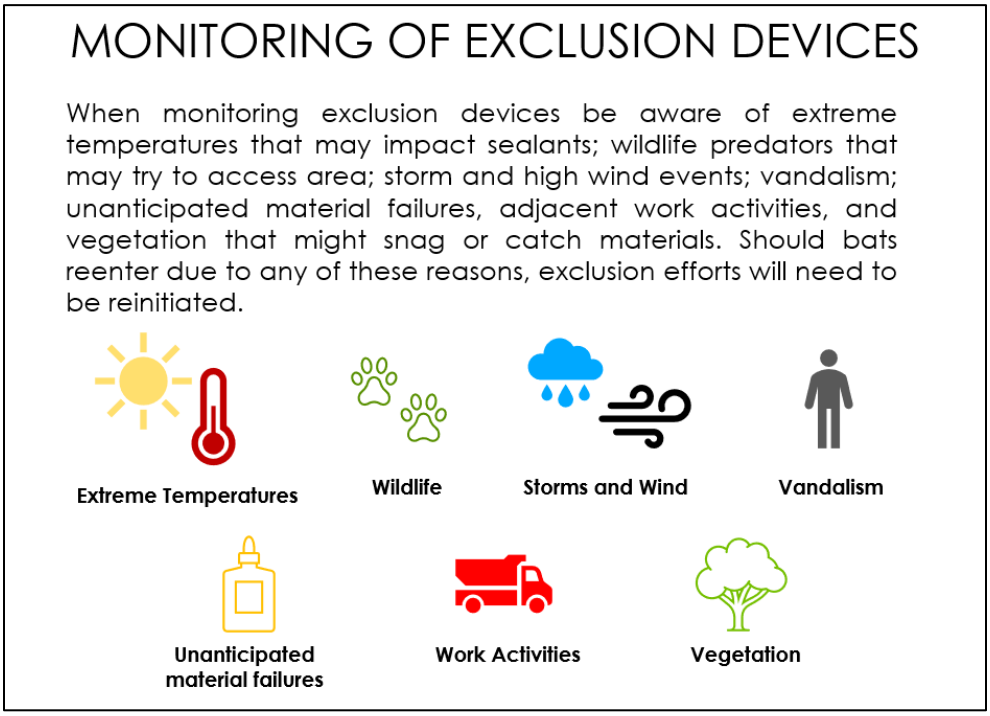
When conducting an exclusion, it is important to recognize that not all bats leave at the same time, especially when weather conditions are poor, and it may take several days for all bats to leave the exclusion site. State law requires that "*a minimum of four consecutive days/nights for which the low temperature is forecasted by the U.S. National Weather Service to remain above 50° F prior to repairs and during the time-period specified."* Following the four-day period, it is recommended that the exclusion area be reviewed to verify that bats are no longer leaving the structure during the emergence period, 30 minutes before sunset or 30

minutes before dawn (see **Section on Emergence/Re-entry Assessments**). If bats are still present and temperatures are above the minimum, inspection should occur of all exclusion materials and any access points that may have been missed. Should materials fail and allow bats to access the structure, another inspection must occur, exclusion devices mended, and the four-day minimum period observed. Once bats are no longer present, the entry and exit points can be sealed and work activities may take place. Caution needs to be taken as it is not uncommon for bats to remain in the structure for longer than 4 days even with ideal conditions.

Site fidelity for colonial bats is high and it is not uncommon for groups of displaced bats to roost on the exterior of their former structure in exposed, sub-optimal areas during the first few days after exclusion of a roost. If alternative roost sites are in short supply, this may be more pronounced. The risk of bat injury and mortality is higher until which time excluded bats find alternative roosting. Bats located in warmer areas often rely on the same roost year-round and will actively seek re-entry. For large roosts, FDOT may consider installing alternative roosting areas, such as bat houses, prior to exclusion.

If the structure is proposed for full demolition, close coordination with the construction contractor may be required to ensure that bats do not re-enter the structure during the demolition phase. If multiple days are required for the demolition, the Bat Exclusion Management Plan should include requirements that workers are advised that former roosting crevices should never be left open overnight. Monitoring is necessary during phased structure demolition to ensure that exclusion is working as designed and that bats have been, and continue to be, excluded. Monitoring events should always be scheduled/considered after significant storm events (e.g., depressions, tropical storms, hurricanes) even if the exclusion is complete and the bridge sealed.

FIGURE 15 – Monitoring of Exclusion Devices.



REMOVAL OF EXCLUSION MATERIALS

Once work activities are complete, exclusion materials may be removed to allow bats to reenter the structure (unless other reasons dictate the bats remaining excluded – see discussion on **Permanent vs Temporary Exclusion** below). Care should be taken when removing these materials to ensure no externally roosting bats are attached to the materials during the removal process. Additionally, the removal crew should ensure all materials are properly disposed of and not left on site as such materials can be environmentally hazardous, especially if allowed to enter waterways and/or storm drains.

MITIGATIVE MEASURES

PHOTO 18 – Pole Bat House

Mitigative measures for displacing a bat roost are not required by regulation. However, measures can be implemented to provide bats with alternative roosting opportunities in advance of exclusion so as to reduce pressure on bats during displacement and alleviate the desire for bats to try to regain access to the structure. Mitigative measures may be considered where impacts to the roost could affect migration, breeding, rearing of young, and hibernation or in some cases where no alternative roosting sites exist (e.g., other structures or natural features to utilize in the region). The installation of alternative roosts should be done in coordination with someone knowledgeable of the ecology of the bat(s) species. Mitigative measures should focus on solutions that fit within the parameters of the normal function of the transportation structure's operation and maintenance. Bat houses (see **PHOTO 18**) are frequently used as a mitigative measure. There are a variety of designs and ready-made houses available. *Bat Conservation International* evaluates bat houses for effectiveness and is a useful source for designs.

