Building Sustainable Communities on an Ecological Foundation
Bioengineering GROUP

18 Commercial Street | Salem, MA 01970
p: 978-740-0096 | f: 978-740-0097
bioengineering.com

23 June 2011

Vincent Spada, Project Manager
Kleinfelder/SEA Consultants
215 First Street, Suite 320
Cambridge, MA 02142-1245

Re: Wildlife Habitat Risk Assessment, PTAB Launching Pit and Overall Project Impact Area.
Contract 12 - Project, Cambridgepark Drive Area Drainage Improvements Project, Cambridge, MA

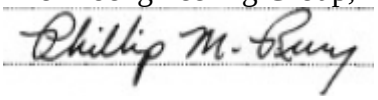
Dear Mr. Spada,

As requested to address ecological impact concerns of the DCR, Bioengineering Group performed site visits and ecological research needed to assess:

1. Potential impacts and risks posed to Alewife Reservation wildlife by night time drilling and utility installation activity
2. Potential impacts and risks to Alewife Reservation wildlife from exposure to artificial lights, in the unlikely event that daylight work periods must be extended to include night work under lights, as a contingency plan, and
3. Wildlife ecological risks and benefits of summer *versus* autumn clearing and grubbing throughout the overall project impact footprint

Site visits were made to document wildlife habitat value and to observe wildlife activity abutting the cleared work area around the pilot tube auger boring (PTAB) launching pit located between the bike path and south bank of the Little River. Our field observations were supplemented with a review of ecological literature for both the Alewife Reservation and regarding potential impacts of artificial lighting on nocturnal wildlife. This report briefly summarizes our approach, results, conclusions, and recommendations regarding the overall ecological benefits *versus* risks to Reservation wildlife of night time work for both the summertime utility installation and for the seasonal timing of the clearing and grubbing needed for the larger project impact footprint.

Sincerely,
The Bioengineering Group, Inc.



Phillip M. Rury, Ph.D., FLS
Senior Ecologist

Cc: T. Ritchie, T. Perreault, J. Struzziery (SEA)
R. Garner and D. Bitsko (Bioengineering Group)

Wildlife Habitat Risk Assessment for the PTAB Launching Pit and Project Impact Areas at the Alewife Reservation Stormwater Treatment Project Site

Approach and Methods

Prior to conducting site visits to document the value of wildlife habitat abutting the cleared work area and activity of wildlife within the work site and surrounding intact habitat, site-specific data on the flora and fauna of the Alewife Reservation were reviewed. Data included the flora and fauna species lists presented in the 2003 Alewife Master Plan, as well as the Breeding Bird Survey and Mammal Tracking Survey conducted for Friends of Alewife Reservation (FAR) by David Brown's Wildlife Services in 2002. Information and maps of wildlife habitats, including areas (known as leks) used for mating rituals by American woodcock (*Scolopax minor*), were obtained from the 2002 breeding bird and mammal surveys. Additionally, data were obtained from *An Alewife Ecology Area Guide* published by the Mystic River Watershed Association (1994) that contains a multi-year compilation of natural history data for the Alewife Reservation.

An initial habitat reconnaissance was conducted between 9:30 AM and 12:30 PM on June 1, 2011 to document the dominant plant communities and species adjacent to the work area. Subsequent morning (7:30 to 10 AM) and dusk/evening (6:00 to 8 PM) visits to the site were made on June 2, 2011 for additional insight to wildlife activity. Because the migratory woodcock is known to breed at the Alewife Reservation and exhibit early evening mating display behavior in open, grassy woodland habitats such as that adjacent to the northwest corner of the cleared work area, evening observations were focused on this habitat.

The woodcock is not a state- or federally-listed bird species, but is protected as a federal trustee resource under the Migratory Bird Treaty Act (MBTA) and its populations are declining in some regions due to habitat loss. It is thus a popular and useful indicator or sentinel species, used to infer potential impacts or risks from anthropogenic disturbances, including environmental contamination and habitat losses. For the Alewife Reservation, in particular, the woodcock serves as a highly sensitive indicator of potential project impacts to the breeding bird community as well as other migratory bird species protected under the MBTA that breed and/or feed within the Reservation.

