

Environmental Assessment

Attachment K. Kentucky Terrestrial Nuisance Species Management Plan

Kentucky Terrestrial Nuisance Species Management Plan 2008

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Table of Contents

Acknowledgements.....	3
Goals and Objectives	4
Introduction.....	6
Most Problematic Kentucky TNS List.....	13
Existing Authorities, Regulations, and Programs	18
Objectives, Strategies, Actions, and Cost Estimates.....	30
Program Monitoring and Evaluation	36
References.....	37
Glossary	38
Appendix I: Acronyms.....	41
Appendix II: Other Identified TNS within Kentucky	42

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Goals and Objectives

TNS Definition and Overview

Terrestrial nuisance species (TNS) are non-native species that threaten the diversity or abundance of native terrestrial species or the ecological stability of ecosystems, or commercial, agricultural, or recreational activities dependent on such ecosystems. To address this issue, the Kentucky Department of Fish and Wildlife Resources (KDFWR) is developing a plan to help manage problems associated with TNS. The Kentucky Terrestrial Nuisance Species Management Plan (hereafter referred to as, the “Plan”) will help compliment any existing Kentucky TNS management efforts as well as coordinate and guide any implementation of KDFWR programs and policies involved in managing TNS.

The Plan has been created to help Kentucky deal with the myriad of problems associated with TNS. The aim of the Plan is to identify and describe TNS problems within Kentucky and to provide specific management actions that can mitigate current situations and prevent future problems. To help us achieve the aim of the Plan, the following goals and objectives have been developed.

To successfully implement our Plan, KDFWR officials hope to achieve the following **4 goals**:

1. Stop new introductions of TNS to Kentucky.
2. Prevent the spread of TNS currently in Kentucky and neighboring states.
3. Limit damages from TNS that cannot be eradicated.
4. Educate the public and stakeholders so they do not facilitate introductions and/or dispersal of new or existing TNS.

The **4 objectives** necessary to meet these goals include:

1. Provide programs to prevent introductions and transport of TNS.
2. Raise public and stakeholder awareness of TNS issues.
3. Develop and utilize a TNS early detection and rapid response (EDRR) system.
4. Offer effective communication and coordination of TNS management activities.

This Plan attempts to incorporate realistic and efficient objectives to achieve the desired goal of minimizing the adverse effects of TNS by using the most environmentally sound and effective methods available.

By developing this Plan, agencies and citizens throughout Kentucky can work to prevent invasions that could inflict more severe impacts while limiting the spread of those TNS already in the state. Implementation depends upon state agencies and citizens recognizing the importance of the state’s terrestrial resources in relation to economic, social, and

biological activities. All must have knowledge of the invaders, agree to contain them, and cooperate to prevent introductions of new TNS.

Introduction

The state of Kentucky is located in the east-central United States and contains numerous terrestrial habitats, including karst systems, flood plains, flat lands, bottomlands, rolling hills and meadows, knobs, plateaus, valleys, rocky ridges, and mountains. Residing in these habitats are diverse native flora and fauna, many of which are identified by federal and state agencies as threatened or endangered (U.S. Fish and Wildlife Service, 2008), (Kentucky State Nature Preserves Commission, 2005). Like many states, Kentucky is experiencing adverse biological, socio-economic, and aesthetic impacts from TNS that threaten terrestrial ecosystems statewide.

Excluding the turn of the 20th century devastation of the American chestnut tree by the chestnut blight, the ecological and economic impacts of TNS on the state's wildlife and terrestrial resources have been limited to specific areas or types of ecological systems without inflicting severe damage on the entire state. However, certain TNS (e.g. feral hog, hemlock wooly adelgid, sudden oak death, chronic wasting disease, amur honeysuckle) have the potential to devastate certain native ecosystems and/or organisms. All threats must be treated seriously, or the problem and management costs will continue to grow. Most TNS identified in this Plan have spread to Kentucky through a combination of natural and human forces. Recognition of those forces is the first step in limiting future impacts.

To prevent and manage TNS in Kentucky, an understanding of the state's major regional terrestrial habitats is necessary. Kentucky encompasses 39,732 square miles of land including five major regional terrestrial habitats. These five diverse and distinct regions include the Mississippi Embayment, Mississippian Plateaus, Western Coal Field, Bluegrass, and Eastern Coal Field. Below, the major geographic features of these regions are described. The information describing these regions and the map (Figure 1) have been gathered from the University of Kentucky's Kentucky Geological Survey website (<http://www.uky.edu/KGS/>). Because these regions are naturally occurring, they are not limited by state or county boundary lines. Thus, regional and statewide coordination of TNS management efforts are essential because each of Kentucky's five distinct regions encompasses numerous counties (see Figure 2) and shares a border with at least one neighboring state.

Land Regions and County Maps of Kentucky

Mississippi Embayment (or Jackson Purchase Region)

This region at the far western end of the state is located in the Gulf Coastal Plain of the central United States and consists of alluvial deposits and loess. This area is characterized by flood plains with low hills. It is bounded by the Mississippi River, Ohio River, and Kentucky Lake and includes the lowest elevations in the state.

Mississippian Plateaus (or Pennyryle Region)

The region stretches along the southern border of Kentucky from the Land Between the Lakes in the west to the Pottsville Escarpment in the east. The southern portion of the

Mississippian Plateaus consists of flat lands with some rolling hills. In the center of the region lies a treeless area called The Barrens. The northern section consists of rocky ridges and underneath lie numerous caves.

Western Coal Field

The Western Coal Field is located in northwestern Kentucky and is characterized by hills bordered by the Ohio River on the north, and the Mississippian Plateaus on the east, west, and south. It is called the Western Coal Field because of its large coal deposits.

Bluegrass Region

In north central Kentucky lays the Bluegrass Region. This area extends into Ohio but is bordered in Kentucky on the north and west by the Ohio River. This area is characterized by rolling meadows in the central portion and by knobs on the eastern, southern, and western edges. These areas are referred to as the Knobs Region.

The region is named for Kentucky bluegrass (*Poa pratensis*), which has been extensively used in pastures here. The details of the introduction of bluegrass to the area are obscure, but it is probably of Eurasian origin and arrived in central Kentucky with the first European settlers.

Eastern Coal Field

The Eastern Coal Field covers the eastern end of the state, stretching from the Appalachian Mountains westward across the Cumberland Plateau to the Pottsville Escarpment. This area consists of mountains, plateaus, and valleys. The Cumberland and Pine Mountains are found in this region as well as Black Mountain, the highest point in the state. As suggested by the name, coal underlies much of the region.

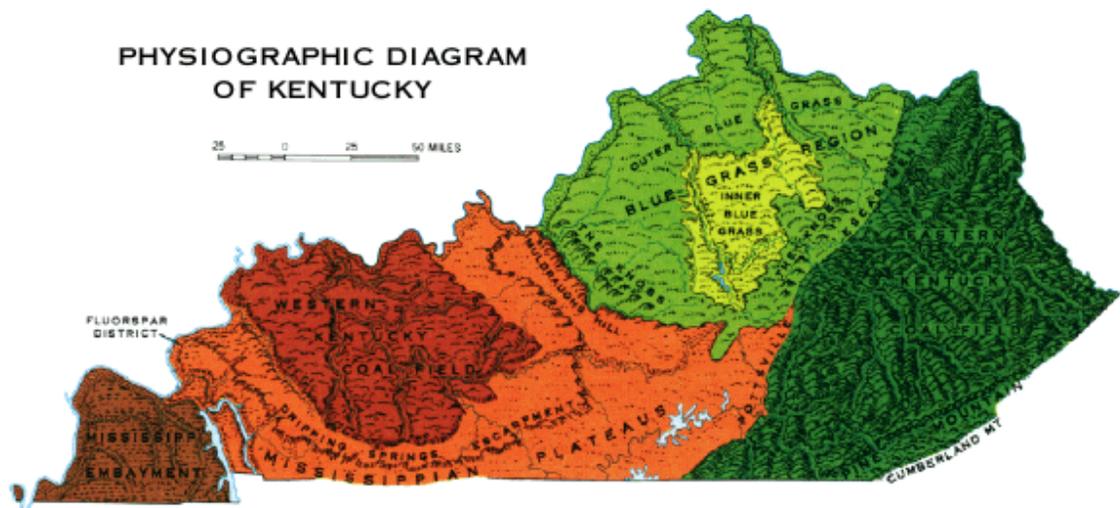


Figure 1. Map of the five major terrestrial physiographic regions within Kentucky (<http://www.uky.edu/KentuckyAtlas/kentucky-atlas.html>). The color scheme for each unit is as follows: Mississippi Embayment (Brown), Mississippian Plateaus (Orange),

Western Coal Field (Red), Bluegrass (Light Green), and Eastern Coal Field (Dark Green).

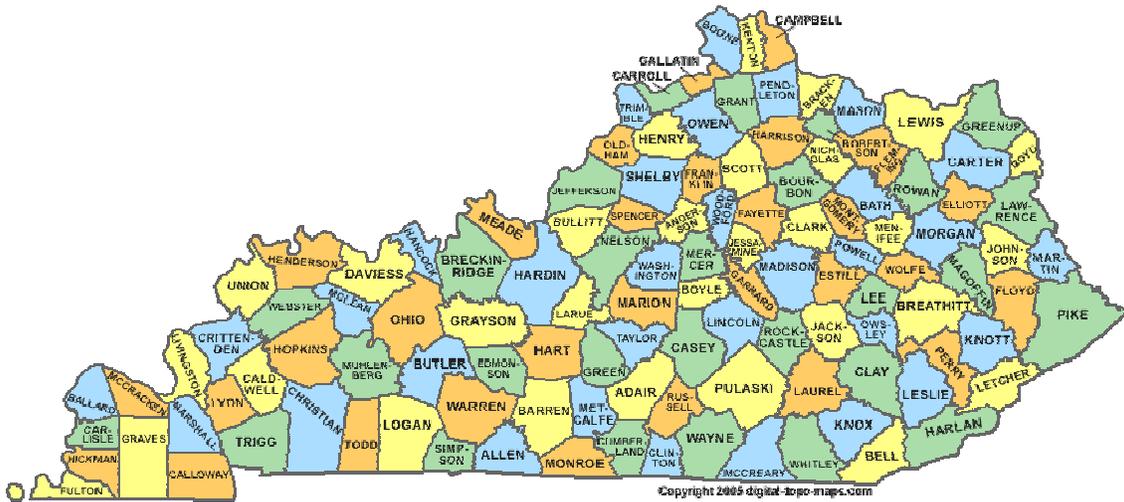


Figure 2. Map of Kentucky counties. A county map is provided because TNS distribution data in Kentucky are reported by county (<http://county-map.digital-topo-maps.com/kentucky.shtml>).

What are TNS?

Terrestrial nuisance species are non-native species that threaten the diversity or abundance of native terrestrial species, the ecological stability of ecosystems, or commercial, agricultural, or recreational activities dependent on such ecosystems.

Of course, these species did not migrate here naturally. Since the arrival of the earliest European settlers, native ecosystems have accommodated non-native introductions. Settlers brought many agricultural, medicinal, and horticultural species to North America in an effort to ease hardship and reap benefits provided by these species. Many of these species continued to benefit human populations and never caused significant harm to native species, ecosystems, and human utilization of these natural resources. However, once introduced (intentionally or accidentally), a relatively small percentage (~15%) of these introduced organisms can cause a great deal of harm to the nation’s native flora and fauna and the human use of them (Office of Technology Assessment, 1993). These species are termed “nuisance species,” and if not managed effectively, can cause or have caused great biological, socio-economic, and aesthetic harm. This Plan does not try to manage all nuisance species within Kentucky, only those species deemed most problematic and primarily inhabiting terrestrial environments, hence the term “terrestrial nuisance species.”

Why are TNS so successful?

Unfortunately, once introduced, many TNS are equipped for a speedy and successful takeover of native ecosystems. They have numerous adaptations and advantages that allow them to quickly colonize and spread.

Some of these adaptations include:

- Reproductive characteristics that facilitate rapid dispersal and colonization and self-sustaining populations. Many of these organisms possess one or more of these traits: high seed counts, prolific vegetative growth, high survival, rapid maturation, and allelopathy.
- Wide tolerance of diverse and fluctuating environmental conditions. Kentucky has a temperate climate and variety of ecosystems that allow many opportunities for TNS to thrive. Some of these ecosystems are fragile, increasing the need to prevent TNS introductions.

Because native populations evolved within their native ecosystems, checks and balances exist to prevent a single organism from dominating a system. Terrestrial nuisance species did not coevolve with the native organisms in their new environment and therefore lack many natural controls resulting in competitive advantages.

Some of these advantages are:

- Lack of predators that limit a species in its native range.
- Ability to utilize and compete for limited nutrients, food supplies, or other resources.
- Tolerance of a wide range of environmental conditions.

These adaptations and advantages help TNS populations explode because they can quickly outcompete and overrun existing native species, especially in newly open spaces within recently disturbed areas.

Pathways: How do TNS get here, and how do people contribute to their spread?

An important component of preventing and managing TNS is understanding pathways. Pathways are natural and man-made connections that facilitate the introduction or spread of TNS or their reproductive materials. Understanding these avenues of spread is particularly important because preventing new introductions is the single most effective way Kentucky can avoid the much higher costs of managing existing TNS problems. Terrestrial nuisance species can be introduced by natural phenomena such as wind currents and animal transport as well as human actions. Once established, TNS can spread via natural pathways much like native organisms. Such spread can decrease the health and human use of terrestrial systems. These terrestrial systems are important to many in Kentucky for recreation and commercial use. Below, are the most common ways in which humans contribute to the spread of TNS in Kentucky.