PROFESSIONAL ASSISTANCE FOR BAT EXCLUSION

If a District determines that bat exclusion will be required, it will be necessary to identify whether FDOT will use an existing contract (e.g., District-Wide with these capabilities) or whether the construction or maintenance contractor will be required to conduct the exclusion. In either case, the work should be performed by a specialty contractor or bat professional experienced in conducting bat exclusions for transportation projects. This work can be included in a construction contract through use of a SP. If done through a District-Wide Contract or other similar contract confirmation with the District Procurement Office may be required to ensure proper contractual mechanism.

A general review for bat exclusion professionals online will identify pest control companies and wildlife trappers. While most contractors may be appropriate for private homes, they are not equipped to handle transportation structures and bridges. When searching for bat expertise, you may contact the Florida Bat Conservancy or FWC for information regarding the types of questions to ask when selecting an appropriate firm. The professional or firm should indicate their experience in performing bat exclusions on transportation structures or using similar methods on other structures.

NOTE - Any exclusion product can cause bat disturbance, harm or fatality if improperly installed. In addition, no damage should occur to the transportation structure. All of which indicate the importance of utilizing experienced professionals.

Another consideration for contracting with professionals is their proximity to the project area. Bat exclusion is continuous and meticulous work. Keeping the exclusion structure secure and well maintained is critical as bats will try to return to their roosts.

PHOTO 19 - Specialized Equipment, Boom Lift (Ocklawaha River Bridge).

The professional's availability is also a crucial factor in selection to ensure the work is completed within the allotted timeframe. Structures may require considerable time to install, inspect, and monitor. In addition, cold periods and maternity season can constrain schedules.

Site-specific exclusion needs and access should be compared against the professional firm's equipment capability and may require MOT plans/aspects. High bridges, or bridges over water or rail, may require specialized equipment. Examples of equipment that may be required include scaffolding, snooper trucks, boom lifts, fall protection equipment, inspection platforms, and other aerial lifts. If the professional firm under consideration does not have access to these types of equipment, review existing District Contracts to see if alternative support is available, or whether the District Structure Office or Maintenance Office can provide equipment.

The selected professional or firm should:

- Have the ability to identify signs of bat presence, locate roosts, and identify probable species
- Knowledge of bat species listing status and regional distribution
- Knowledge of annual bat biological cycles and life history characteristics
- Understand species and seasonal requirements of roosts
- Experience with a variety of exclusion techniques and their appropriate application and limitations
- Understand health and safety issues
- Experience with techniques to avoid, and minimize negative impacts on bats
- Ability to provide structure and species specific exclusion recommendations
- Communicate information and recommendations clearly and concisely
- Understand materials and equipment needed and can access them
- Have insurance coverage commensurate with work required

PHOTO 20 - Access Issue - Low Continuous concrete multibeam bridge over water.

COSTS

Costs for bat exclusion are determined by a number of factors. One of the first considerations is accessibility. Do landscaping, trees, roads, water, railroad tracks, navigational channels need to be worked around or over? Is height a major issue for the project? Are any special materials or additional equipment such as scaffolding and aerial lifts required? Each job presents unique challenges and often requires custom-tailored approaches, so a discussion with the contractor or professional biologist is required. Having the professional or contractor firm conduct a field review of the structure is helpful to facilitate a more accurate cost analysis.

PHOTO 21 - Access Issue - High bridge structures (Ocklawaha River Bridge).

TIMEFRAMES

Bat exclusion should occur no sooner than one month prior to construction. Understanding the amount of time that it will take to complete a bat exclusion effort and to begin project work will vary based on a number of factors. These factors include the time of year when exclusion will occur, weather conditions, accessibility, and the size of project. If the weather is warm and calm, bats will vacate the exclusion area within days. Conversely, cooler temperatures or severe weather will limit bat activity – necessitating a longer time period to complete exclusion. No exclusion activities are permitted during the maternity season (April 16th to August 14th). The farther out in time from construction that exclusion is installed, the more important it becomes to monitor that it remains in place.

ACCESSIBILITY

Accessibility is a primary issue when considering bat exclusion. Beyond physical access, there may be issues associated with obtaining permissions to access and work if it is not FDOT ROW. Additional coordination and permitting may be required if the structure is located over a navigation channel, railroad tracks, highway, or a third-party ROW.

PERMANENT VS. TEMPORARY EXCLUSION

Before bats are excluded, it should be determined whether or not they will be allowed to return or be permanently excluded. Allowing bats to return to their former roost after structure work is completed benefits the bats, natural environment, and the local communities.

For most maintenance related, or other short-term exclusions, the exclusion devices are removed once the work is complete, and bats are allowed to return. For long-term projects that involve major modifications or are complete replacements, bats are typically allowed to return once the project is complete.

In some instances, there may be a need to permanently exclude bats from all or part of a structure. Examples could include, but not limited to, safety concerns, ROW issues (see **FIGURE 16**), impact to public, etc. Copious amounts of bat urine over an extended period of time can - corrode metal, cause etching of polished

surfaces, and color porous stone such as marble and alabaster. Closing off a portion of a structure while leaving other areas open for roosting can be considered. One example could be permanently excluding bats from those areas of a bridge where their guano or staining is of concern on a public walkway or where people frequent.