Although relatively few field monitoring studies have been published on the impact of short- and long-term exposures of nocturnal wildlife to artificial light, several reports were found and reviewed as context for assessing potential risks that night work lighting would adversely affect the behavior of nocturnal birds and mammals adjacent to the PTAB launching pit work site. Reports by various authors consistently indicate that there is a range of hypothetical or documented

impacts/ risks or even benefits to nocturnal wildlife from chronic, long-term exposures to permanent night lighting in urban, suburban and rural areas. Several of the studies reviewed are listed in the references section below.

Results and Discussion

Wildlife Habitat Value of Plant Communities. Densely vegetated habitats abutting the work site along most of three sides provide significant food and cover resources for bird and mammal populations. The bike path and large buildings abut the South edge and nearly half of the habitat along the East side of the work site is degraded due to monocultural stands of Japanese knotweed (*Polygonum cuspidatum*). Higher quality habitats found West and North of the work area result from the dense nature of the forest groves, scrub/shrub uplands and wetlands, and edge habitat formed at the interfaces of these wooded areas with open grassy and emergent marsh habitats within localized depressions and the Little River floodplain. Despite a high incidence of invasive vegetation in some areas near the work site (e.g., Japanese knotweed, common reed, purple loosestrife, multiflora rose, buckthorns, oriental bittersweet, and Tartarian honeysuckle) these plant communities collectively provide significant wildlife habitat value due to an "oasis effect" within an urban setting.

The plant communities within the project area offer valuable habitat by providing abundant, diverse and important sources of food for wildlife, including fruits and seeds of species such as:

- Black cherry – *Prunus serotina*
- Mulberry – *Morus alba*
- Crabapple – *Pyrus coronaria*
- Domestic apple – *Malus pumila*
- Wild apple – *Malus sylvestris*
- Staghorn sumac – *Rhus typhina*
- Elderberry – *Sambucus canadensis*
- Silky dogwood – *Cornus amomum*
- Bayberry – *Myrica pensylvanica*
- Northern arrowood – *Viburnum recognitum*
- Grapes – *Vitis* spp.
- Virginia creeper – *Parthenocissus quinquefolia*
- Blackberry – *Rubus allegheniensis*
- Raspberry – *Rubus idaeus*

All of these fruit producing plants are either in flower or are developing flowers that will feed pollinators and produce fruits to support wildlife throughout the summer. Since the PTAB launching pit site was cleared and grubbed, Alewife Reservation wildlife will focus their foraging almost entirely within the undisturbed habitats abutting and surrounding the cleared work site.

Alewife Bird and Mammal Populations. Surveys of mammals, migrant birds, and breeding birds conducted by David W. Brown in 2002 documented a great abundance and diversity of wildlife inhabiting or foraging within the Alewife Reservation that are especially significant for a highly developed urban setting with heavy human traffic. During the 2002 bird breeding season, 40 migratory or resident bird species were found to be breeding within the Reservation and 12 others were nesting and breeding offsite but recorded as visitors feeding within the Reservation habitats. Nine bird species of winter visitors also were reported at one time or another during the winter of 2002 but were not seen at the Reservation during other seasons. Brown also noted significant use of the unfrozen river and ponds by waterfowl and herons due to the abnormally warm winter.