Physical transport

Humans contribute to the spread of TNS by physically transporting them from one location to another. TNS can be moved from location to location attached to transportation sources, in cargo, people's feet, etc. Further complicating the problem, Kentucky's natural areas are used by many outdoor recreational enthusiasts from neighboring and nearby states, increasing the chance of new TNS introductions into Kentucky from out-of-state sources.

Release into the wild

A source of TNS introductions in Kentucky has been through direct unintentional or intentional release into the wild. This can occur in different ways:

Gardens and nurseries

The sale of non-native terrestrial plants from nurseries or garden centers is an economic asset to many communities, but inaccurate labeling and lack of knowledge about native and non-native species provide a pathway for introducing and spreading TNS. Non-native species that have the ability to overwinter in Kentucky's terrestrial habitats could be particularly problematic. Compounding the problem, many garden and nursery TNS are available for purchase on the Internet.

Nursery and plant wholesalers and retailers do not always ensure that species sold to the public are not TNS. Many do not know which species are problems. Some TNS available at nursery or garden stores may be mislabeled or confused with similar looking native plants. Other non-invasive plants may have TNS "hitchhikers" attached to or mixed in with them.

Purposeful introduction

Some plant TNS were initially released through well-intentioned, but in hindsight, ill-informed government programs for erosion control, road barriers, etc. Other plant TNS were introduced through government sponsored agricultural programs, mainly as forage for livestock.

Failure to maintain effective biosecurity

Researchers may release TNS when they fail to properly contain experiments and subjects or dispose of live material after a project has been completed. Furthermore, many TNS are readily available from biological supply houses and can be ordered through catalogues and the Internet.

Cultural

Ethnic or religious groups may intentionally release culturally familiar organisms for food, medicine, or religious reasons. Examples of TNS in Kentucky believed to be released through this pathway include garlic mustard (food source) and Japanese hops (medicinal properties).

Is Kentucky vulnerable?

Make no mistake, Kentucky, with its abundance of terrestrial ecosystems, is vulnerable. Terrestrial habitat within the state includes 39,732 square miles of land area (http://www.netstate.com/states/geography/ky_geography.htm). We share a common border with seven other states (Missouri, Illinois, Indiana, Ohio, West Virginia, Virginia, and Tennessee) making their TNS problems our TNS problems and vice-versa. Kentucky has major transportation corridors along our interstate highways and major shipping corridors along the Ohio and Mississippi Rivers. Furthermore, the state's temperate climate and variety of terrestrial ecosystems provide many opportunities for adaptable and tolerant TNS to thrive. Many native ecosystems are fragile with numerous imperiled flora and fauna.

What does Kentucky have to lose?

Although all the impacts of existing TNS on Kentucky's terrestrial habitats are currently unclear, our experiences, and the experiences of other states, warrant immediate action. Kentucky has 11 terrestrial species that are listed as federally endangered (U.S. Fish and Wildlife Service, 2008). Including five mammals, four plants, one bird, and one insect. Four plants and one bird species are also listed as federally threatened (U.S. Fish and Wildlife Service, 2008) in the state. Furthermore, 390 plants, 317 animals, and one lichen are listed by the state as endangered, threatened, of special concern, or historic (Kentucky State Nature Preserves Commission, 2005). Approximately 42% of the 958 aquatic and terrestrial species listed as federally threatened or endangered in the United States are at risk primarily due to non-indigenous species (Wilcove *et. al.*, 1998). To illustrate this sense of urgency, a new TNS Cogon grass (*Imperata cylindrica*), was discovered in Kentucky while this Plan was being drafted. Kentucky cannot afford to take chances and must resolve to be as proactive as possible. The single most important way to prevent biological, socio-economic, and aesthetic loss in this state is to prevent new introductions of TNS.

What are the negative impacts associated with TNS?

Once established, TNS have serious biological, socio-economic, and aesthetic impacts.

Biological impacts include:

- Disruption of balanced food webs and nutrient cycling.
- Degradation of native habitats.
- Reduced abundance of native organisms due to increased competition (i.e., food resources, nesting areas).
- Decreased biodiversity.
- Alteration of natural disturbance regimes.

Beyond the terrestrial systems where TNS reside, their impacts are felt by local, state, and federal entities that must provide resources to prevent, contain, and limit the socio-economic impacts of TNS.

Socio-economic impacts include:

- Depletion of limited management resources.
- Lost tourism dollars when recreational experiences such as hunting and hiking are no longer possible or pleasant.
- Reduced property values resulting from TNS overgrowth and “smothering” of forests and opens spaces.
- Decrease productivity and increase costs when TNS interfere with commercial logging and agricultural operations.
- Interference with transportation right-of-ways.

All of these problems must be dealt with, and the costs associated with managing TNS can soar. For example, estimated damage and control costs of invasive species (aquatic and terrestrial) in the U.S. alone amount to more than \$138 billion annually. (Pimentel *et al.*, 2005). Kentucky simply cannot afford to act indecisively.

Finally, the loss of aesthetic value that is felt by every citizen and/or visitor to Kentucky due to TNS must be considered. For example, what dollar amount equals not being able to share a favorite hunting spot with a child or grandchild? How many future memories will be lost because hiking areas have been degraded? Although biological and socio-economic loss can be quantified through losses of biodiversity and dollar amounts, aesthetic loss to current and future generations cannot.

Most Problematic Kentucky TNS List- 2008

When attempting to develop a TNS Management Plan, it is important to identify problematic TNS established in the state and those that may potentially arrive. Potential arrivals may already exist in neighboring states or have life histories that could allow them to survive in Kentucky's climate and terrestrial ecosystems. In Kentucky, numerous TNS are established. Established TNS and potential arrivals currently include six microorganisms, 39 plants, four insects, two birds, and a mammal. Those TNS considered the most problematic to Kentucky are listed below and are candidates for active management. All other identified TNS are listed in Appendix II. Furthermore, when provided, the lists contain general Kentucky distribution information as well as a summary of comments reviewers may have had about a particular TNS. Due to the nature of the TNS problem, the lists should be updated annually to reflect any new problems and/or changes in priorities.

<u>Scientific Name</u>	<u>Common Name</u>	<u>Distribution</u>	<u>Comments</u>
TN Microorganisms: Established			
<i>Cryphonectria parasitica</i>	Chestnut blight	Widespread	
<i>Discula anthracnose</i>	Dogwood anthracnose	Widespread	Seems to be much less a problem in areas of open, upland forest than in mesic areas
<i>Nectria coccinea</i> (fungus) via <i>Cryptococcus fagisuga</i> (insect)	Beech bark disease	Known in OH, WV	Would be devastating for beech forest, but will not remove beech as a species
<i>Sirococcus clavignenti-juglandacearum</i>	Butternut canker	Widespread, most trees in KY affected	Without intervention may mean the loss of the species
TN Microorganisms: Potential Arrivals			
<i>Phytophthora ramorum</i>	Sudden oak death		Infestation would have devastating economic and ecological effects
CWD prion	Chronic wasting disease		Arrival could devastate the states successful elk restoration program
TN Plants: Established			
<i>Ailanthus altissima</i>	Tree-of-heaven	Widespread in KY	Invades disturbed ground and open forest; rapid growth; forms dense colonies prolific sprouter; rapid spread; prolific seeder (wind)
<i>Alliaria petiolata</i>	Garlic mustard	Most abundant in basic soils but spreading elsewhere	A serious pest of mesic forest and woodland; Highly disruptive to ecological systems and species
<i>Bromus inermis</i>	Smooth brome grass	Largely in high-base soils areas, but scattered	Strongly rhizomatous and quickly forms monoculture; especially of concern for prairie areas, pasture

		throughout KY	
<i>Bromus tectorum</i>	Cheatgrass	Throughout KY	Invades disturbed ground of many types, in large infestations becomes a fire hazard and an ecological disruptor
<i>Carduus nutans</i>	Musk thistle	Across state, most abundant on base-rich soils	Largely a disturbed ground/Ag weed, but with potential to invade natural grassland/woodland (not forest); prolific seeder; chemical control must be timed correctly because seed can ripen in treated heads
<i>Celastrus orbiculata</i>	Oriental bittersweet	Across state, most abundant on base-rich soils; rapidly spreading	Bird and people spread; measures to prevent its use in decorations needed; can form large thickets; usually open ground, but can invade forest, woodland; threatens native bittersweet's gene pool
<i>Centaurea biebersteinii</i>	Spotted knapweed	Across state, prefers base-rich soils	Spreads rapidly, difficult to eradicate; invades grasslands easily; promoted by fire—will invade open forest, woodland
<i>Centaurea solstitialis</i>	Golden star thistle	Few scattered records for KY	Potential for serious pest in open lands—especially Ag and highway areas
<i>Conium maculatum</i>	Poison hemlock	Widespread	Forms large patches that choke out native spp., can poison livestock
<i>Coronilla varia</i>	Crown vetch	Widespread, widely planted on roadsides; for erosion control	Forms monocultures that choke out most other species; fire promoted; especially prolific on base-rich soils; can invade grasslands, open forest, woodlands; threatening federally listed sp.
<i>Daucus carota</i>	Queen Anne's-lace	Widespread	Serious pest in native grasslands/glades
<i>Dioscorea oppositifolia</i>	Chinese yam	Throughout KY	Serious pest of open, mesic forest, woodland, riparian areas; plowing, disking, etc spread it through fields and field to field; forms DENSE choking monocultures
<i>Elaeagnus umbellata</i>	Autumn olive	Across KY	Most planted (mine areas, roadsides, w/l openings), and escaped; can form dense thickets under which little grows; persists under canopy; bird spread
<i>Euonymus alatus</i>	Winged euonymus	Throughout KY; prefers base-rich soils	Widely cultivated and escaped; bird spread; will established in open or closed habitat and can form dense thickets
<i>Euonymus fortunei</i>	Winter creeper	Throughout KY; prefers base-rich soils	Widely cultivated and escaped; bird spread; will established in open or closed habitat and can form dense thickets; high climber and can choke trees
<i>Frangula alnus</i>	Glossy buckthorn	Scattered in northern KY; a calciphile with ability to spread to more acid soils	Bird spread, forms dense, vegetation choking thickets, primarily an open land species
<i>Imperata cylindrica</i>	Cogon grass	Recently found in southern KY	Aggressive, extremely difficult to eradicate/control colonial grass; forms sold for ornament can revert to aggressive form
<i>Lespedeza bicolor</i>	Shrubby bushclover	Across KY	Much planted with mine reclamation and in w/l openings; a serious pest in areas where Rx fire used as in grassland, forest or woodland; fire

			scarified seed and enhanced plant; forms dense thickets that can choke regen trees and native species
<i>Lespedeza cuneata</i>	Chinese bushclover	Statewide	Serious pest in grasslands; responds well to prescribed fire
<i>Lespedeza stipulacea</i>	Korean clover	Throughout KY	Widely planted for wildlife; Highly invasive in disturbed sites such as roadsides, lawns, waste areas and areas under Rx burn such as grassland, woodland
<i>Lespedeza striata</i>	Japanese clover	Throughout KY	Widely planted for wildlife; Highly invasive in disturbed sites such as roadsides, lawns, waste areas and areas under Rx burn such as grassland, woodland
<i>Ligustrum sinense</i>	Chinese privet	Throughout KY, but scattered	Widely planted for ornament and escaping; serious pest of wet to mesic forest systems; can establish under canopy; bird spread, capable of forming regen killing thicket
<i>Ligustrum vulgare</i>	European privet	Throughout KY, but scattered	Similar to Chinese privet, maybe not quite as aggressive
<i>Lolium arundinaceum</i>	Kentucky 31 fescue	Widespread	Serious invader of grasslands/glades; threatens federally endangered sp.; can be damaging to wildlife and livestock
<i>Lonicera japonica</i>	Japanese honeysuckle	Widespread	Serious pest in forests, open habitats too; chokes out native veg.
<i>Lonicera maackii</i>	Amur honeysuckle	Across KY, most abundant in base-rich soil areas	Aggressive, rapidly spreading (birds) shrub/small tree which forms dense vegetation excluding (including trees) thickets under tree canopy or in open
<i>Lonicera morrowii</i>	Morrow's honeysuckle	Scattered across KY	Similar to Amur honeysuckle, but not with the same foot hold
<i>Lonicera tatarica</i>	Tartarian honeysuckle	Scattered across KY	Similar to Amur honeysuckle, but not with the same foot hold
<i>Melilotus alba</i>	White sweet clover	Throughout KY, especially in base-rich areas	Widely grown for forage; w/l openings, mine reclamation; extremely difficult to eradicate from thin gravelly or rock soils (such as glades); fire scarified seed so potential problem for grasslands, woodlands
<i>Melilotus officinalis</i>	Yellow sweet clover	Throughout KY, especially in base-rich areas	Widely grown for forage; w/l openings, mine reclamation; extremely difficult to eradicate from thin gravelly or rock soils (such as glades); fire scarified seed so potential problem for grasslands, woodlands
<i>Miscanthus sinensis</i>	Chinese silver grass	Across KY, scattered, locally abundant	Aggressive, rapidly spreading (wind blown seed); forms dense colonies excluding other vegetation; an extreme fire hazard in late fall/winter/early spring; invades open disturbed ground, grasslands, woodlands and open forest; fire promoted, so of concern for Rx burn areas
<i>Paulownia tomentosa</i>	Chinese empress-tree	Across KY, scattered, locally abundant	Generally along roadsides, open areas, but can establish in forest after fire, wind events etc.; prolific seeder (gravity, wind) and sprouter
<i>Pueraria lobata</i>	Kudzu	Scattered across KY, but	Damaging to forests; dense climbing mats cover and choke out all vegetation