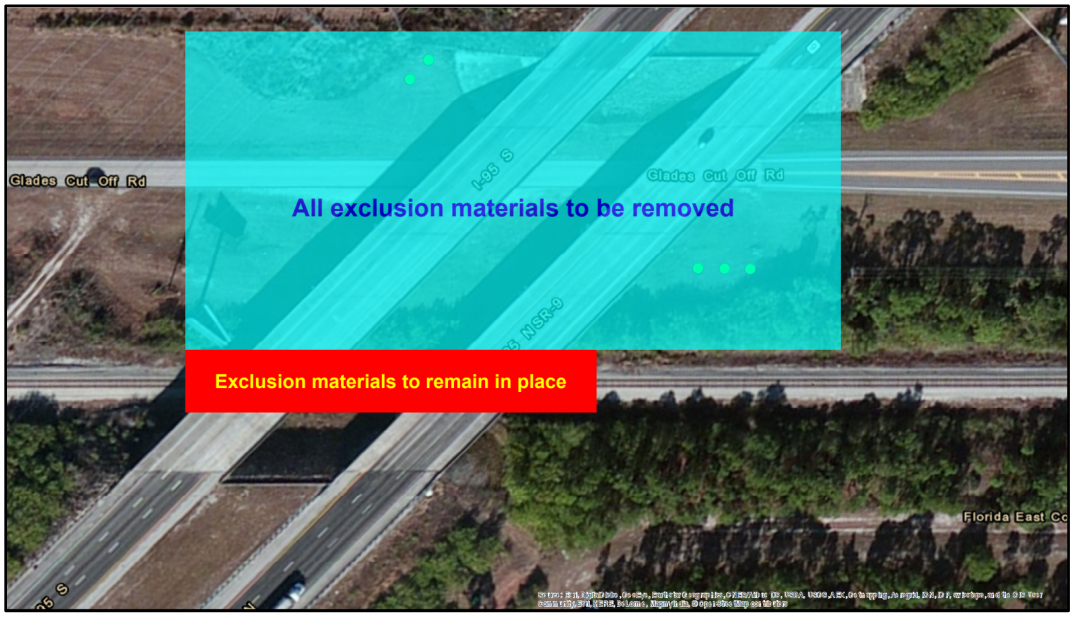


FIGURE 16 - Area over railroad tracks permanently excluded to avoid future safety concerns and ROW conflicts. Citation - *Fly-By-Night,* I-95 and Glades Cut Off Rd., District Four.

WHEN TO CONDUCT FEDERAL AND STATE AGENCY COORDINATION

All species of bats in structures are protected under the FAC; therefore, advance coordination is recommended with your District's ETAT FWC representative prior to conducting exclusion activities. Coordination would include site assessment; minimization measures; and a *Bat Exclusion Management Plan* that considers site specific measures, sets timeframes, and lays out exclusionary measures. FWC can provide technical assistance if provided with a proposed *Bat Exclusion Management Plan*.

For federally listed and candidate species, such as the Florida bonneted, gray, and tricolored bats, FDOT must consult under Section 7 or 10 with the District's USFWS ETAT representative under the ESA. This would be conducted by the FDOT District EMO or OEM depending on the level of consultation required. The USFWS typically asks FDOT to conduct field inspections if suitable roosting habitat (including bridges and similar structures) occur within a project site. Initial inspection is done visually. Where identification of bat presence or bat species identification cannot be made visually, USFWS may request acoustic surveys (see **PHOTO 4**, Acoustic Detector System). The USFWS has developed protocols for conducting roost field inspections and acoustic surveys.

OTHER AGENCY CONSIDERATIONS

RAILROADS

When seeking to access railroad property for working or installing equipment under, over or adjacent to ROW and tracks, FDOT must coordinate, permit and sometimes contract with the railroad (i.e., FEC, CSX,

etc.). Railroads require FDOT and consultants to complete a permit application to demonstrate adequate insurance, address operational issues and comply with safety codes and standards. The Federal Railroad Administration (FRA) requires the presence of a railroad "flagger" when workers are in the railroad ROW (on, over or under). A flagger is a person who can communicate directly with train crews and dispatchers and is designated to protect workers near the tracks in the railroad ROW. Their sole responsibility, per FRA regulations (49 CFR Part 214), is to protect railroad infrastructure, and ensure the safety of those performing work near the tracks. Each FDOT District has a Railroad Coordinator with responsibility to address questions, issues, and facilitate coordination and communication with the Railroad. Coordination, permitting, and scheduling a flagger can take time and resources so early planning is necessary if proposing bat exclusion efforts on, over, under or adjacent to rail lines.

PHOTO 22 – Bat Exclusion (2019), *Fly By Night,* on I-95 Bridge over the FEC rail line and CR 709, Martin County, District Four.

NAVIGABLE WATERS

Installation of a bat exclusionary system over navigational waterways often requires the use of barges or floating structures to assist in the installation of an exclusionary system. These vessels may obstruct navigation or create hazards, therefore notices to boaters in the area may be required if proposed work impacts navigational access. The term "navigable waters of the United States" and all other terms relating to the geographic scope of jurisdiction are defined at 33 CFR Part 329. They are those waters of the United States (WOTUS) that are subject to the ebb and flow of the tide shoreward to the mean high water mark, and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. The two primary regulatory agencies are the U.S. Coast Guard (USCG) and the U.S. Army Corps of Engineers (USACE). Generally, any proposed modification to a bridge or causeway across a navigable waterway of the United States must apply for a Coast Guard bridge permit. This includes all temporary structures that may be needed for a bat exclusion. Coast Guard District Offices issue "Notice to Mariners" as circumstances prescribe. These notices include information about work in progress in the waterway and cautionary information. Information regarding bat exclusion efforts that may affect navigation must be submitted at least 60-days prior to the beginning of construction.