During the tracking inventory, Brown (2002) reported sign or sightings of 16 species of resident mammals within the Alewife Reservation, including:

- Beaver – *Castor canadensis*
- Muskrat – *Ondatra zibethica*
- Woodchuck – *Marmota monax*
- Gray squirrel – *Sciurus caroliniensis*
- Chipmunk – *Tamias striatus*
- White-footed mouse – *Peromyscus leucopus*
- Meadow vole – *Microtus pensylvanicus*
- Short-tailed shrew – *Blarina brevicauda*
- Cottontail rabbit – *Sylvilagus floridanus*
- Eastern coyote – *Canis latrans*
- Red fox – *Vulpes vulpes*
- Mink – *Mustela vison*
- Long-tailed weasel – *Mustela frenata*
- Striped skunk – *Mephitis mephitis*
- Raccoon – *Procyon lotor*
- White-tailed deer – *Odocoileus virginianus*

Brown mapped locations of mammal sightings/sign in 2002 and other locations where some of the same mammals were seen by other naturalists before 1994 were mapped in the *Alewife Ecology Area Guide* cited above. Beaver have felled many aspen trees in groves between the southern PTAB work area and Little River while muskrat dens are common along the river banks and shorelines of ponds in the Reservation. Brown (2002) commented that fields in the Reservation represent significant wild mammal habitat with meadow vole runways, cottontail rabbit feeding sign/scat, and woodchuck dens that form a large prey base for red fox, Eastern coyote, long-tailed weasel, and mink, for which abundant sign are found in these areas. Brown also cited evidence that coyotes hunt the open fields for voles and rabbits north of the Little River, suggesting that the "Belmont Uplands" silver maple (*Acer saccharinum*) forest is likely used for temporary coyote lay sites since it abuts several productive fields and is the part of the park most remote from human and dog intrusion. Brown noted that all sign of Eastern coyote is north of the river and all red fox sign is south of it, presumably because red foxes will not persist in areas that are invaded by coyotes.

Wildlife Seen Near the HDD Work Site. Field observations at or in habitats abutting the cleared PTAB launching pit work site focused primarily on birds whereas only incidental observations of mammals were made during site visits (see circles and crosshairs in Figure 1). Common bird species most often seen foraging in habitats surrounding the cleared work area and/or flying over or sometimes entering the work area included:

- American robin - *Turdus migratorius*
- Black-capped chickadee – *Parus atricapillus*
- Song sparrow – *Melospiza melodia*
- Red-winged blackbird – *Agelaius phoeniceus*
- Tree swallow – *Iridoprocne bicolor*
- Chimney swift – *Chaetura pelagica*
- Mourning dove – *Zenaida macroura*

A majority of the bird activity, including singing and foraging, was observed in the grassy shrub woodland at the NW corner of the spoil piles and in the groves of trembling aspen (*Populus tremuloides*) found West of the proposed NSTAR conduit and between the north edge of the work area and the Little River. Chimney swifts and tree swallows were most abundant and active at dusk, concentrating their foraging (for flying insects) on the open woodland and aspen groves between the work site and Little River (see Figure 1). Much less bird activity was seen adjacent to the East and West edges of the work area in more degraded habitats with a much higher incidence of invasive vegetation.

Large wildlife were not deterred from visiting the habitat abutting the cleared work area, since three white-tailed deer were seen browsing on hay bales at the northern fence line of the PTAB launching pit area and one wild turkey hen (*Mellagris gallopavo*) flew into the spoil pile area of the site during the day and foraged briefly there before entering the wooded habitat West of the work area (see X labels in Figure 1). Eastern cottontail rabbits also are very common in the Reservation and were seen at the site by Bioengineering Group representatives on two separate dates, during the day and at dusk.

Brown (2002) reported that the American woodcock and some other birds are early nesters at the Reservation so that the males had ceased displaying by early June. No American woodcock were seen anywhere during the three site visits, including the most suitable open grassy woodland and adjacent edge habitats abutting the West and North edges of the work area (Figure 1). Their absence seems to corroborate published reports of them as early Spring arrivals at Alewife Reservation that complete their mating rituals in April and May then remain mostly secretive and inconspicuous during summer and early fall months while rearing their young prior to the southward autumn migration.

Most other birds at the Reservation are well into their breeding season and beyond their most sensitive mating behavioral period. For example, the initial hatch now has occurred in Massachusetts for wild turkeys, such as the female seen foraging in the spoils portion of the work area, so bird breeding behavior will not be disturbed by the summertime PTAB pit preparations, horizontal drilling, and subsequent utility installation.