		plentiful in SE and W KY	
<i>Pyrus calleryana</i>	Flowering pear, Callery Pear	Throughout KY, scattered, locally abundant	Widely planted street/yard tree; bird spread-primarily starlings; establishes in open disturbed ground-roadsides, waste areas, fields, but also in grasslands and woodlands; tolerant of fire (good resprouter); expansion currently rapid
<i>Ranunculus ficaria</i>	Fig buttercup	Isolated locations, locally abundant	Forms dense colonies usually in moist or wet soil in floodplains or edges of ponds/lakes; threatens wetland habitat
<i>Rosa multiflora</i>	Multiflora rose	Statewide	Problem in forest openings, woodlands, and grasslands – seeds spread by birds; persistent in forests
<i>Sorghum halepense</i>	Johnson grass	Widespread	Invades grasslands and woodlands from adjacent ag and roadside locations; difficult to control
<i>Stellaria media</i>	Common chickweed	Throughout KY	Primarily a species of disturbed, open ground, but can spread into forest settings and displace natives-extremely difficult to eradicate/control in this case without damage to natives
TN Plants: Potential Arrivals			
<i>Solanum varium</i>	Tropical Soda Apple	Gulf coastal plain, Piedmont; most likely show up in western KY	Aggressive, rapidly spreading, serious Ag pest and potential ecological one
TN Insects: Established			
<i>Adelges tsugae</i>	Hemlock wooly adelgid	In SE KY right now (8 counties)	Can cause nearly total mortality of hemlocks; will irreparably alter forest ecosystems
<i>Lymantria dispar</i>	Gypsy moth	Currently in Ohio/WV; individuals caught yearly in N. KY	Potential to disrupt upland oak systems in KY, cause large ecological shift and economic loss and shifts; oaks would not be dominants in many forest areas
TN Insects: Potential Arrivals			
<i>Agrilus planipennis</i>	Emerald ash borer	At KY's northern border and probably in the state	Could cause loss of an important set of forest and woodland trees-both ecological and economic distress
<i>Solenopsis wagneri</i>	Fire ant		Colonies have been destroyed each time it has been found in KY
TN Birds: Established			
<i>Cygnus olor</i>	Mute swan		Aggressive birds; damaging to ecosystem by reducing availability of resources needed for other waterfowl; trampling nests of other bird spp.

<i>Sturgus vulgaris</i>	European Starling	Throughout KY	Unfortunately naturalized; eradication not possible, but control appropriate in some areas; Cause crop damage; a nuisance bird nearly year around because of large flock size; histoplasmosis and other disease threats in areas of roost trees—often residential; one of the species that spread <i>Pyrus calleryana</i>
TN Mammals: Established			
<i>Sus scrofa</i>	Feral hog	Released in western and eastern KY	Get them now

Reviewers:

JB- Joyce Bender, Kentucky State Nature Preserves Commission

DDT- David Taylor, US Forest Service

RB- Rob Paratley, UKY Herbarium

MM- Michael Mahala, UKY Invasive Species Specialist

Existing Authorities, Regulations, and Programs

What has been done to stop the introduction and spread of TNS in Kentucky?

Effective and efficient management of TNS within Kentucky requires a thorough understanding of existing federal, regional, and state programs related to TNS as well as existing authorities governing these efforts. While efforts at each of these levels exist, Kentucky does not have an inclusive TNS management strategy. This section of the Plan synthesizes information regarding authorities, regulations, and management programs currently in place in Kentucky at either the federal, regional, or state level. Less formal TNS management efforts are also addressed at the end of the section. Some information gathered for this section derives from the Kentucky Legislature website (www.lrc.ky.gov).

Federal Role

Below are some federal agencies that have either jurisdiction over lands in Kentucky or the ability to offer assistance with TNS if they become problematic within the state.

U. S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service's (USFWS) mission is working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. In Kentucky, the USFWS is responsible for managing the Clarks River National Wildlife Refuge.

USFWS has regulatory authority to enforce the Lacey Act. Under the Lacey Act, the Secretary of the Interior is authorized to regulate the importation and transport of species, including offspring and eggs, determined to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources of the U.S. Wild mammals, wild birds, fish, mollusks, crustaceans, amphibians, and reptiles are the only organisms that can be added to the injurious wildlife list. Furthermore, the USFWS has enforcement authority of the federal Endangered Species Act, which could be applied if a particular TNS was threatening the survival of a federally-listed threatened or endangered species within Kentucky.

Animal and Plant Health Inspection Service

The U. S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) works to protect the health and value of American agriculture and natural resources. APHIS International Services facilitates international trade and fulfills APHIS' mission to prevent the international spread of pests and to prevent the reintroduction of pests and disease threats already eliminated in the United States. In response to needs expressed by the American people and Congress, APHIS' mission has expanded over the years to include such issues as wildlife damage and disease management; regulation of genetically engineered crops and animal welfare; and protection of public health and safety as well as natural resources that are vulnerable to

invasive pests and pathogens. In Kentucky, APHIS has coordinated sudden oak death (*Phytophthora ramorum*) surveys in nurseries (see U. S. Forest Service).

U. S. Forest Service

The USDA Forest Service's mission is to achieve quality land management under the sustainable multiple-use management concept to meet the diverse needs of people. The U. S. Forest Service has identified invasive species as one of the four critical threats to our nation's ecosystems. In response to this threat, they have implemented the U. S. Forest Service invasive species program. The goal of the program is to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of invasive species across all landscapes and ownerships. Additionally, a national survey designed to gather information on the distribution of sudden oak death (*Phytophthora ramorum*) began in 2004. The national surveys efforts were concentrated in two areas, forests (coordinated by USDA Forest Service) and in nurseries (coordinated by USDA-Animal Plant Health Inspection Service). Funding for Kentucky forest surveys expired in 2007 but nursery surveys are funded through 2008. The national surveys have found no evidence of sudden oak death (*Phytophthora ramorum*) in Kentucky. The U. S. Forest Service has the authority to manage millions of acres of national forests and grasslands nationwide, including the Land between the Lakes National Recreation Area and Daniel Boone National Forest in Kentucky.

National Park Service

The National Park Service's (NPS) mission includes preserving unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. In response to the threat of invasive species, the NPS has developed a "Strategic Plan for Managing Invasive Nonnative Plants on National Park System Lands." As part of the program, the NPS is testing mechanical, chemical, and cultural management methods and biological control techniques. The plan has provided a strong and clear policy on managing non-native plant species within the national park system. In Kentucky, NPS-managed lands include Mammoth Cave National Park and Cumberland Gap National Historic Park.

Regional Role

Management efforts of TNS occur on a regional as well as national and state level. Kentucky is involved regionally in efforts to prevent, detect, and control TNS. Regional coordination provides networking opportunities for participants and can help coordinate management activities such as monitoring, research, and educational efforts. Kentucky is a member of the following regional group.

Southeast Exotic Pest Plant Council

The Southeast Exotic Pest Plant Council (SE-EPPC) is a regional non-profit organization dedicated to controlling invasive plants (terrestrial and aquatic) and restoring natural ecosystems. Kentucky has a state chapter, the Kentucky Exotic Pest Plant Council (KY-EPPC), which is discussed further under the state role.

The University of Georgia's Bugwood Network has developed an Early Detection and Distribution Mapping System (EDDMapS) to provide a more accurate picture of the distribution of invasive species. SE-EPPC has partnered with the Bugwood Network to utilize this mapping system, and it is currently available in Kentucky. EDDMapS will allow land managers, agencies and others to set priorities for early detection and rapid response (EDRR), as well as formulate overall invasive plant management action plans. The program aims to train users of the system, help verify data, and encourage data collection within the state.

State Role

Each state has primary responsibility for the health of wild flora and fauna and their habitats. To maintain or improve environmental conditions, states must manage threats, such as TNS. This section attempts to describe TNS regulations as they relate to potential TNS pathways of introduction and spread and the specific groups of organisms that are regulated. Existing authorities and regulations that are or could be applied to prevention, detection, and control efforts are listed below. A synopsis of information within the regulation, as related to TNS, is provided here.

The Kentucky Department of Fish and Wildlife Resources

The Kentucky Department of Fish and Wildlife Resources (KDFWR), which includes the Division of Fisheries (DOF) and the Division of Wildlife (DOW), is a steward of Kentucky's fish and wildlife resources and their habitats. The Department manages for the perpetuation of these resources and their use by present and future generations, and through partnerships, enhances wildlife diversity and promotes sustainable use, including hunting, fishing, boating, and other nature-related recreation. KDFWR is funding the development of this TNS Management Plan.

KDFWR- Existing Authorities Relevant to TNS Management

In terms of the KDFWR's roles in preventing and controlling TNS, the following Kentucky Revised Statutes (KRS) have been identified as relevant to management of TNS within the state.

KRS 150.105 Destruction or control of animals causing damage.

Synopsis: With approval, conservation officers may destroy or bring under control any wild animal, fish or wild birds, protected or unprotected which are causing damage to persons, property or other animals, fish or birds or spreading diseases and which in the judgment of the Commissioner of Kentucky Fish and Wildlife Resources, with the approval of the Commission, should be eliminated or controlled to prevent further damage.

KRS 150.180 Buying, selling, or transporting protected wildlife, mussels and fishes, raw fur, or processed wildlife.

Synopsis: (6) No out of state wildlife may be brought into Kentucky without a permit. No permit will be issued unless the wildlife are deemed safe.

KRS 150.720 Administrative regulations relating to cervids -- Costs resulting from importation of diseased animal.

Synopsis: (1) The Department of Agriculture in cooperation with the Department of Fish and Wildlife shall promulgate administrative regulations pertaining to health requirements, eradication of diseases, and identification of privately owned and farm-raised cervids maintained for the production of meat and other products. The Department of Fish and Wildlife in cooperation with the Department of Agriculture shall promulgate administrative regulations pertaining to the importation and holding of cervids. (2) If any person imports a diseased animal into the Commonwealth in violation of the statutes and administrative regulations, then that person shall be responsible to the Department of Agriculture and the Department of Fish and Wildlife for all costs incurred in the investigation, response, and eradication of that disease.

KRS 150.740 Ban on Cervidae importation -- Penalties -- Reports on chronic wasting disease to be submitted to Interim Joint Committee annually -- Authority of department to seize captive cervids -- Hearing -- Appeal.

Synopsis: Provides penalties for the importation of cervids and gives KDFWR authority to seize and destroy any imported cervids in an effort to keep the state free of chronic wasting disease.

Kentucky Department of Agriculture

The Kentucky Department of Agriculture (KDA) is a consumer protection and service agency. Through their Division of Pest and Noxious Weed Control, the Noxious Weed Control Program aims to help control thistles, multi-flora rose, and various other weeds on agricultural operations statewide. Through this program they also provide demonstrations to farmers on how to control agricultural nuisance weeds. Furthermore, falling under the authority of the KDA Commissioner, the chair of the Department of Entomology of the agricultural experiment station at the University of Kentucky is the state entomologist. The state entomologist's office is also involved in preventing, detecting, and managing established and potential TNS.

KDA- Existing Authorities Relevant to TNS Management

In terms of the KDA's roles in preventing and controlling TNS, the following Kentucky Revised Statutes (KRS) have been identified as relevant to management of TNS within the state.

KRS 246.295 Administrative regulations relating to cervids -- Costs resulting from importation of diseased animal.

Synopsis: See *KRS 150.720* on page 20.

KRS 249.180 Landholder to cut Canada thistles.

Synopsis: Every person holding or leasing lands on which any Canada thistles are growing, shall cut them to prevent them from going to seed and their seed from ripening.

KRS 249.183 Canada and nodding thistle eradication areas, establishment, duties of agriculture department.

Synopsis: The fiscal court of any county may, after notice and hearing, declare that a threat exists to the natural resource development and the agricultural economy of the county by reason of the growth and infestation of Canada thistles (*Cirsium arvense*) or nodding thistles (*Carduus nutans*) or both. If this occurs, KDA has the authority to remove Canada thistles (*Cirsium arvense*) or nodding thistles (*Carduus nutans*) or both, from any landowner's property in that Kentucky county.

KRS 249.187 Thistles a public nuisance in eradication area, abatement.

Synopsis: The existence or growth of Canada or nodding thistles in any county declared to be a thistle eradication area is declared to be a public nuisance and the Commissioner of Agriculture may bring an appropriate action in such county to enjoin such nuisance. At the request of the Commissioner the county attorney shall prosecute such action.

KRS 249.190 Entry and cutting of thistles on failure of landholder -- Exemption.

Synopsis: (1) Any person who holds land on which Canada or nodding thistles are growing and likely to ripen seed, neglects or refuses to cut and destroy them, the Commissioner of Agriculture shall give fifteen days' notice in writing to the person who holds the land, to cut and destroy the Canada or nodding thistles. On the neglect or refusal of the person who holds the land to cut and destroy them at the end of fifteen days, the Commissioner of Agriculture may enter upon or hire other persons to enter upon the land and cut down and destroy the Canada or nodding thistles. The Commissioner of Agriculture may recover from the person who holds the land the reasonable costs of the eradication. (2) Land on which conventional farm machinery cannot be safely operated shall be exempt from this section.

KDA Division of Pest and Noxious Weed Control- Existing Authorities Relevant to TNS Management

KRS 249.420 Duties.

Synopsis: In addition to its other duties, the division shall promote and sponsor programs to control pests and noxious weeds, enforce related regulatory and service measures assigned to the department, and conduct a Johnson grass control and eradication program.

KRS 249.430 Authority of division.