Certain structures or work in or affecting navigable waters of the United States are also regulated under other authorities of the Department of the Army (USACE). Although rare, a USACE permit may be required if a bat exclusionary structure or associated installation method affects navigable waters of the United States. Coordination is recommended if there is a question as to whether the bat exclusion efforts may require additional consideration during project permitting.

Note that in-water work such as the use of a barge may require consultation with the USFWS should the use of a vessel/barge impact listed species such as the manatee.

WATER MANAGEMENT DISTRICT, RIGHT-OF-WAY OCCUPANCY APPROVAL

For those exclusionary efforts that occur in, on, or over a Water Management District's (WMD) ROW, coordination is recommended to determine if a temporary permit may be required. ROW Occupancy Permits protect the WMD's ability to effectively maintain and operate the regional flood control system while also allowing for essential facilities (e.g., bridges and utility crossings) and compatible recreational uses (e.g., linear parks, trails, docks, and marinas) within the ROW. Applications are required to include specific details about the proposed improvements or activity, contain complete design plans (if an improvement is proposed in the ROW) and, in most cases, an application fee.

OFF-SYSTEM CONSIDERATIONS (COUNTY, CITY, LOCAL, WATER CONTROL DISTRICTS, ETC.)

If the bat exclusion work is proposed to occur on a transportation structure that is "off-system," defined as any project not located on the State Highway System (SHS), coordination may be required with the local governing agency, such as the City, County, and local Water Control District. In the case of a Local Agency Program (LAP) project, FDOT may serve in more of an advisory role to the participating agency in conducting the exclusion.

INTERNAL COORDINATION

FDOT's District EMO or District Environmental Permit Office should coordinate internally with the other District offices as needed. Offices may include but are not limited to District Structures Design, District Structures Maintenance, District Utility Office, District Construction, District Railroad Coordinator, etc. when a bat roost has been identified. A few examples of when coordination may be needed are listed below; however, this list is not exhaustive.

- When minimization measures are developed that may involve the structure, operation of structure, traffic on structure, maintenance of structure, inspection of the structure, etc.
- When exclusionary devices are proposed for a structure.
- When project schedules may be impacted.
- When special equipment is needed to perform inspections for bats or bat exclusions.
- When commitments or conditions are being considered for a project activity.
- When utilities or railroads are involved.

It is recommended that internal coordination occur early and often to avoid confusion or conflicting activities.

PUBLIC ENGAGEMENT CONSIDERATIONS

Most bat roosts pose no threat to humans and will remain unnoticed throughout the life of the structure. However, large bat colonies on structures can attract public attention. Measures to minimize human contact with bats such as signage and fencing may be needed at visited locations. For example: a fence may prevent access to areas where young or sick bats sometimes fall, and signs to warn visitors not to handle bats.

Should the public raise concerns about bat presence on a structure or the exclusion from a structure, coordinate with the District Public Information Officer and Project Manager (PM). FWC, Florida Bat Conservancy, and Bat Conservation International maintain helpful public information about the ecological and economic benefits of bats, plus information on any health and safety concerns.

SECTION 7: PROJECT PHASE ACTIVITIES

Typically, the District EMO or Environmental Permit Office is responsible for evaluating the project area for bat roosts during the distinct phases of project delivery. For maintenance activities that do not go through the project delivery process, it is typically the responsibility of the District Structures Maintenance Office or designee to evaluate the work area for bats. It is important to identify bats in a project area as soon as practicable to ensure enough time and consideration is given for exclusion. Coordination with the District EMO is recommended regarding project activities scheduling.

PD&E PHASE

Project Development and Environment (PD&E) Studies are conducted to comply with the National Environmental Policy Act (NEPA) for federally funded major projects. State funded projects follow the PD&E process to ensure compliance with state and federal regulations. As part of this phase, an in-depth analysis of the effects of the project on natural resources is undertaken with consideration of project alternatives. This includes field inspections to determine whether listed species or otherwise protected species are located within the project area. During the PD&E phase, the presence of bat roosts would be assessed as a part of the Natural Resources Evaluation (NRE) described in the *Protected Species and Habitat* chapter of the PD&E Manual. Prior to the field inspections, the project team should coordinate with USFWS and FWC in early project development to discuss the *ETDM Programming Screen Summary Report* and ensure that potential protected species and habitat issues identified previously have not changed since the screening. If an endangered species, such as Florida bonneted, gray, or tricolored bat, is identified, then consultation must commence with the USFWS.

When bats are identified in the NRE, an implementation measure is included that FDOT will conduct bat exclusion for the project. Note that the guidance outlined within this document is not intended to exceed the amount of assessment expected as outlined in FDOT's PD&E Manual, but rather to provide a template to document bats and their roosts based on data collected as part of the Study.

PD&E REEVALUATIONS

During PD&E reevaluations (Design phase) if new ROW is proposed that includes structures that were not previously evaluated, the designated District office should consider potential bat impacts, conduct an analysis of the potential impacts to bats due to the design changes, and perform a bat inspection survey.

DESIGN PHASE

During Design, information gathered during PD&E is reviewed with attention to details regarding protected species and wildlife. If species-specific field inspections are required for bats or additional agency coordination or consultation is needed, those activities must be completed before construction activities commence. Some projects, which did not require a PD&E phase, start during the Design phase and typically have a shorter delivery schedule. Although these projects may be smaller in scope, there still remains a potential for involvement with bats. It is therefore imperative to determine whether structures within the project area could support roosting habitat by reviewing available GIS, aerial, and desktop (EST) information. If it is determined that there is a potential for active roost sites, a field inspection should be performed to determine presence.