Potential Impacts of Artificial Light on Nocturnal Wildlife. Literature reviews of "ecological light pollution" such as that of Longcore and Rich (2004), conference proceedings about artificial light impacts, and studies of various organisms have shown a range of adverse and beneficial impacts on nocturnal species that are either attracted to or repelled by artificial light. Some species enjoy a net benefit while others are affected adversely or experience a combination of positive and negative impacts of night lighting. Longcore and Rich summarized known or possible effects on populations and behaviors of insects and wildlife as follows:

- Ecological light pollution includes chronic or periodically increased illumination, unexpected changes in illumination, and direct glare

- Animals can experience increased orientation or disorientation from additional illumination and are attracted to or repulsed by glare, which affects foraging, reproduction, communication, and other critical behaviors

- Artificial light disrupts interspecific interactions evolved in natural patterns of light and dark, with serious implications for community ecology

Nocturnal predators that are not repelled by bright lights actually may benefit from increased visibility of prey. While any amphibian, bird, reptile, bat, or other mammal predators of insects attracted to night lighting may benefit from higher concentrations of prey found within night-lit habitats, such concentrated feeding, ultimately, also could cause a reduction in some prey populations. Other wildlife may forage less at higher light levels, as reported for small rodents (Lima, 1998) as well as some lagomorphs (Gilbert and Boutin, 1991), snakes (Klauber, 1939), and bats (Rydell, 1992). Some herbivorous mammals are known to forage less during moonlit nights, presumably to avoid increased nocturnal predation.

Adverse ecological effects of <u>permanent</u> artificial lighting that illuminates ground-level habitats and/or the associated night sky include:

- Disorientation and attraction to lights of migratory birds that fly during the night, often leading to fatal collisions with very tall, lighted structures

- Disruption in nocturnal breeding and territorial behaviors of some birds

- Delay or disruption of nocturnal wildlife feeding due to elevated light levels, including some amphibians (e.g., tree frogs) and small mammals

- Disruption of egg laying and mating by fireflies, moths and other insects

- Reduced anti-predatory defenses in moths and other insects that congregate at bright lights contributing to increased predation by bats, although Frank (2002) noted that no extinctions of moth populations

thriving near urban lights have been reported due to artificial light

- Increased raptor or mammal predation on amphibian, bat, bird, and small mammal species that are adapted to feeding in the dark but become more visible and vulnerable as prey themselves when opportunistically feeding on insects around lights

Most studies have documented adverse impacts of long-term exposures of wildlife to permanent artificial lights, rather than short-term exposures to night lights used for shorter duration at temporary work sites. Nocturnal bird mortalities associated with artificial lighting most often result from collisions with tall, lighted structures such as buildings, communication and electrical transmission towers, rather than street lights or work lights. Moonlight has been shown to mitigate disorientation of migrating birds by tall artificial lighting, resulting in fewer collisions with light towers and other tall structures, apparently due to the better visibility of such obstacles at night. So it is plausible that permanent urban night lighting already surrounding the Alewife Reservation has a mitigating effect on migratory birds comparable to that of moonlight.

As noted by Riiters and Wickham (2003), 20% of land area in the coterminous USA lies within 125 meters of a road and experiences light pollution. Sources of ecological light pollution surrounding the Alewife Reservation include sky glow, lighted buildings and towers, security lights, streetlights, and lights on vehicles. The nature and magnitude of light impacts depends on the brightness (measured in lux or foot candles as perceived by the human eye) and wavelengths emitted, so that some light sources have more pronounced effects on fauna (and flora) than others. For example, moths and many other insects are attracted to ultraviolet wavelengths emitted by high pressure sodium lamp but not to the more energy efficient, low pressure sodium lamps that lack these wavelengths.