Synopsis: The division may: (1) Utilize the services of a state advisory committee on Johnson grass control to be composed of persons interested in Johnson grass control appointed by the commissioner; (2) Issue and enforce regulations for the eradication and control of noxious weeds, including Johnson grass, and pests; (3) Cooperate with county agricultural agents, vocational agricultural teachers, University of Kentucky extension specialists, civic groups, or any federal, state or county agency in promoting county programs and organizations to control and eradicate noxious weeds and pests; (4) Conduct or assist any governmental agency in conducting local or county-wide surveys to determine the degree of Johnson grass infestation; (5) Cooperate with federal or state agencies in research and educational work in the field of pest and noxious weed control;

(6) Assist counties in qualifying for cost-sharing programs to control Johnson grass or other noxious weeds; (7) Publicize the threat of noxious weeds and pests and methods of combating them; (8) Cooperate with the Department of Highways, county fiscal courts, transportation and industrial organizations in controlling Johnson grass and other noxious weeds on their premises and rights-of-way; (9) Accept funds or contributions to carry out the purposes of KRS 249.400 to 249.430.

KDA State Entomologist- Existing Authorities Relevant to TNS Management

KRS 249.040 Establishment of quarantines.

Synopsis: Provides the state entomologist, with the advice and consent of the KDA Director and Commissioner, authority to establish and maintain quarantines against the importation into this state and against the transportation within this state, of any trees, plants, and parts of plants, whether nursery-grown or not, from any state or from any county within the state where the plants or parts of plants are known to be affected with dangerous insect pests or plant diseases.

KRS 249.050 Inspection of articles and premises -- Diseased plants to be destroyed - Hindering inspection prohibited.

Synopsis: Provides the state entomologist authority to inspect areas where diseased plants are believed to occur and have them destroyed if necessary.

KRS 249.070 Entomologist to inspect nurseries and order management of plant pests - Shipment of affected stock prohibited -- Exception.

Synopsis: (1) All nurseries in Kentucky shall be inspected by the state entomologist, his deputy, or by a nursery inspector, once each year. The state entomologist may collect specimens of plant material in order to make cultures and positive identifications of plant pests. (3) The owner or manager of an affected nursery shall, within the time specified, take steps for the mitigation of plant pests. (4) No owner or manager of affected nursery stock shall sell or offer for sale, ship, deliver, or remove from a nursery any nursery stock affected with plant pests, until the stock has been officially inspected and a certificate covering it has been issued by the state entomologist.

KRS 249.100 Plants to bear inspection certificate.

Synopsis: Trees, plants, or parts of plants, whether nursery-grown or not, that are sold, shipped, or transported into this state shall bear a copy of a certificate of inspection from a state or United States government inspector. Transportation companies within the state shall notify the state entomologist at once when the trees or plants are received by them without a valid certificate. Nursery stock or other trees, plants, or parts of plants shipped into this state in violation of a state or United States quarantine may be seized and destroyed or returned to the shipper at the expense of the owner or possessor.

KRS 249.101 Nursery records -- Prohibitions.

Synopsis: Nurseries shall maintain for one-year records of plant purchases, acquisitions, sales, or other distributions, excluding retail sales, and make the records available upon request to the state entomologist for inspection.

KRS 249.105 Inspection of shipments.

Synopsis: All shipments of nursery stock entering the state, as well as intrastate shipments, may be inspected in transit or at their destination.

KRS 249.990 Penalties.

Synopsis: (1) Any person who violates any of the provisions of KRS 249.020 to 249.100 or hinders the carrying out of any of the provisions of those sections shall be fined not less than twenty-five dollars (\$25) nor more than five hundred dollars (\$500). (2) Any fine imposed for a violation of subsection (4) of KRS 249.070 may be recovered in the county in which the nursery is situated or the county to which the nursery stock is shipped. (3) Any person who knowingly neglects or refuses to comply with the provisions of KRS 249.180 or 249.190 shall be fined not less than fifty dollars (\$50) nor more than two hundred dollars (\$200). Each day of violation after the notice provided in KRS 249.190 shall be a separate offense.

KRS 249.991 Penalties.

Synopsis: (1) Any person who interferes with or attempts to prevent the Commissioner of Agriculture from exercising any of his powers under KRS 249.183 to 249.195 shall be punished by a fine of not more than one thousand dollars (\$1,000) or by imprisonment for not more than six (6) months. (2) Any person who violates any regulation prescribed by the Commissioner under KRS 249.183 to 249.195 shall be fined not less than fifty dollars (\$50) nor more than two hundred dollars (\$200). Each day of violation after the notice provided in KRS 249.190 shall be a separate offense.

Kentucky Energy and Environment Cabinet

The mission of the Energy and Environment Cabinet (formerly the Environmental and Public Protection Cabinet) is to improve the quality of life for all Kentuckians by simultaneously innovating and creating efficient, sustainable energy solutions and strategies; protecting the environment; and creating a base for strong economic growth. The Energy and Environment Cabinet consists of three departments, four commissions, two branches, and the Office of the Secretary that serve the taxpayers of Kentucky in many capacities. The Kentucky State Nature Preserves Commission (KSNPC) and the Kentucky Division of Forestry (KDF) both fall under the umbrella of the Energy and Environment Cabinet.

Kentucky State Nature Preserves Commission

The Kentucky State Nature Preserves Commission's mission is to protect Kentucky's natural heritage by (1) identifying, acquiring and managing natural areas that represent the best known occurrences of rare native species, natural communities and significant natural features in a statewide nature preserve system; (2) working with others to protect biological diversity; and (3) educating Kentuckians as to the value and purpose of nature preserves and biodiversity conservation. Since 1991, the Commission has been actively working to identify, contain, and where possible eradicate invasive plant species within the boundaries of state nature preserves. The Commission provides educational information on invasive plants on their website and in public presentations. Since 2007,

the Commission has been developing protection priorities and carrying out treatments to combat the hemlock woolly adelgid within the boundaries of state nature preserves affected by this forest pest.

In terms of terrestrial plants and animals occurring on KSNPC properties, the following Kentucky Administrative Regulation (KAR) has been identified as relevant to management of TNS within the state.

KSNPC- Existing Authorities Relevant to TNS Management

400 KAR 2:090. Management, use, and protection of nature preserves.

Synopsis: Section 13.1. Plant species not native to the site or vicinity may be eliminated. Section 13.3. Control of exotic plants and animals may be undertaken in a manner approved by the commission. There may be no attempt to eradicate exotic species that have become a stable part of the biotic community unless this can be accomplished without disturbance of natural conditions. Section 13.4. Control measures shall be undertaken only by commission staff or others approved by the commission. Section 13.5. Habitat manipulations and protective measures in favor of particular species may be undertaken only as approved by the commission. Approval will be based upon a finding by the commission that describes the proposed activities and addresses species life history, habitat requirements of the species, characteristics and objectives of the preserve and other relevant information. Section 13.6. No plants, animals, or their reproductive bodies can be brought into a nature preserve except with approval of the commission.

Kentucky Division of Forestry

In 1912, the Kentucky Legislature formed the Kentucky Division of Forestry (KDF). The initial emphasis for the division was to reduce the severity of wildfires in the state. Now the division's expanded mission is to protect and enhance the forest resources of the Commonwealth through a public informed of the environmental and economic importance of these resources. Today, Kentucky has 11.9 million acres of forestland, of which 87 percent is privately owned.

KDF- Existing Programs Relevant to TNS Management

The KDF's Forest Health Program focuses on identifying and monitoring for potential insect, disease, and invasive and exotic plant problems that threaten Kentucky forestlands. Their work with the Hemlock woolly adelgid and the Emerald Ash borer in 2007 are described below.

Hemlock woolly adelgid

Hemlock woolly adelgid surveys were completed in the Northeastern, Eastern, Kentucky River and Southeastern districts. By spring 2008, the adelgid was found in 30+ sites in Bell, Clay, Grayson, Harlan, Laurel, Leslie, Letcher, Oldham, and Whitley counties. The infestations in Grayson and Oldham counties were fairly isolated and were eradicated by the landowner. Predatory beetles were released on Kentucky Ridge State Forest, located in Bell County, and were strategically placed in several significantly infested locations

with more to be released in spring 2008. Hemlock woolly adelgid periodic surveys began in the northeastern, eastern and southeastern regions of the state in late December 2007 and will conclude in April 2008.

Emerald Ash Borer

In the spring of 2007, Emerald Ash Borer (EAB) was discovered in Hamilton County, Ohio, about four miles north of the Kentucky border. Currently, the entire states of Illinois, Indiana, and Ohio are under federal quarantines that restrict the movement of ash trees, branches, logs, and firewood out of those states. Kentucky is cooperating with the USDA-Plant Protection and Quarantine personnel to enforce this federal quarantine.

Firewood movement has been a major factor in the spread of EAB; thus, the Kentucky state parks have banned firewood from quarantined areas. The Kentucky Forest Health Task Force produced a firewood poster that will be displayed at all state and federal parks, campgrounds, and various other sites across the state.

Currently, ash trees are being monitored at select locations across the state. This early detection effort hopes to identify any EAB invaders and eradicate them before an infestation could spread statewide.

KDF- Existing Authorities Relevant to TNS Management

In terms of the KDF's roles in preventing and controlling TNS, the following Kentucky Revised Statutes (KRS) have been identified as relevant to management of TNS within the state.

KRS 149.630 Control zone to be prescribed -- Notice required.

Synopsis: Whenever the secretary for environmental and public protection finds that any forest area is infested, threatened to be infested, infected, or threatened to be infected with insects or disease, he shall determine whether measures of control are needed and are available and the area over which the control measures shall be applied. He shall prescribe the proposed zone in which control measures are to be applied, and shall publish notice of the proposal, as required by law. Such notice shall include a brief description of the location of the proposed zone of infestation or infection and the approximate time when control measures will be executed.

KRS 149.640 Control measures may be applied -- Agreements with landowners -- Cost.

Synopsis: The secretary for environmental and public protection may apply measures of infestation and infection control on public and private forests and other lands anywhere in the Commonwealth, to any trees, timber, plants or shrubs thereon harboring or which may harbor any insects or disease. The secretary may enter into agreements with owners of such lands covering the control work on their lands, and fix the pro rata basis on which the cost of such work will be shared between the Commonwealth and said owner; provided, that the failure of the secretary to offer an agreement to or execute an agreement with any owner shall not impair the right of the secretary's representatives to enter on the lands of said owner to conduct control operations.

KRS 149.650 Authority to control other holdings -- Cost.

Synopsis: The secretary for environmental and public protection is authorized to carry out control work on other adjacent or interior holdings, which, if uncontrolled, would cause a reinfestation or reinfection of the controlled area, and to contract with owners of land in the affected area relative to payment of the cost of such work.

KRS 149.660 Cooperation with other agencies.

Synopsis: The secretary for environmental and public protection may cooperate with the federal government or agencies thereof, other agencies of the Commonwealth, county or municipal governments, agencies of neighboring states, or other public or private organizations, or individuals and may accept such funds, equipment, supplies or services from cooperators and others as may be deemed appropriate. The secretary may provide in agreements with the federal government or its agencies for matching of federal funds as required under federal laws relating to forest pests.

KRS 149.670 Revolving fund account provided.

Synopsis: All monies collected under the provisions of KRS 149.610 to 149.680, including such as may be contributed or paid by the federal government or any other public or private agency, organization or individual, shall be placed in the State Treasury to the credit of a revolving, trust or agency fund account for use by the Environmental and Public Protection Cabinet in carrying out the purposes of KRS 149.610 to 149.680.

KRS 149.680 Personnel -- Equipment -- Regulations.

Synopsis: The secretary for environmental and public protection is authorized as required by law, to employ necessary personnel, procure necessary equipment, supplies and services; to enter into contracts in the name of the secretary and to provide funds to any agency of the United States for work or services under the forest pest control program. The secretary for environmental and public protection may prescribe rules and regulations for carrying out the purposes of KRS 149.610 to 149.680.

Kentucky Department of Highways

The Kentucky Department of Highways falls under the umbrella of the Kentucky Transportation Cabinet. Their mission is, "To provide a safe, secure, and reliable highway system that ensures the efficient mobility of people and goods, thereby enhancing both the quality of life and the economic vitality of the Commonwealth."

The following Kentucky Revised Statutes (KRS) has been identified as relevant to management of TNS within the state.

Kentucky Department of Highways- Existing Authority Relevant to TNS Management

KRS 176.051 Department to eradicate noxious weeds on right-of-ways -- Advertisement of program.

(1) The Department of Highways shall keep all state right-of-ways free of the species of grass, *Sorghum halepense*, commonly known as Johnson grass, and the species of weed commonly known as giant foxtail, both of which are noxious weeds, and the thistles

Cirsium arvense and *Carduus nutans*, commonly known as Canada thistles and nodding thistles, respectively, multiflora rose, wild cucumber, and black nightshade; and, upon written request, shall give priority to any abutting property owner engaged in a program of eradication of Johnson grass, giant foxtail, Canada thistles, nodding thistles, multiflora rose, kudzu, wild cucumber, and black nightshade; and shall cooperate with the abutting owner by eradicating the Johnson grass, giant foxtail, Canada thistles, nodding thistles, multiflora rose, kudzu, wild cucumber, and black nightshade from abutting state right-of-ways. The department shall take steps to eradicate this grass and these weeds or thistles by the use of chemicals or any other means found to be effective by the department. (2) The Department of Highways shall inform property owners of the availability of the eradication program. In carrying out this responsibility the department shall, no later than the first week in March of every year, advertise in each county, pursuant to the provisions of KRS Chapter 424 that the program is available. The department shall stipulate in the advertisement the place and manner in which an interested property owner may make a written request for inclusion in the program.

Kentucky Forest Health Task Force

The Kentucky Forest Health Task Force consists of various federal and state agency personnel, University of Kentucky personnel, as well as other interested stakeholders. The mission of the Kentucky Forest Health Task Force is to identify and prioritize threats of insects, disease, invasive species and environmental factors to the integrity of Kentucky's forest resources, and recommend sound and timely approaches to addressing them.