The Design phase may include several review periods as the engineering plans progress. Discussions with the PM will yield details about the project delivery schedule and review milestones pertinent to a *Bat Exclusion Management Plan*.

It is quite common for Design phase decisions to refine or modify project limits or structure designs after the PD&E phase has been completed. As such, the impacts of these design changes may not have been studied. In this case, potential bat roosts should be evaluated.

Below are considerations for determining the timing of project bat field inspection(s). Note that "FDOT" below includes district-wide environmental, construction engineering & inspection, or other contracts that contain bat specialty services outside of a construction contract. "Contractor" below may include a design-build firm.

- If bats are to remain or require exclusion, FDOT can evaluate implementing SP measures such as SP0070104-10 (bats general) or SP0070104-11 (bats in bridges) (see **FDOT's Specification Workbook**).
- If FDOT's existing SPs are not sufficient to call out to the construction contractor what their responsibilities are for the bat exclusion, an MSP can be requested. Coordination with FDOT's Specifications Office will be required. See FDOT's Standard Specifications Library for the most recent version of SPs for bat exclusion.
- Are the appropriate pay items and quantities in the contract documents, or will they require updating?
- What advanced utility relocation (prior to FDOT construction contractor activities) work needs to be considered in conjunction with the *Bat Exclusion Management Plan* and project schedule?
- When are the affected structures scheduled for work activities? Is there any schedule flexibility (e.g., a delayed start in the construction contract) to work around the April 16 – August 14 bat maternity mandated timeframe or periods when temperatures may dip below 50° F?
- Will FDOT, or the Construction Contractor, be responsible for the *Bat Exclusion Management Plan*, exclusion installation, maintenance, and removal? Note that each of these items listed should be considered individually. For example, FDOT may develop the *Bat Exclusion Management Plan* for the contractor to carry out. In this instance, FDOT would need to ensure the proper pay items and any SPs are included in the contract for the contractor to carry out the installation, maintenance, and removal.
- Will FDOT, or the Construction Contractor, be responsible for coordination with FWC (if needed)?

- Are barges/in-water work activities proposed that require permits or permissions, navigable waters public notices, or 3rd party permissions? See section on **Navigable Waters**.
- Will work impact railroad ROW requiring permissions, permits, or flagger assistance? See section on **Railroads**.

PRE-CONSTRUCTION COORDINATION

The designated District office, usually the District EMO, District Environmental Permit Office, or approved consultant firm responsible for the bat exclusion will take the lead in coordinating with the various District offices. Coordination with the Specifications Office, the Design PM, Procurement Office, Construction Project Administrator, and the District Utility Office is advised to ensure the proper timing of all pre-construction related bat exclusionary efforts.

CONSTRUCTION PHASE

The construction phase of project delivery is primarily accomplished through the Design-Bid-Build and Design-Build processes. The Design-Bid-Build (conventional) process is a form of project delivery whereby the FDOT either performs the design work in-house or negotiates with an engineering design firm to prepare drawings and specifications under a design services contract, and then separately contracts for construction services by engaging a contractor through competitive bidding. The Design-Build form of project delivery is a system of contracting whereby one entity performs both engineering design and construction under one contract. For either contracting process, the designated District office should coordinate with the Construction Project Administrator and the Utility office to ensure that a bat field inspection has been conducted and bat exclusion installed, if required, prior to the start of work (structural work). Work activities may be performed in phases with structural work occurring earlier or later than roadway work. Thus, consulting with the PM should prove beneficial when determining construction methodologies and scheduling.

DESIGN-BID-BUILD PROJECTS

For conventional construction projects, the bat field inspection and, if bats are present, exclusion activities are often conducted by FDOT prior to the contractor's notice to proceed (NTP). Alternatively, all or part of these efforts may be included in the contractor bid package. Once a contractor has been selected, it is good practice for the designated District office to attend the pre-construction meeting to specifically discuss the following:

- *Bat Exclusion Management Plan*
- schedule timeframes for structural work
- locations of bat roosts
- status of bat exclusion efforts
- installation/maintenance/removal of exclusionary devices
- responsible party and current status of each of the above activities
- contractor bat education
- what to do and who to contact if additional bat roosts are identified or if exclusion should fail
- pass on any project specific commitments made to the regulatory agencies (FWC and/or USFWS)

Please refer to **Section 8.2** of the Construction Project Administration Manual & Standard Spec 7.1.4 for additional guidance. If the FDOT will be responsible for exclusionary device installation, it is good practice to have the installer meet with the Construction Engineering and Inspection (CEI) and roadway contractor on-site to review the exclusionary and structural activities. The project contractor may request adjustments of the exclusionary devices (either previously installed or proposed for installation) to better accommodate specific means and methods so long as the requirements of agencies for the protection of bats and bat roots are adhered to. If a regional biologist or specialty firm is hired by FDOT, they should anticipate attending the preconstruction meeting and coordinate specific details with the project team.

DESIGN-BUILD PROJECTS

As the contractor's design team may propose changes as part of an alternative technical concept (ATC), it is important that the FDOT Construction Project Administrator and Design PM coordinate proposed changes with the designated District office responsible for bat exclusion efforts to ensure these changes do not change the *Bat Exclusion Management Plan* if already developed or implemented. As with conventional projects, if the Design-Build Firm is responsible for bat exclusion efforts, then the Design-Build Firm's specialty firm or professional biologist agent should attend the preconstruction meeting, or "kick-off" meeting, so that the designated District office can specifically address bat management.