In road-lit areas and within urban or suburban settings such as Cambridge, urban habitats such as the Alewife Reservation already are receiving a chronic influx of artificial lighting from adjacent developments, so nocturnal wildlife populations inhabiting or foraging in the Reservation may be acclimated to chronic infiltration of night lighting into at least the peripheral portions of their habitats. Thus, it is likely that the addition of temporary night work lighting directed into cleared and grubbed work areas that no longer provide nesting or foraging habitat would incrementally increase existing light pollution levels, but only slightly and for short periods of time that are ecologically insignificant over the long term.

Potential Disruption of Wildlife Activity from Day and Night Drilling. Based on the seasonal breeding patterns of birds and mammals documented for the Alewife Reservation and related field observations of wildlife activity at or adjacent to the PTAB launching pit work area, the most sensitive reproductive activities of the most vulnerable species, such as American woodcock, already have ended. Thus, the day and night time drilling using the PTAB process, which is a low-impact horizontal directional drilling (HDD) method, within the cleared launching pit site

adjacent to the bike path at the southern edge of Alewife Reservation is very unlikely to adversely affect wildlife populations, even those nocturnal feeders and/or bird species with night courtship behaviors during the Springtime.

Artificial light may alter feeding and breeding behaviors or success of some nocturnal wildlife in relatively pristine suburban and rural habitats now lacking ecological light pollution. In contrast, short-term uses of temporary artificial lighting to illuminate work areas within urban habitats supporting wildlife that are pre-acclimated to light pollution can be reasonably expected to add a small, but ecologically insignificant and temporary incremental risk of impact to nocturnal behavior, consisting mostly of foraging. Despite the daytime construction equipment activity and noise from continual dewatering operations at the site in early morning, midday and dusk/evening, the normal patterns and frequency of bird activity observed at the launching pit work site, as well as visits to the work site by white-tailed deer and a wild turkey, indicate that continued day and night time PTAB activity and related utility construction will pose no significant risk of adverse effects on wildlife during the next several months.

Due to the abundance and diversity of wildlife food plants surrounding much of the PTAB work area, preservation of these plant communities during the summertime utility work will continue to support foraging by wildlife adjacent to the work area. Since the night light towers to be used at the PTAB site will be only 25 feet tall and migratory birds are not at risk during their summer residency, even from collisions with much taller light towers and buildings, the lights will pose no significant risk of collision to migratory birds. No ecologically adverse or significant increases of night time illumination within adjacent habitats are expected because all work lights will be directed into the cleared work area and little if any bleeding of the light into the adjacent forest and woodland habitats is expected due to the very high density of the vegetation, including some areas of the invasive Japanese knotweed.

Ecological Risks/Benefits of Summer versus Autumn Clearing and Grubbing. As noted above, the mosaic of plant communities within the larger project impact area surrounding three sides of the cleared PTAB launching pit work site provides an abundant and diverse source of fruits and seeds eaten by wildlife that are now in the early stages of flowering and fruiting. Despite some areas of degraded field, forest, and woodland habitat dominated by invasive plant species of little value to wildlife, the overall benefit of these plant communities to resident birds and mammals is significant enough to warrant their preservation throughout the summer. This will allow wildlife populations inhabiting and/or foraging within this part of the Alewife Reservation to benefit nutritionally before these habitats are lost in October.

If portions of the created or enhanced upland and treatment wetland habitats can be completed and planted before the Spring return of migratory birds for the 2012 breeding season, the temporary, short-term loss of these food plants in October also can be mitigated to some extent. While the temporary reduction in vegetative

cover during construction should not adversely affect breeding bird populations, working at night prior to their return may help increase the amount of replanted habitat available to migratory birds after they return. However, the use of artificial lights within the larger project area, as a contingency plan to offset any unexpected schedule delays, should not occur during either the alewife return migration in the Little River nor after the return of migratory birds and onset of the bird breeding season.