Their website states:

“Declining forest health resulting from insects, disease, and invasive species is a serious threat to the sustainability of Kentucky's forests. The Kentucky Forest Health Task Force hopes to facilitate coordination, raise awareness, and serve as an advocate for matters related to forest health, including:

- Exotic species detection and management.

Pending threats from invasive exotic species are a constant concern. Sudden oak death, the gypsy moth, and the emerald ash borer all have potential for dramatic impacts in Kentucky. The Kentucky Forest Health Task Force is working to facilitate coordination among state and federal agencies monitoring exotic introductions to minimize their impact.

The sustainability of Kentucky's forests is threatened by varying management philosophies, forest utilization practices, and invasive species introductions. Research on the ecology and management of regeneration and sustainability of oak-dominated deciduous forests and southern pine beetle-impacted conifer forests is on going. The Kentucky Forest Health Task Force is working to facilitate coordination among researchers and managers to focus efforts on furthering forest sustainability.

It is the Kentucky Forest Health Task Force's belief that we can work better together to address these forest health issues impacting Kentucky's natural resources. Coordination among State and Federal agencies, private landowners and interest groups along with our universities can lead to more timely and effective measures to meet these challenges.

Since its establishment in early 2004, the Kentucky Forest Health Task Force has worked to establish itself as an information clearinghouse for issues impacting forest health in Kentucky. Informational meetings, newsletter articles, and a developing web site have helped further our goals. The Kentucky Forest Health Task Force is working with federal, state, and local officials, as well as universities, to facilitate coordination, cooperation, and education."

Kentucky Exotic Pest Plant Council (KY-EPPC)

The Kentucky Exotic Pest Plant Council (KY-EPPC) was established in 2000 to address invasive plants in the state. It is a non-profit organization and state chapter of the Southeast Exotic Pest Plant Council (SE-EPPC). KY-EPPC's purpose is, "To raise awareness and promote public understanding regarding the threat posed by invasive exotic pest plants to native plant communities in Kentucky; to facilitate the exchange of information concerning the management and control of invasive exotic pest plants through support of research and monitoring; to serve as an educational, advisory and technical support resource on exotics in Kentucky; to initiate actions to protect Kentucky from the introduction, establishment and spread of invasive exotics; and to provide a forum for all interested parties to participate in meetings, workshops, and on a rotational basis with other chapters, host a symposium for the SE-EPPC to share the benefits from the information provided by SE-EPPC and other recognized experts". Furthermore, the KY-EPPC has a list of invasive plants that are ranked in terms of threat and, in conjunction with Bernheim Arboretum and Research Forest, provides a yearly "Kentucky's Least Wanted Plants" poster.

Other Programs

In addition to the authorities, regulations, groups, and programs listed above, Kentucky also attempts TNS prevention, detection, control, and education through:

- The University of Kentucky (UKY) has recently formed (2007) the UK Invasive Species Initiative. They are attempting an interdisciplinary approach to help monitor, model, prevent, mitigate, and eradicate invasive aquatic and terrestrial species in Kentucky.
- The Tracy Farmer Center for the Environment at UKY has an outreach program that teaches students about invasive species utilizing a hands-on approach.
- The goal of the Kentucky chapter of The American Chestnut Foundation is to restore this respected tree to its rightful position as a dominant tree throughout its natural range. The American Chestnut Foundation is selectively breeding American chestnuts (*Castanea dentata*) to develop a tree that has a high degree of resistance to chestnut blight (*Cryphonectria parasitica*) and will be able to thrive and reproduce independently in a forest setting.

- The newly formed (2008) Save Kentucky's Hemlocks aims to raise public awareness and funds to support containment and control of the hemlock woolly adelgid on state and private natural areas.

Objectives, Strategies, Actions, and Cost Estimates

An important component of strategic planning is the development of specific strategies and actions to attain Plan objectives and ultimately Plan goals. For reference, the goals and objectives of the TNS Plan are listed below.

The **4 main goals** of the Plan are:

1. Stop new introductions of TNS into Kentucky.
2. Prevent the spread of TNS currently in Kentucky and neighboring states.
3. Limit damages from TNS that cannot be eradicated.
4. Educate the public and stakeholders so they do not facilitate introductions and/or dispersal of new or existing TNS.

The **4 objectives** necessary to meet these goals include:

1. Provide programs to prevent introductions and transport of TNS.
2. Raise public and stakeholder awareness of TNS issues.
3. Develop and utilize an early detection and rapid response (EDDR) system.
4. Offer effective communication and coordination of TNS management activities.

Objective 1: Provide programs to prevent introductions and spread of TNS.

Strategy 1A: Create a TNS coordinator position or collaborate with the KDFWR-Division of Fisheries (DOF) to create a Nuisance Species (NS) coordinator position that deals with both ANS (see ANS Plan) and TNS.

Action 1A1: Creation of a full-time (37.5 hours/week) TNS coordinator position would allow one person to focus on developing and implementing efficient and effective TNS management programs. Alternatively, the KDFWR-DOW (Division of Wildlife) could collaborate with the KDFWR-Division of Fisheries (DOF) to create a Nuisance Species coordinator position that deals with both ANS (see ANS Plan) and TNS. This could save time and money, reduce duplication of efforts, and keep KDFWR nuisance species (ANS and TNS) work under a central umbrella. Funding for this combined position could utilize federal funding for ANS issues (expected in March 2009) and additional DOW funding could be provided to cover TNS concerns.

Cost Estimate: For creating a TNS Coordinator position, \$50,000/year salary (including healthcare and retirement benefits) + \$8,000 (16% administrative overhead costs) = \$58,000. For a combined NS position, DOW could provide the remaining 25% of salary and benefits not covered by the ANS Plan = \$14,500 plus any additional funding deemed necessary to cover coordination of TNS management efforts.

Strategy 1B: Annually review and update the Plan to address identified gaps and needs and make necessary changes to the KY TNS species list.

Action 1B1: Due to the evolving nature of the TNS problem, the Plan will need to be reviewed and updated annually. The TNS coordinator (or the combined NS coordinator) could address identified gaps and needs, and review and update the KY TNS species list and associated pathways on an annual basis.

Cost Estimate: \$0/year.

Strategy 1C: Identify and secure outside funding to maintain existing and create new TNS management programs.

Action 1C1: Maintaining existing and creating new TNS management programs may require additional funding. The TNS coordinator (or the combined NS coordinator) could work to identify and secure outside funding. Information regarding grants and other funding opportunities could be disseminated to other interested parties who could also submit proposals to secure funding.

Cost Estimate: For postage, media, etc. = \$250/year.

Strategy 1D: Identify and secure funds to research the biological and economical impacts of TNS in Kentucky.

Action 1D1: When developing efficient and effective TNS management strategies, it is important to know the biological and economical impacts unique to the state. The TNS coordinator (or combined NS coordinator) could work to identify and secure research funds. Information obtained could also be disseminated to interested parties who could submit proposals to secure funding.

Cost Estimate: For postage, media, etc. = \$250/year.

Strategy 1E: Develop a database of TNS (density and range) from existing datasets to determine baseline levels.

Action 1E1: Information about the occurrence of TNS in Kentucky is currently unclear. Little is known about the extent of infestations and the movement of TNS into and around the state. Creating a database from existing datasets, including the KY Fish and Wildlife Information System, could begin to address this but would require agreement and cooperation between state agencies, consulting firms, and other entities involved in data collection. Efforts could be made to compliment the existing EDDMapS (nuisance plants) to provide a more accurate picture of the distribution of all nuisance species within Kentucky while saving additional time and money.

Cost Estimate: \$0/year (if purchase of GIS software license and computer is not needed).

Strategy 1F: Develop a Kentucky Feral Hog Eradication Program.

Action 1F1: Feral hogs cause major ecosystem damage and can potentially spread disease to people, livestock, and pets. Their relative recent introduction in Kentucky may allow for a successful eradication attempt. Baseline feral hog populations will need to be determined before attempting such a strategy as well as follow up population surveys after eradication attempts are made.

Cost Estimate: If agency personnel is used costs would be limited to travel and gear = \$25,000/year.

Strategy 1G1: Continue to support control efforts of the hemlock wooly adelgid in eastern Kentucky.

Action 1G1: The wooly adelgid has the capacity to decimate Eastern hemlock stands in eastern Kentucky. Loss of the Eastern hemlock could severely damage the ecology and hydrology of eastern Kentucky forests. In 2008, the DOW financially supported efforts to control the wooly adelgid with the insecticide imidacloprid. If the wooly adelgid continues to threaten Kentucky's hemlocks, DOW should continue to support these attempts.

Cost Estimate: To purchase and apply imidacloprid in select areas of eastern Kentucky = \$50,000/year.

Strategy 1H1: Lobby USDA (U.S. Forest Service and APHIS) to continue sudden oak death surveys in Kentucky's forests and nurseries.

Action 1H1: Although national surveys coordinated by the USDA have found no evidence of sudden oak death (*Phytophthora ramorum*) in Kentucky, an outbreak could alter Kentucky forest ecosystem services severely. Past national surveys efforts were concentrated in two areas, forests (coordinated by USDA Forest Service) and in nurseries (coordinated by USDA-Animal Plant Health Inspection Service). Funding for nursery surveys are funded through 2008 but Kentucky forest surveys expired in 2007. Efforts should be made to ensure that sudden oak death surveys continue in Kentucky.

Cost Estimate: \$0/year.

Objective 2: Raise public and stakeholder awareness of TNS issues.

Strategy 2A: Develop a TNS education program specific to Kentucky.

Action 2A1: Impacts of TNS vary from state to state, and currently Kentucky does not have a TNS education program specific to the state. The TNS coordinator (or the combined NS coordinator) could develop a TNS education program specific to Kentucky. Any existing federal, regional, state agency, and non-government organization (NGO) education campaigns relevant to Kentucky could be incorporated to save time and money.

Cost Estimate: Computer, presentations, webpage design, printing supplies, postage, signage, etc. = \$15,000/year.

Strategy 2B: Target and educate key groups about TNS.

Action 2B1: The TNS Plan has identified groups most likely to facilitate introductions and/or spread of TNS (see Introduction section) in Kentucky. The TNS coordinator (or the NS coordinator) could target and educate these groups as well as other groups such as students and NGO's that could help prevent introduction and spread of TNS.

Cost Estimate: For in-state travel = \$5,000/year.

Strategy 2C: Identify and secure outside funding to maintain and improve the TNS education program.

Action 2C1: Developing, maintaining, and expanding the TNS education program may require substantial funding. The TNS coordinator (or the NS coordinator) could work to identify and secure outside funding for the TNS education program and campaign. Information regarding grants and other funding opportunities could be disseminated to other interested parties who could also submit proposals to secure funding.

Cost Estimate: For postage, media, etc. = \$250/year.

Strategy 2D: Assess public and stakeholder awareness and perceptions of TNS by incorporating TNS questions into the proposed ANS annual survey.

Action 2D1: Public and stakeholder awareness and perceptions of TNS in Kentucky are unknown. Incorporating TNS questions into the proposed annual ANS survey could identify TNS awareness gaps and shortfalls. Future education efforts could be tailored to address these gaps resulting in more efficient and effective educational programs. An annual survey could also help determine the success of TNS education message conveyance on a year-to-year basis.

Cost Estimate: \$0/year.

Objective 3: Develop an early detection and rapid response (EDRR) system.

Strategy 3A: Develop an effective TNS EDRR system or incorporate TNS into the proposed ANS EDRR system.

Action 3A1: The TNS coordinator could work to develop a TNS EDRR system. Alternatively, the NS coordinator could incorporate TNS into the proposed ANS EDRR (see ANS Plan) resulting in an EDRR covering all nuisance species in Kentucky. An effective and flexible EDRR system could include the following components:

- a) Conditions under which the EDRR team would be deployed.
- b) List of approved control and containment techniques.

- c) Personnel trained in approved EDRR procedures.
- d) Licenses and permits necessary for specific control techniques.
- e) Funding mechanisms.
- f) Criteria for measuring response effectiveness.

Cost Estimate: For communication efforts (possible meeting, phone calls, mailings, etc.) to develop (not utilize) an EDRR system = \$250/year.

Strategy 3B: Utilize the EDRR system as determined by conditions and criteria.

Action 3B1: The EDRR system could be utilized when conditions determined during development of the rapid response system are met.

Cost Estimate: Cost of EDRR system utilization will vary depending upon equipment and supplies needed, TNS type, etc. and should become clearer as the EDRR system develops. Estimate = \$10,000/utilization.

Objective 4: Offer effective communication and coordination of TNS management activities.

Strategy 4A: Establish a permanent Kentucky Nuisance Species Task Force.

Action 4A1: To guide and assist the development of the KY ANS Management Plan, the KYANSTF was created. The KYANSTF was initially created for the time period required for ANS Plan approval. To guide and assist the development of the TNS Plan an unofficial TNS Task Force was also created. To maximize the effectiveness and efficiency of statewide nuisance species management efforts, a permanent Kentucky Nuisance Species (ANS and TNS) Task Force should become a permanent body.

Cost Estimate: For communication efforts between members, including possible meetings, phone calls, and mailings = \$250/year.

Strategy 4B: Generate strong in-state, regional, and national ties.

Action 4B1: Cooperation and strong ties between in-state, regional, and federal organizations are essential for successful TNS management because TNS do not respect county, state, or political boundaries. Regular communication between these organizations will be necessary to keep up with new TNS threats as well as provide opportunities for cooperative prevention. The proposed TNS or NS coordinator could handle these duties.

Cost Estimate: Extensive travel for meetings, conferences, and symposiums will be required = \$5,000/year.

Strategy 4C: Foster an exchange of ideas and information regarding TNS within Kentucky.