MAINTENANCE PHASE

Maintenance of transportation facilities is a necessary and perpetually ongoing task. There are 12,595 bridges in Florida and of those FDOT has maintenance responsibility for 7,079, or 56.20%. A total of 13.93% of all bridges currently in service were constructed prior to 1960; 34.14% were constructed in the 1960's and 1970's, while the remaining 51.93% have been built since 1980. The life span of a bridge structure can vary based on preventive maintenance including leveraging advances in materials, design practices, and construction methods. Routine maintenance is critical to extend bridge lifespans, assess infrastructure needs, and progressively-replace aging structures.

Studies indicate that even with large colonies of bats, no structural damage occurs that can be attributable to bats. However, legitimate concerns can arise whereby the presence of bat roosts may interfere with general maintenance or inspection procedures.

Maintenance activities include, but are not limited to, cleaning, painting, preventative maintenance to preserve and lengthen service life, and technical and specialized repairs. These activities may involve the operation of support vehicles and equipment, pavement repair, welding and grinding operations, and associated pollutants, which may impact nearby bat colonies. Maintenance activities which involve the replacement of bridge or culvert components with contrasting materials may modify roost microclimate, dimensions, illumination, etc.; and consequently, may promote roost abandonment. Some maintenance activities (e.g., surface treatments including chip sealing, crack filling, crack sealing, patching) can kill or entomb bats or cause the abandonment of flightless young. Additionally, these activities can create excessive noise, vibrations, and modify thermal conditions of roosts; and consequently, may promote roost abandonment. Pressure washing and cleaning structures can harm bats. If bats are present, exclusion procedures must be implemented prior to potentially injurious maintenance activities.

In general, bats roosting in highway structures are habituated to vibrations and sounds associated with normal traffic and will be minimally disturbed if maintenance operations create these conditions. Structural maintenance only affects bat colonies if the roost is suddenly exposed or if foreign materials (water, tar,

joint filler, gravel, etc.) are introduced. The Maintenance Office should seek ways to minimize impacts as outline in **Section 5**.

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SECTION 9: APPENDICES

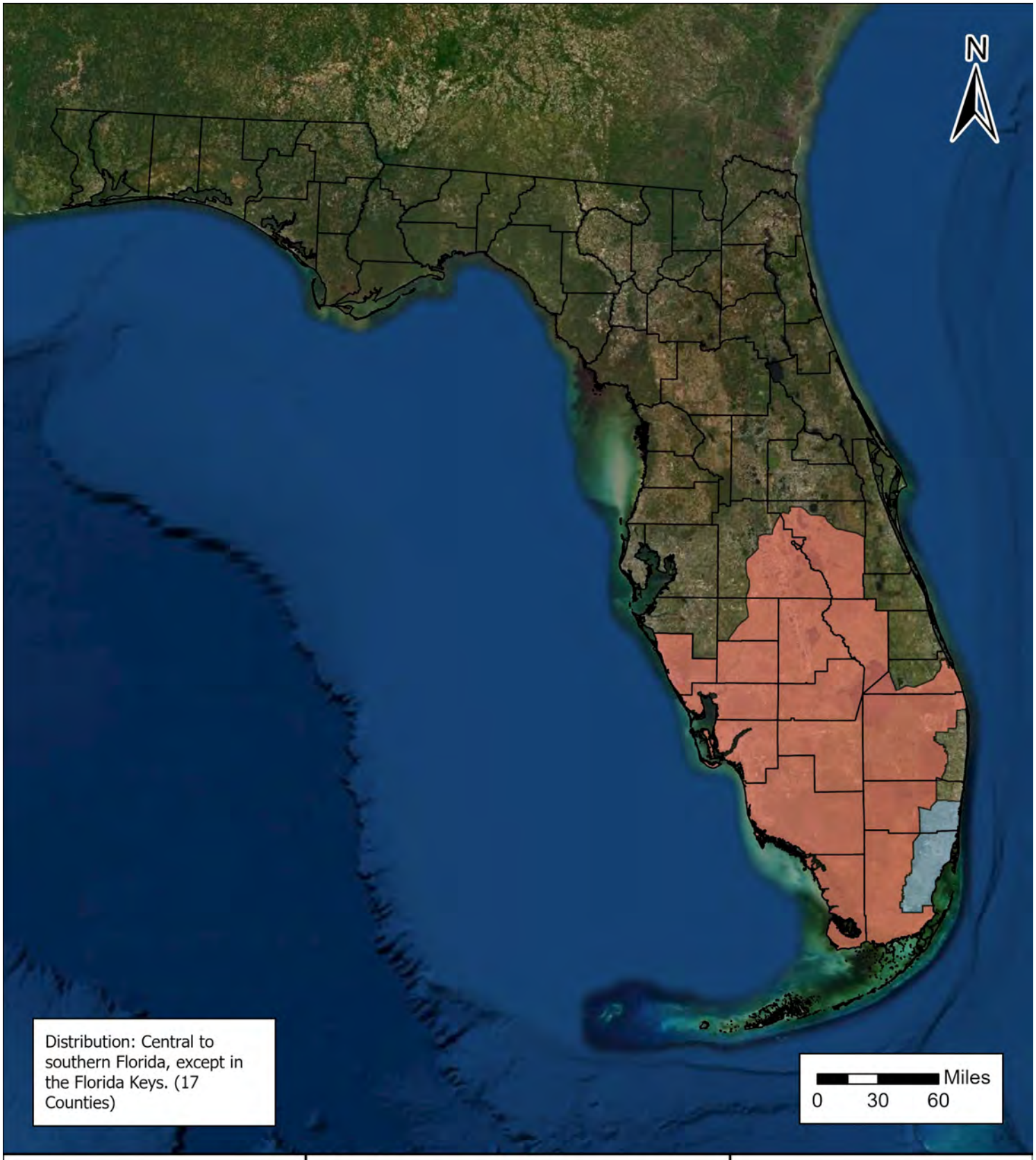
APPENDIX A. BAT DISTRIBUTION MAPS & BAT IDENTIFICATION PHOTOS

APPENDIX B. BAT ROOST INSPECTION FORM

APPENDIX A.