If the use of night lighting were to accelerate the earthworks, habitat enhancement and restoration schedule, it is conceivable that returning bird populations could use many portions of the replanted, upland and wetland habitats during the Spring breeding season. For example, several acres of woody vegetation will be planted with mature shrubs and trees, including the upland, riparian woodland, and scrub-shrub wetland habitats. Unlike vulnerable herbaceous wetland plantings that must be enclosed by protective fencing to prevent foraging damage by geese and other large waterfowl while they become established, the diverse plantings of woody species need not be protected by fencing. Thus, all woody plants that can be installed early in the Spring of 2012 will provide useable habitat for resident wildlife and for migratory birds, as soon as they return to the Reservation.

Conclusions and Recommendations

Based on a preponderance of evidence from prior site-specific studies and recent field observations of flora and fauna at Alewife Reservation, published data on theoretical impacts and risks of artificial light to nocturnal wildlife behavior, and a consideration of the urban setting and likely pre-acclimation of wildlife in the Alewife Reservation to existing urban light pollution, we can reasonably conclude that the use of artificial lights to illuminate work sites at night will not adversely affect the breeding, feeding or migratory behavior of nocturnal wildlife known to breed and/or forage within the diverse habitats of the Alewife Reservation.

Early breeder bird species that are most sensitive to daytime and nocturnal human disturbances while courting/mating in early Spring, such as American woodcock, are no longer conducting evening mating displays in habitats adjacent to the PTAB work area and were not seen there after dusk. In addition, woodcock and many other migratory birds using the site will begin their southward migration beginning in late September or early October, before the clearing, grubbing and construction activity within the larger project impact footprint of the Reservation. Clearing of the larger project area now planned for October, thus, is unlikely to pose an ecological risk to migratory bird species residing in or passing through the Alewife Reservation, even if artificial lighting is used at night to enable around-the-clock area work and thus accelerate project construction.

If around-the-clock construction were to be needed as a contingency, to maintain the construction schedule and assure that work areas are stabilized before the return of the alewife and/or migratory birds for their early Spring breeding season,

the benefits of a more stabilized work area to both the alewife and breeding birds almost certainly will outweigh any unexpected risks to nocturnal wildlife from using artificial lights for night work from October to April 15th.

Finally, due to the abundance and diversity of the wildlife food resource within the currently undisturbed habitats of the larger project impact footprint, delay of clearing and grubbing throughout the larger project area until October is preferred to assure that the wildlife populations inhabiting or foraging there have the full nutritional benefit of this food resource prior to the autumn bird migrations and subsequent winter conditions that will be experienced by resident wildlife. The loss of some or all of this food supply that would result from a summer start of clearing and grubbing of the larger project area clearly poses a much greater risk of adverse, albeit short-term and temporary impact to the wildlife of the Alewife Reservation, as strongly contrasted with the *de minimis* risk of negative short-term effects on fauna from night lighting directed into cleared work areas.

Bioengineering Group therefore recommends the following:

1. Request landowner approval from DCR for the use of night lighting directed into the PTAB launching pit work area and complete the PTAB and utility installation work as quickly as possible, to minimize overall disturbances of wildlife that inhabit and/or feed within the adjacent plant communities.

2. Adhere to the original schedule of an October start date for the clearing, grubbing and subsequent earthwork throughout the larger project impact footprint, so as to preserve the abundant wildlife food resource provided by diverse plant species that are now in early stages of flowering and fruiting.

3. Request landowner approval from DCR for the use of night lighting directed into the active work areas throughout the larger project footprint, as a contingency plan for mitigating unexpected project delays, beginning in October after most migratory birds have left the Reservation but ending prior to the Spring spawning season for alewife returning to the Little River and/or return of migratory bird populations for the 2012 breeding season.

4. Night lighting should not be used during the alewife migration/spawning period (April 15 to May 31) and migratory bird breeding season.

5. Evaluate the possible use of Low Pressure Sodium lighting to illuminate night work areas, as a lower cost, more energy efficient alternative to lighting that emits wavelengths known to attract moths and other insects, so as to mitigate the low-level risk of increased predation of insects drawn to work lights.