Action 4C1: Currently, there is not an annual state level opportunity for those working with TNS in Kentucky to network and exchange knowledge. Providing space and a forum for an annual Kentucky Nuisance Species Conference could fill this need.

Cost Estimate: \$1,000/year.

Budget Totals

For DOW to create a TNS coordinator position and carry out all proposed TNS management activities = \$170,250/year.

For DOW to support a combined NS coordinator position and to carry out all proposed TNS management activities = \$99,500/year.

Program Monitoring and Evaluation

A program monitoring and evaluation system provides a means for determining success of proposed TNS management efforts. The system can also be an important component of the annual review process because it can provide opportunities to “adjust” management actions if the intended results are not achieved. In this Plan, we have developed specific strategies and actions to help us achieve outlined goals and objectives. However, we do not know which TNS management strategies will be achieved in the first year of implementation. With this in mind, the following approach of monitoring and evaluating the early years of management actions is proposed.

A three-method approach could be applied to the goals and objectives of the plan. First, an “indicator action” method could be used to select a proposed program (e.g., feral hog eradication program) and determine whether the program has been funded and effectively executed. Establishment and effective execution of a program would provide a measurement of success.

A second method applies “quantitative biological measures.” This method uses field sampling to determine whether TNS have spread or if new introductions have occurred. Since Kentucky does not have a TNS baseline database, this method could not be currently employed. However, it could in the future if necessary baseline data are collected or if a baseline database is created from existing datasets.

A third method could utilize “quantitative social methods.” Public and stakeholder awareness and perceptions of TNS can be determined through the use of questionnaires. Use of indicators 1 and 3 could measure some aspects of Plan progress even without indicator 2.

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Glossary

Adaptation- the development of physical and behavioral characteristics that allow organisms to survive and reproduce in their habitats.

Allelopathy- the release into the environment by one plant of a substance that inhibits the germination or growth of other potential competitor plants.

Alluvial- used to describe the environment, action, and sedimentary deposits of rivers or streams.

Biodiversity- the range of organisms present in a given ecological community or system.

Biosecurity- precautions taken to minimize the risk of introducing a TNS outside a contained area.

Biotic- used to describe living features of a natural system.

Bottomland- low-lying fertile lands bordering a river.

Calciphile- A plant that tends to be restricted to basic (alkaline) soils.

Cervid- any ruminant mammal, for example, a deer, elk, or reindeer, characterized by the presence of antlers in the male or sometimes in both sexes. Family: Cervidae

Colonize- to establish plants or animals, or become established, in a new area.

Control- limiting the distribution and abundance of TNS through biological, chemical, or mechanical means.

Dispersal- the movement of organisms away from their place of birth or from centers of population density.

Disturbed- a geographic area altered from its natural state.

Early Detection and Rapid Response (EDRR)- efforts designed to detect new TNS in time to allow efficient and environmentally sound assessments to be made and respond to invasions in an effective, environmentally sound manner that will prevent the spread and permanent establishment of invasive species.

Ecosystem- the complex of a community of organisms and its environment.

Eradicate- to completely eliminate a population from a geographic area.

Escarpment- a steep slope or cliff that marks the boundary of a flat or gently sloping upland area such as a plateau, often formed by faulting or erosion.

Fauna- the animal life of a particular region or period, considered as a whole.

Flora- plant life, especially all the plants found in a particular country, region, or time regarded as a group.

Food web- the interlocking food chains within an ecological community.

Introduction- the intentional or unintentional release, escape, dissemination, or placement of a species into an ecosystem as a result of human activity.

Invasive species- a non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Knobs- rounded hills.

Localized- restricted to a particular location.

Loess- a deposit consisting predominantly of silt, sometimes with smaller amounts of very fine sand and/or clay.

Mesic- growing in or characterized by moderate moisture.

Mitigate- to reduce the severity of impacts on fish or wildlife habitat.

Monoculture- consisting of a single species.

Native species- with respect to a particular ecosystem, a species that other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

Naturalized- to cause a plant or animal from another region to become established in a new environment or to adapt successfully to new environmental conditions

Non-indigenous- an organism transported intentionally or accidentally from another region.

Non-native- an organism living beyond its natural or historical range of distribution.

Pathways- natural and human connections that allow movement of organisms or their reproductive materials, such as seeds, spores, or eggs, from place to place.

Physiographic- refers to the physical features of the earth's surface.

Reclamation- The process by which lands disturbed as a result of mining activity are reclaimed back to a beneficial land use.

Riparian- situated along or near the bank of a river.

Ruderal- a plant that grows in disturbed ground.

Scarified- plant seeds that require the stimulus of fire for germination.

Stakeholders- individuals and entities with a common interest in particular TNS, pathways, or associated issues, including but not limited to, State, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests, and private landowners.

Terrestrial nuisance species- non-native species that threaten the diversity or abundance of native terrestrial species or the ecological stability of ecosystems, or commercial, agricultural, or recreational activities dependent on such ecosystems.

Appendix I: Acronyms

ANS	Aquatic Nuisance Species
APHIS	Animal and Plant Health Inspection Service
DBNF	Daniel Boone National Forest
DOF	Division of Fisheries
DOW	Division of Wildlife
EAB	Emerald Ash Borer
EDDMapS	Early Detection and Distribution Mapping System
EDRR	Early Detection and Rapid Response
KAR	Kentucky Administrative Regulations
KDA	Kentucky Department of Agriculture
KDF	Kentucky Division of Forestry
KDFWR	Kentucky Department of Fish and Wildlife Resources
KRS	Kentucky Revised Statutes
KSNPC	Kentucky State Nature Preserves Commission
KYANSTF	Kentucky Aquatic Nuisance Species Task Force
KY-EPPC	Kentucky Exotic Pest Plant Council
NGO	Non-governmental Organization
NPS	National Park Service
NS	Nuisance Species
SE-EPPC	Southeast Exotic Pest Plant Council
TNS	Terrestrial Nuisance Species
UKY	University of Kentucky
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service

Appendix II: Other Identified TNS within Kentucky

<u>Scientific name</u>	<u>Common name</u>	<u>Distribution</u>	<u>Comments</u>
TN Plants: Established			
<i>Acer ginnala</i>	Amur maple	If present, most likely in vacant lots, waste areas, roadside near populations centers	Often cultivated; wind blown seed can established in open disturbed ground and in forest; potential to be a pest understory shrub/tree in forests
<i>Acer platanoides</i>	Norway maple	Currently limited, isolated distribution in KY	Potential to become a serious forest pest; invades intact forest in northeast US
<i>Agrostemma githago</i>	Corncockle	Common agronomic weed	
<i>Akebia quinata</i>	Five-leaf akebia	Localized infestations	Potential to be a serious pest in relatively small areas
<i>Albizia julibrissin</i>	Mimosa	Becoming more common in KY; widespread, but still mostly localized	Invades open disturbed areas, but have seen in forest following fire; prolific seeder (gravity) and if injured, sprouter
<i>Allium spp.</i>	Wild onion	Some are native	<i>A. vineale</i> is in ag lands
<i>Ampelopsis brevipedunculata</i>	Porcelain berry	Across the state, but not abundant	Potential to form large local infestations (e.g., Louisville area)
<i>Arctium minus</i>	Common burdock	Scattered across the state	Primarily an open, disturbed ground species: roadside, field, waste area; some concern in Ag areas
<i>Arthraxon hispidus</i>	Hairy jointgrass	Scattered across the state; is likely to be come more abundant	Invades disturbed areas where moist and light to moderate shade, then moves into adjacent undisturbed areas
<i>Berberis thunbergii</i>	Japanese barberry	Scattered in state	Will grow in open habitats or forest; bird spread, can form large thickets; harbors alternate phase of black stem wheat rust
<i>Bromus tectorum</i>	Cheatgrass	Seen occasionally in open disturbed areas	
<i>Cardiospermum halicacabum</i>	Balloonvine heartseed	W. KY; localized, likely to spread	Invades disturbed ground; can become monoculture; largely an Ag weed, but with potential to invade natural systems
<i>Chrysanthemum leucanthemum</i>	Ox-eye daisy	Widespread	This species is naturalized in KY; not likely to eradicate it or effectively control it; it can be a serious problem for natural grasslands and localized control is appropriate
<i>Cirsium arvense</i>	Canada thistle	Across KY, usually localized occurrences; Ag fields, roadsides primarily	Strongly rhizomatous and forms large monocultures; chokes out native species; spreads rapidly; can invade grassland, woodland
<i>Clematis terniflora</i>	Japanese Virgin's-bower	Scattered across KY, large presence in McCreary county on roadsides	Widely cultivated and escaped; prolific seeder; will establish in open or closed habitats if stem can reach light; High climber and can choke tree vegetation; will grow on ground in grassland; fire sets back does not kill, may promote germination; wind dispersed; will grow in open forest or woodland

<i>Dipsacus sylvestris</i>	Common teasel	Throughout KY	Mostly roadsides; also waste areas, fields; can form dense monocultures
<i>Elaeagnus angustifolia</i>	Russian olive	Scattered across KY	Much planted (mine areas, wind breaks); bird spread
<i>Eleusine indica</i>	Goose grass	Across KY	Primarily an Ag weed, also in gardens, disturbed ground, roadsides; competes with native species
<i>Elytrigia repens</i>	Quackgrass	Across KY, usually localized	Serious Ag pest and homeowner garden pest; has potential to invade native grasslands, woodlands
<i>Erodium cicutarium</i>	Redstem stork's bill	Localized, scattered in KY	Disturbed, open ground weed including roadside, field, waste area
<i>Euonymus alatus</i>	Winged euonymus	Common in some urban woodlands around Lexington	
<i>Frangula alnus</i>	Glossy buckthorn	Scattered	One to watch; serious pest elsewhere
<i>Glechoma hederacea</i>	Ground ivy	Throughout KY	Primarily a pest of disturbed ground- roadside, field, lawn, garden, but does grow in mesic forest and can choke vegetation; a prolific and aggressive spreader
<i>Hedera helix</i>	English ivy	Throughout KY; generally localized infestations	Grows in open or closed habitat; can choke vegetation if on ground or climbing; bird spread
<i>Humulus japonicus</i>	Japanese hops	Concentrations in KY River drainages in Central KY	Aggressive vine; invading floodplain terraces; forms choking mats
<i>Ipomoea hederacea</i>	Ivy-leafed morning-glory	Throughout KY	Primarily an Ag pest, but also in waste areas, roadsides, yards
<i>Ipomoea purpurea</i>	Purple morning-glory	Throughout KY	Primarily an Ag pest, but also in waste areas, roadsides, yards
<i>Lotus corniculatus</i>	Bird's foot trefoil	Across KY	Generally open areas: roadsides, waste areas, w/l openings, mine sites; fire scarified seed; a potential problem in Rx burn area: grasslands, woodlands
<i>Mentha piperata</i>	Peppermint	Scattered in KY, locally abundant	Generally in moist, low ground; locally a pest with potential for large colonies; spread is slow unless physically moved
<i>Morus alba</i>	White mulberry	Across KY, scattered, locally abundant, especially on base-rich soils	Biggest threat is damage to native Red mulberry gene pool; can establish in forested situations; bird spread
<i>Mosla dianthera</i>	Miniature beefsteak	Mostly central and eastern KY, but spreading	Primarily in moist, disturbed areas with sun or light to moderate shade; spread by water and soil (mud); can form large patches, often with <i>Microstegium</i>
<i>Ornithogalum umbellatum</i>	Star-of-Bethlehem	Across KY, scattered, locally abundant	Spreads rapidly once established (veg); can invade intact forest; generally a weed of lawns, roadsides
<i>Plantago lanceolata</i>	Buckhorn plantain	Throughout KY	Generally an Ag/ disturbed ground species: roadsides, fields, lawns, waste area
<i>Poa pratensis</i>	Bluegrass	Throughout KY	Generally in Ag/ lawn environments, can invade shaded, moist grassland

<i>Polygonum cespitosum</i>	Oriental ladythumb	Throughout KY	Mat forming, spreading on moist disturbed soils, sun or shade; a threat to wetlands; generally ruderal and fields
<i>Polygonum persicaria</i>	Lady's thumb	Throughout KY	Naturalized in moist to wet areas, usually open and disturbed; control may not be possible, but localized eradication may be in order
<i>Populus alba</i>	White poplar	Scattered throughout KY, locally abundant	Forms large colonies excluding other vegetation; spread is vegetative so not a serious threat, although local populations may warrant treatment
<i>Rumex acetosella</i>	Sheep sorrel	Throughout KY	Primarily an Ag, disturbed ground species including gardens, mine lands, fields, pasture, roadside; extremely difficult to control/ eradicate; poses some threat to native grasslands
<i>Salix cinerea</i>	Pussy willow	Not often seen	
<i>Setaria faberi</i>	Giant foxtail	Throughout KY	Primarily an Ag weed: pasture, field, but also ruderal and through contaminated straw and hay, yards and plantings; can invade grasslands, woodlands and displace native species
<i>Setaria viridis</i>	Green foxtail	Throughout KY	Primarily an Ag/ disturbed ground species: fields, roadsides, gardens, pasture; spread in contaminated straw/ hay
<i>Spiraea japonica</i>	Japanese spiraea	Scattered in eastern and southern KY	Can form thickets in wetlands (usually somewhat open) or mesic forest
<i>Tussilago farfara</i>	Colt's foot	Throughout KY	A disturbed ground specialist; especially common on unstable or unconsolidated materials: mine spoils, shale road cuts; dry or moist; forms large mats; aggressive spreader with wind blown seed; will spread from disturbed ground into adjacent woodland or open forest
<i>Verbascum thapsus</i>	Common mullein	Throughout KY	Disturbed open ground: fields, roadsides, waste areas, mine lands, pasture; some threat to native grasslands
<i>Verbena brasiliensis</i>	Brazilian vervain	If present, in Jackson Purchase area	Mostly disturbed, open ground: roadsides, fields, waste areas; some potential to invade native grassland
<i>Vinca major</i>	Bigleaf periwinkle	Scattered across KY	Primarily a garden/ yard plant; seldom escaping from established areas; low threat
<i>Vinca minor</i>	Lesser periwinkle	Scattered across KY, locally abundant	Where established (e.g., old home sites) a serious problem, site to site spread is very slow; established populations expand rapidly and exclude most other plants; generally in some shade
<i>Wisteria sinensis</i>	Chinese wisteria	Scattered across KY, locally abundant; may actually be <i>Wisteria x formosa</i>	Forms dense thickets and can smother vegetation; spread from site to site slow
TN Insects: Established			
<i>Harmonia axyridis</i>	Asian ladybug	Widespread at least in Central/ eastern KY	A nuisance insect because of wintering in homes and some tendency to bite; probably

			causes ecological harm as well
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Reviewers:

JB- Joyce Bender, Kentucky State Nature Preserves Commission

DDT- David Taylor, US Forest Service

RB- Rob Paratley, UKY Herbarium

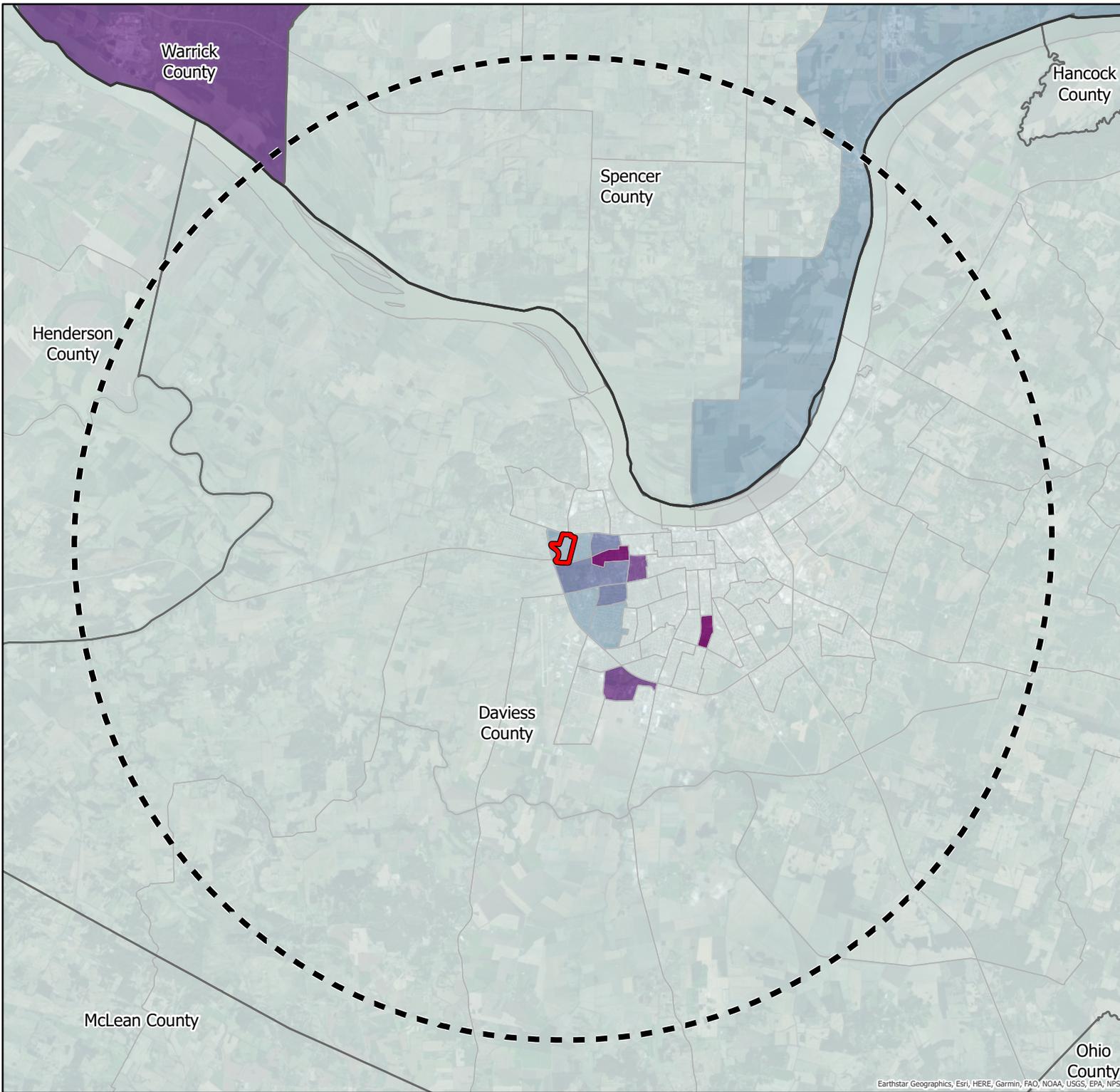
Environmental Assessment

Attachment L. Cultural Resources Reports and Correspondence

The reports titled *An Archaeological Survey for the Proposed Big Rivers Operation Center in Owensboro, Daviess County, Kentucky* (Rusche, 2023) and *Cultural Historic Survey for the Proposed New Transmission Operation Center in Daviess County, Kentucky* (Dickerson and Reynolds 2023) are on file with at the USDA Rural Utilities Service National Office, along with correspondence. The reports have been omitted from the document for confidentiality concerns. Please contact the USDA-RUS Federal Preservation Officer with any questions.

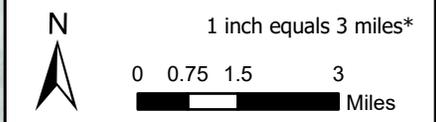
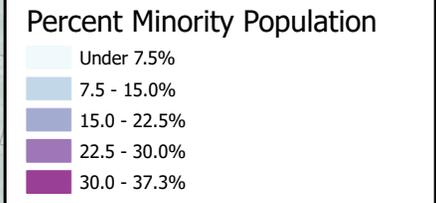
Environmental Assessment

Attachment M. Environmental Justice Demographic Maps



Big Rivers Electric Corporation
Transmission Operations Center
Environmental Assessment
Area Minority Population Screening

-  Transmission Operations Center Site Area
-  Site Boundary - 10 mi Buffer Area
-  State Boundary
-  County Boundary
-  Block Group Boundary

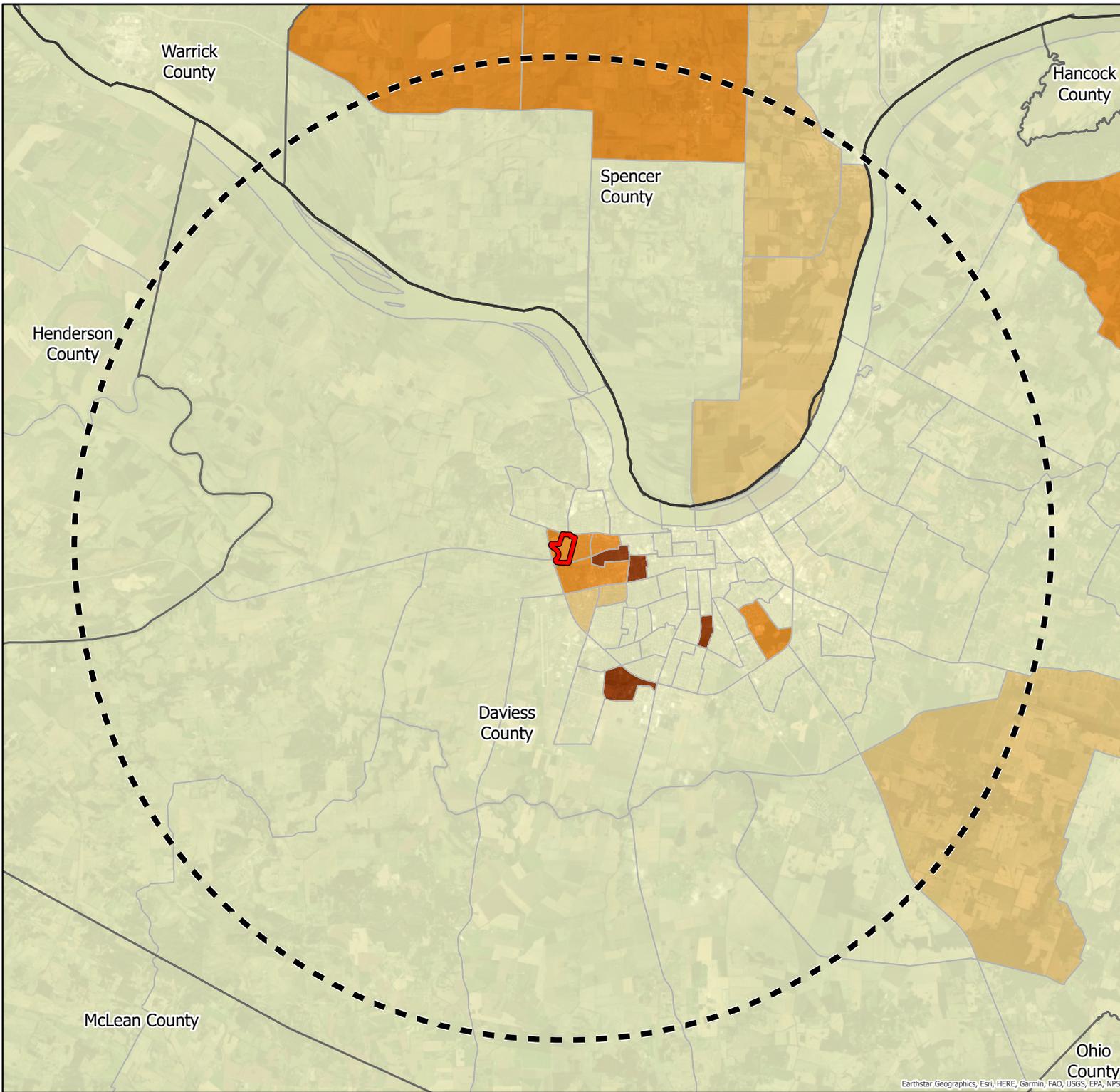


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Disclaimer: Maps are not intended to provide survey grade data.



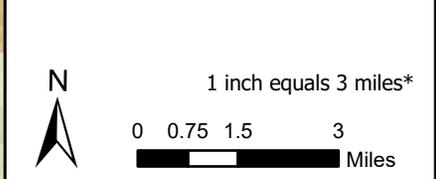
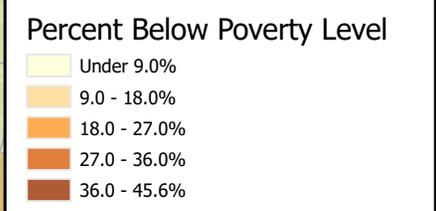
Title: Area Minority Population Screening	Prepared: S. McEwen-Barbas
Site: Transmission Operations Center Site	Reviewed: M. Krajewski
Figure: 3 of 5	Date: 11/11/2022
Source: American Community Survey 5yr 2000	Revision: 0

Ohio County
Earthstar Geographics, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS



Big Rivers Electric Corporation
Transmission Operations Center
Environmental Assessment
Area Poverty Screening

- Transmission Operations Center Site Area
- Site Boundary - 10 mi Buffer Area
- State Boundary
- County Boundary
- Block Group Boundary



*When printed on 8.5" x 11" page
Disclaimer: Maps are not intended to provide survey grade data.

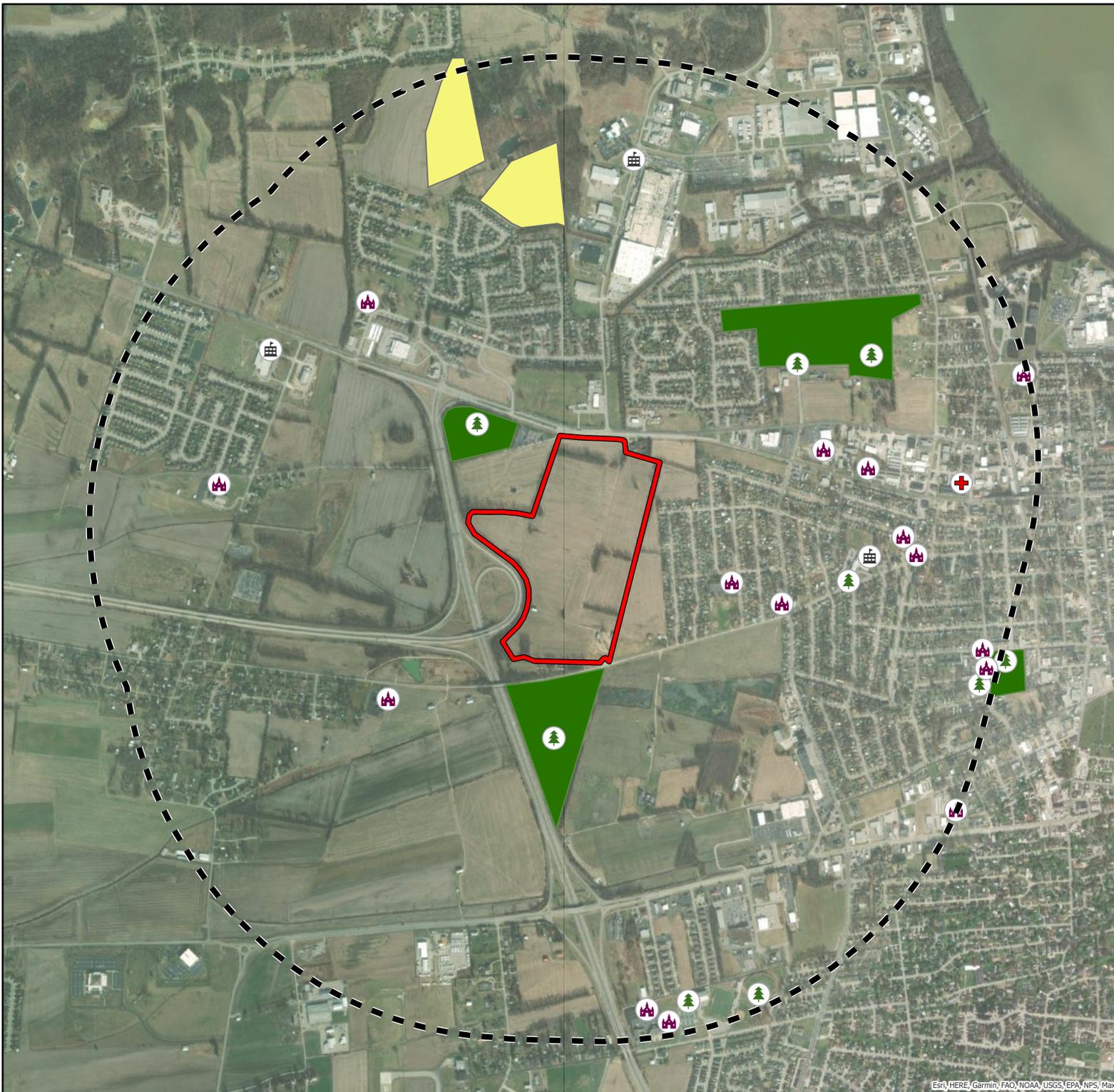


Title: Area Poverty Screening	Prepared: S. McEwen-Barbas
Site: Transmission Operations Center Site	Reviewed: M. Krajewski
Figure: 2 of 5	Date: 11/11/2022
Source: American Community Survey 5yr 2000	Revision: 0