Bat Identification Photos & Distribution Maps

Florida Bonneted Bat / Florida Mastiff Bat,
Eumops floridanus
Federally Endangered
Photo by Dustin Smith, Zoo Miami.



Office of Environmental Management

Florida Bonneted Bat

Eumops floridanus

Distribution Map

Distribution

Urban Bat Area

FDOT

Velvety Free-Tailed Bat / Pallas' Mastiff Bat, *Molossus molossus*

Photo J. Scott Altenbach. Bat Conservation International.

Office of Environmental Management

Velvety Free-Tailed Bat

Molossus molossus

Distribution Map

Distribution

FDOT

Brazilian / Mexican Free-Tailed Bat,
Tadarida brasiliensis
State Species of Greatest Conservation Need.
Photo by Ann Froschauer, USFWS.

Office of Environmental Management

Brazilian Free-Tailed Bat

Tadarida brasiliensis

Distribution Map

Distribution

FDOT

Rafinesque's Big-Eared Bat, *Corynorhinus rafinesquii*

State Species of Greatest Conservation Need

Photo by James Kiser.

Office of Environmental Management

Rafinesque's Big-Eared Bat

Corynorhinus rafinesquii

Distribution Map

Distribution

FDOT

Big Brown Bat, *Eptesicus fuscus*

State Species of Greatest Conservation Need

Photo by James Kiser.

Office of Environmental Management

Big Brown Bat

Eptesicus fuscus

Distribution Map

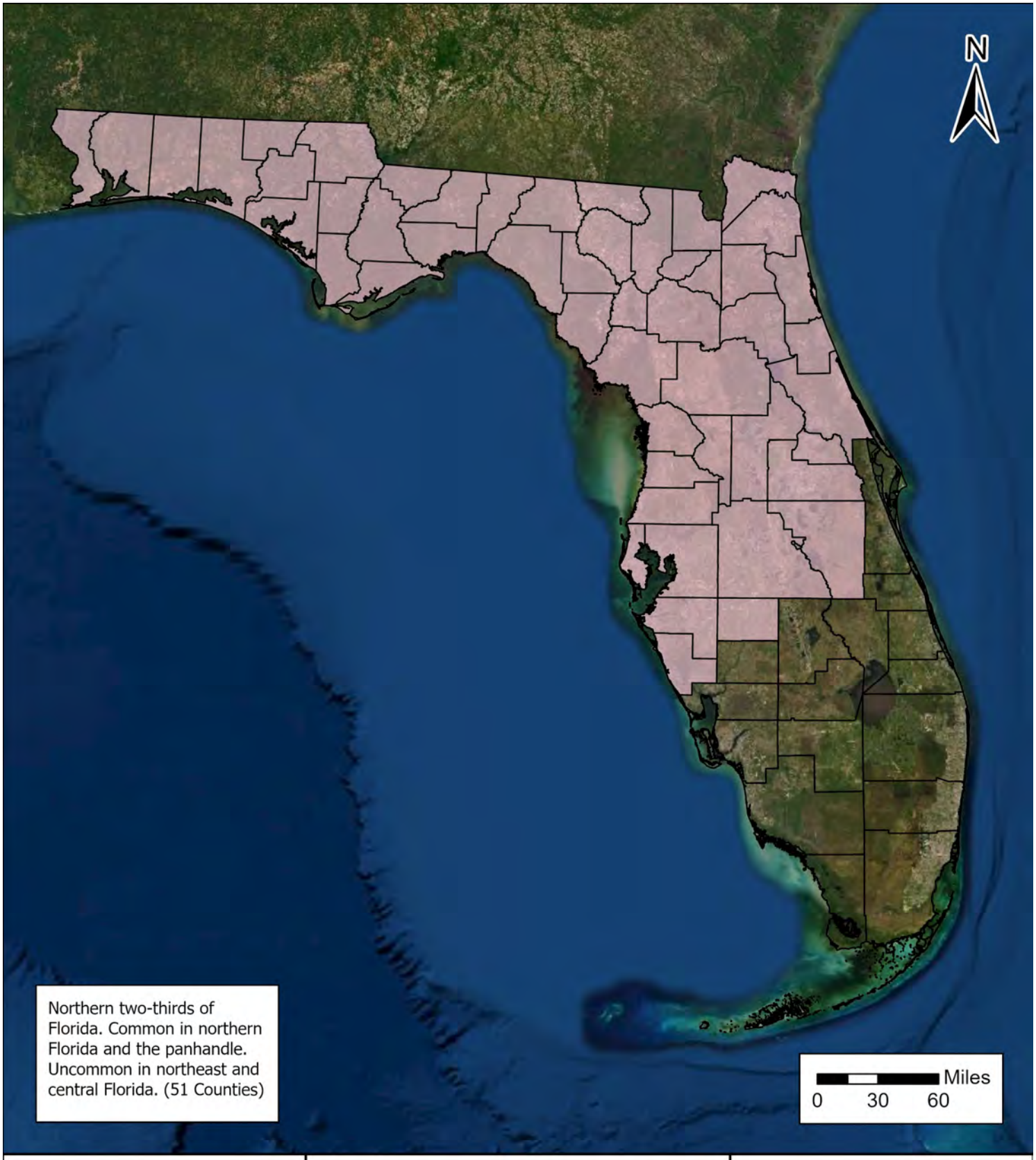
Distribution

FDOT

Southeastern Bat, *Myotis austroriparius*

State Species of Greatest Conservation Need

Photo by James Kiser.