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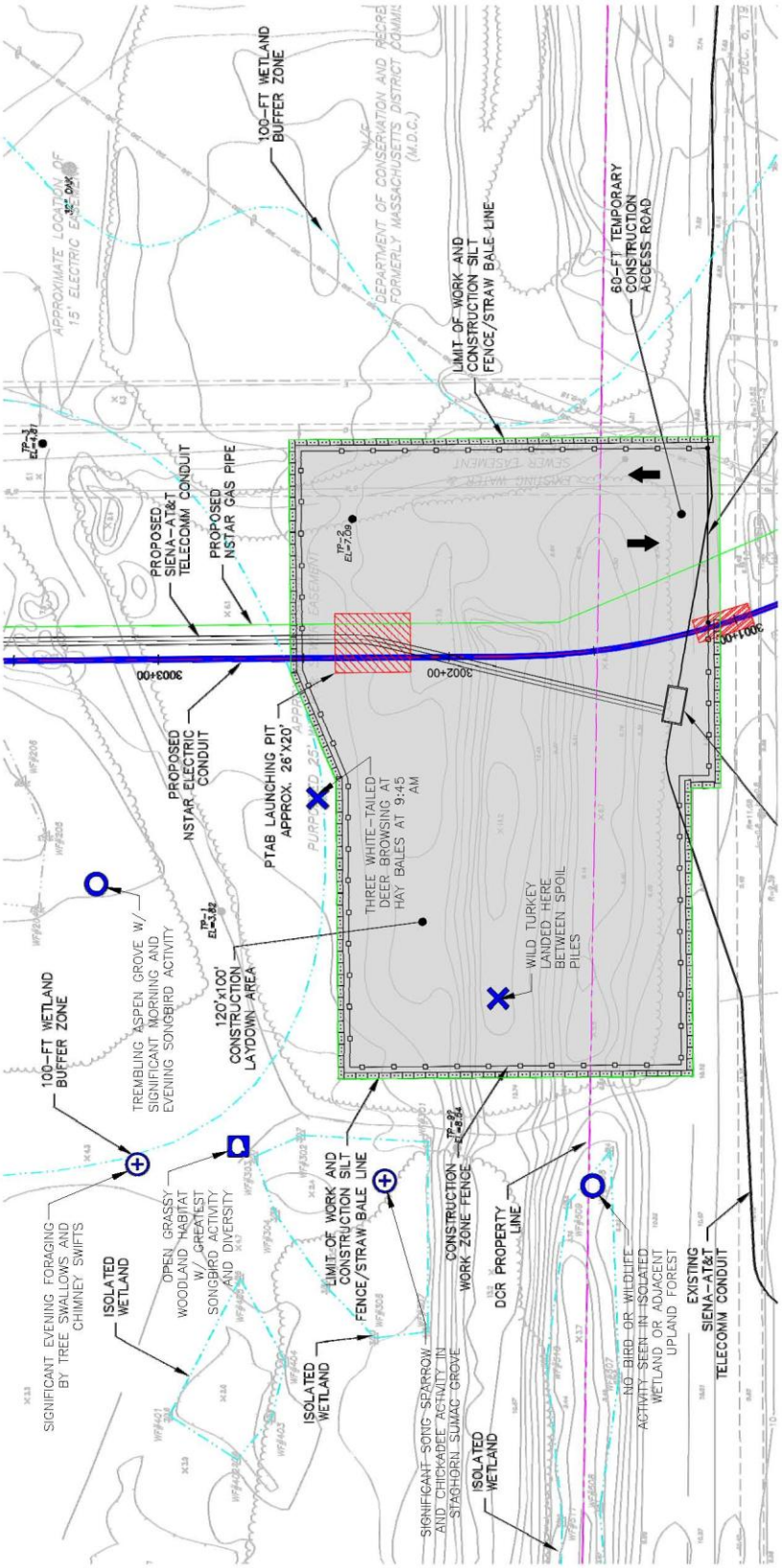

Figure 1. Excerpt of PTAB Launching Pit Site Plan with Locations of Habitat and Wildlife Observations