Office of Environmental Management

Southeastern Bat

Myotis austroriparius

Distribution Map

Distribution

FDOT

Gray Bat, *Myotis grisescens*

Federally Endangered

Photo by James Kiser

Office of Environmental Management

Gray Bat

Myotis grisescens

Distribution Map

Distribution

FDOT

Evening Bat, *Nycticeius humeralis*
Photo by James Kiser.

Office of Environmental Management

Evening Bat

Nycticeius humeralis

Distribution Map

Distribution

FDOT

BAT PHOTO IDENTIFICATION

Tricolored Bat, *Perimyotis subflavus*
Federal Candidate Species for Listing
State Species of Greatest Conservation Need.
Photo by James Kiser.

Office of Environmental Management

Tricolored Bat

Perimyotis subflavus

Distribution Map

Distribution

FDOT

APPENDIX B.

Bat Roost Inspection Form

FDOT BAT ROOST INSPECTION FORM

INSTRUCTIONS: Form is to be used in conjunction with the *Bat Exclusion Handbook* to conduct an inspection of a structure(s) (bridges, culverts, pipes, etc.) and buildings (toll facilities, etc.).

PROJECT INFORMATION			
Project Name:			
FM Number:		Environmental Reviewer:	
County:		Inspection Date:	
Work Mix/Activity Type:			
Transportation Type:	☐ Interstate ☐ U.S. Highway ☐ State Road ☐ County Road; ☐ Building ☐ Toll Facility ☐ Rest or Service Area ☐ Weigh Station ☐ Other:		
Project Description:			

STRUCTURE IDENTIFIERS – Fill Out Only Those That Apply.			
*Structure Number:		Owner of Structure:	
Specify the Location(s) of the Bat Roost(s) within the Project Area:			
Purpose of Structure:			
Structure Material:		Height above Ground:	
Number of Main Spans (Bridge):		Deck Type (Bridge):	
Culvert Type:		General Length:	
Pipe Description:			
Building Description:			

***If working on a bridge or culvert, identify the Structure Number. Bridge numbers are located on the traffic barrier on their right side. Culvert structure numbers are located on the top of the headwall, also on the right side. The structure number can be searched in the *National Bridge Inventory Database*.

Bridge Access Issues: (check all that apply)

- ☐ Over bare ground/sediment
- ☐ Over concrete
- ☐ Over riprap
- ☐ Over flowing water or standing water
- ☐ Over navigable waterway
- ☐ Over vegetation
- ☐ Over dirt road
- ☐ Over two-lane road
- ☐ Over four (or more) lane highway
- ☐ Over railroad tracks
- ☐ Over or in close proximity to utilities
- ☐ Other -

Surrounding Habitat: (check all that apply)

- ☐ Residential - Percent Coverage:____
- ☐ Agricultural - Percent Coverage:____
- ☐ Commercial - Percent Coverage:____
- ☐ Woodland - Percent Coverage:____
- ☐ Mixed - Percent Coverage:____
- ☐ Grassland - Percent Coverage:____
- ☐ Ranching - Percent Coverage:____
- ☐ Riparian - Percent Coverage:____
- ☐ Wetland - Percent Coverage:____
- ☐ Other:

Weather Conditions and Temperature During Inspection:

Human Disturbance or Traffic Under the Bridge or Structure? (i.e., human presence, human activities/vandalism; traffic volumes) ☐ High ☐ Low ☐ None

Additional Comment(s) on Disturbance Levels:

Bat Indicators:
☐ Guano ☐ Staining ☐ Insect/Bat Remains ☐ Smell ☐ Noise ☐ Visual

Observations - Visual, Guano, Staining, Noise, Etc.: (Add in details including listing locations within the structure(s). Sketch details below or on back of page.)

Estimate of Roost Size: (Not Required; however, if bats are able to be seen, try to obtain a quick estimate of their number and location. If the number of bats is large, make a partial count of a small area in the cluster and use that number to extrapolate a size for the entire roost).

Areas Inspected: (check all that apply)

- ☐ Gaps
- ☐ Beam Corners
- ☐ Beam Walls
- ☐ Drainage Pipes
- ☐ Expansion Joints
- ☐ Abutment Crevices
- ☐ Concrete Defects & Deterioration
- ☐ Hollow Columns
- ☐ Other:
- ☐ Abutment Hollows
- ☐ Column Sheaths, External Cavities, Internal Cavities
- ☐ Abutment Sheaths
- ☐ Beam Crevices & Beam Facias
- ☐ Vertical surfaces on I-beams
- ☐ Vertical Surfaces Between Concrete End Walks and Bridge Deck

Describe Areas <u>NOT</u> Inspected Because of Safety or Inaccessibility:

☐ **Site Photos:** Photos that Document Representative Conditions

☐ **Bat Photos:** If a photo can be taken safely and with minimal disturbance.

INVESTIGATOR(s)			
NAME(s):			
PHONE:		EMAIL:	