Ohio County
Earthstar Geographics, Esri, HERE, Garmin, FAO, USGS, EPA, NPS

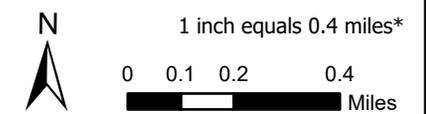
Environmental Assessment

Attachment N. Sensitive Receptors Map



Big Rivers Electric Corporation
Transmission Operations Center
Environmental Assessment
Area Sensitive Receptors

- Transmission Operations Center Site Area
- Site Boundary - 1 mi Buffer Area
- Sensitive Receptors**
- Medical Facility
- Parks and Recreation Area
- Religious Institution
- School
- Protected Areas**
- City of Owensboro
- KY Dept. of Natural Resources



*When printed on 8.5" x 11" page
Disclaimer: Maps are not intended to provide survey grade data.



Title: Area Sensitive Receptors	Prepared: S. McEwen-Barbas
Site: Transmission Operations Center Site	Reviewed: M. Krajewski
Figure: 5 of 5	Date: 11/11/2022
Source: Protected Areas of the U.S. Database, Google	Revision: 0

Environmental Assessment

Attachment O. Traffic Impact Study Report

Big Rivers Electric – Kenergy Operations Center Traffic Impact Study

Submitted to:

Kentucky Transportation Cabinet, District 2

City of Owensboro, City Engineer

Daviess County, County Engineer

Prepared by:

HMB Professional Engineers

3 HMB Circle

Frankfort, KY 40601

February 16, 2022

Updated: March 17, 2022



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Executive Summary

This report presents the Traffic Impact Study for the proposed Big Rivers Electric – Kenergy Operations Center in Owensboro, Daviess County, Kentucky. The new development will be located across KY 331 from KY 331 / Industrial Drive and east of US 60.

Study Area

The new development will be located just east of US 60 and the main entrance will become the south leg of the West 2nd Street and KY 331 (Industrial Drive) intersection. The conceptual site plan is shown in **Appendix A**. Traffic data was collected at the following study intersection:

- US 60 at KY 331 / Bon Harbor Hills – signalized
- KY 331 at Gradd Way - unsignalized
- West 2nd Street / KY 331 (Industrial Drive) – signalized
- West 2nd Street at Commercial Entrance, East of Industrial Drive (containing Subway, Val-U Liquors West and Sturdi Built)- unsignalized

Turning movement counts (TMCs) were collected by Cummins Consulting Services on a typical weekday while school was in session (Thursday, January 27, 2022) for the peak hours of 6:30 – 8:30 AM and 3:00 – 5:30 PM to determine the AM and PM peak period volumes for the intersections noted in Section 1. The AM peak period was determined to be from 6:45 AM – 7:45 AM and the PM peak period was from 3:30 PM – 4:30 PM. In addition to the TMCs, the detailed hourly counts were collected from KYTC for two AADT count stations on US 60, one on KY 331, and one on W 4th St, in the study area to compare against the collected TMCs and derive forecasted traffic. The consultant team also collected intersection geometry as required for capacity analysis including approach lane configurations, departure lane configurations, number and length of turn lanes, presence of channelizing devices, type of traffic control, roadway approach grade, and existing signal timings.

Trip Generation and Traffic Assignment

Trip generation was conducted using information from the applicant and assessed with the *ITE Trip Generation Manual (11th Edition, Institute of Transportation Engineers)*. A conceptual site layout was provided by the applicant detailing the conceptual plan being considered for the site. The conceptual site layout is shown in **Appendix A**. The site trips are described in **Table ES-1**. In total, the development is projected to generate 146 total AM peak hour trips and 150 PM peak hour trips.

Table ES-1 – Trip Generation Summary

ITE Land Use Code (LUC)	Land Use Description	Size	Units	Daily Trips	AM Peak			PM Peak		
					Total	In	Out	Total	In	Out
710	Office	52.71	1,000 Sq Ft	665	97	85	12	98	17	81
150	Warehousing	209.62	1,000 Sq Ft	369	49	38	11	52	14	38
Site Generated Project Trips				1,034	146	123	23	150	31	119
Total External Project Trips				-	146	123	23	150	31	119

Capacity Analysis Results

Traffic operations analysis was performed at all the study intersections under the following analysis scenarios:

- Existing Year (2022)
- Open Year (2024) No Build and Build Conditions
- Design Year (2034) No Build and Build Conditions

Highway Capacity Software (HCS) was used to conduct intersection capacity analysis for each intersection and time period based on the *Kentucky Transportation Cabinet (KYTC) Traffic Impact Study Requirements (2012 Policy)*, and the software outputs were evaluated to determine if any roadway improvements (additional or lengthened turn lanes, modification of traffic signals, etc.) are warranted in order to maintain an acceptable level of service (LOS). The LOS and delay results for the 2034 No Build and 2034 Build scenarios are summarized in **Table ES-2** and **Table ES-3**.

Conclusions

There are minimal changes in LOS and delay between the No Build and Build scenarios, with the exception of the US 60 intersection during the 2034 PM Peak. Due to the heavy westbound left turn volume, this intersection operates at LOS D for the 2034 PM Peak No Build and with the additional traffic, delay increases 12.1 seconds per vehicle resulting in LOS E for the 2034 PM Peak Build. This lower LOS is primarily driven by shift change at several nearby manufacturing facilities and occurs earlier than a typical PM Peak Hour. Looking specifically at the westbound left turn volume, the higher traffic volumes are limited to 3:30-3:45 where the movement volume is 60 percent higher than any other 15-minute period. While this intersection should be monitored long term, improvements were made at this location in 2021, and further improvements are not warranted at this time.

At the proposed entrance, the eastbound right turn lane was not warranted, and a westbound left turn lane can be accommodated in the existing median. Overall, LOS operates at LOS B or better and no queuing concerns were identified.

Table ES-2. 2034 No Build Intersection Level of Service and Delay Summary

Intersections and Approaches	2034 No Build			
	AM Peak		PM Peak	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
1 - US 60 @ KY 331 / Bon Harbor Hills - Signalized				
<i>Eastbound</i>	D	40.5	E	62.2
<i>Westbound</i>	B	17.0	C	20.6
<i>Northbound</i>	C	28.8	E	79.1
<i>Southbound</i>	D	40.3	E	59.5
Overall Intersection	C	28.8	D	48.8
2 - KY 331 @ Gradd Way - TWSC				
<i>Eastbound</i>	-	-	-	-
<i>Westbound Left</i>	A	9.1	A	8.4
<i>Northbound</i>	B	13.0	B	12.7
Overall Intersection	-	-	-	-
3 - W 2nd St @ KY 331 (Industrial Dr) - Signalized				
<i>Eastbound</i>	A	7.8	A	8.1
<i>Westbound</i>	A	5.4	A	6.9
<i>Southbound</i>	B	18.8	C	23.5
Overall Intersection	A	8.5	B	12.4
4 - W 2nd St @ Commercial Entrance - TWSC				
<i>Eastbound Left</i>	A	8.4	A	8.8
<i>Westbound</i>	-	-	-	-
<i>Southbound</i>	B	11.5	B	13.8
Overall Intersection	-	-	-	-

Table ES-3. 2034 Build Intersection Level of Service and Delay Summary

Intersections and Approaches	2034 Build			
	AM Peak		PM Peak	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
1 - US 60 @ KY 331 / Bon Harbor Hills - Signalized				
<i>Eastbound</i>	D	40.9	E	75.2
<i>Westbound</i>	B	17.3	C	23.1
<i>Northbound</i>	C	29.5	F	109.3
<i>Southbound</i>	D	41.0	E	73.1
Overall Intersection	C	29.2	E	60.9
2 - KY 331 @ Gradd Way - TWSC				
<i>Eastbound</i>	-	-	-	-
<i>Westbound Left</i>	A	9.4	A	8.5
<i>Northbound</i>	B	13.7	B	13.1
Overall Intersection	-	-	-	-
3 - W 2nd St @ KY 331 (Industrial Dr) - Signalized				
<i>Eastbound</i>	A	7.3	A	6.8
<i>Westbound</i>	A	5.6	A	6.3
<i>Northbound</i>	B	17.3	B	17.4
<i>Southbound</i>	B	18.9	C	21.5
Overall Intersection	A	8.5	B	11.3
4 - W 2nd St @ Commercial Entrance - TWSC				
<i>Eastbound Left</i>	A	8.7	A	8.9
<i>Westbound</i>	-	-	-	-
<i>Southbound</i>	B	11.7	B	14.0
Overall Intersection	-	-	-	-

Table of Contents

- Section 1 Project Background1**
 - 1.1 Site Description1
 - 1.2 Study Area.....1
- Section 2 Existing (2022) Condition Analysis 3**
 - 2.1 Existing Roadway Conditions.....3
 - 2.1.1 US 60 (Wendell Ford Expressway).....3
 - 2.1.2 KY 331 (Henderson Road / Industrial Drive).....3
 - 2.1.3 Gradd Way and Commercial Entrance.....4
 - 2.1.4 Bon Harbor Hills4
 - 2.2 Existing Turning Movement Data.....4
 - 2.3 Level of Service Criteria6
 - 2.4 Existing Conditions Analysis.....8
- Section 3 2024 and 2034 No Build Scenario Analysis..... 9**
 - 3.1 Traffic Volume Projections.....9
 - 3.2 Level of Service Analysis9
- Section 4 Trip Generation and Traffic Assignment 14**
 - 4.1 Trip Generation14
 - 4.2 Trip Distribution and Assignment14
- Section 5 2024 and 2034 Build Condition Analysis 17**
 - 5.1 Build Level of Service Analysis17
 - 5.2 KY 331 & Industrial Drive Right Turn Lane Assessment17
 - 5.3 KY 331 at W 2nd Street Left Turn Phasing Analysis17
- Section 6 Conclusions.....22**

List of Figures

Figure 1-1 Study Area and Intersection Configuration.....	2
Figure 2-1. 2022 Existing AM and PM Peak Hour Traffic Turning Movement Volumes.....	5
Figure 3-1. 2024 No Build AM and PM Peak Hour Traffic Turning Movement Volumes.....	10
Figure 3-2. 2034 No Build AM and PM Peak Hour Traffic Turning Movement Volumes.....	11
Figure 4-1. External Trip Distribution Percentages	15
Figure 4-2. AM and PM Peak Total External Site Generated Trips	16
Figure 5-1. 2024 Build AM and PM Turning Movement Volumes	18
Figure 5-2. 2034 Build AM and PM Turning Movement Volumes	19

List of Tables

Table 2-2. Level of Service Criteria for Signalized and Unsignalized Intersections.....	6
Table 2-3. Intersection Level of Service and Delay Summary – 2022 Existing Conditions	8
Table 3-1. Intersection Level of Service and Delay Summary – 2024 No Build Conditions	12
Table 3-2. Intersection Level of Service and Delay Summary – 2034 No Build Conditions	13
Table 4-1. Site Generated Trips.....	14
Table 5-1. Intersection Level of Service and Delay Summary – 2024 Build Conditions	20
Table 5-2. Intersection Level of Service and Delay Summary – 2034 Build Conditions	21

Appendices

Appendix A Conceptual Site Plan
Appendix B Intersection Turning Movement Counts
Appendix C HCS Outputs – 2022 Existing, 2024 No Build and 2034 No Build
Appendix D HCS Outputs – 2024 Build and 2034 Build
Appendix E Turn Lane Assessment
Appendix F Intersection Delay Study

Section 1

Project Background

The consultant team was contracted by the developer to prepare a Traffic Impact Study for the proposed Development in Daviess County, Kentucky. The purpose of this report is to document the study area, site conditions, analysis, and findings. Kentucky Transportation Cabinet (KYTC) Traffic Impact Study Requirements - 2012 Policy were followed.

1.1 Site Description

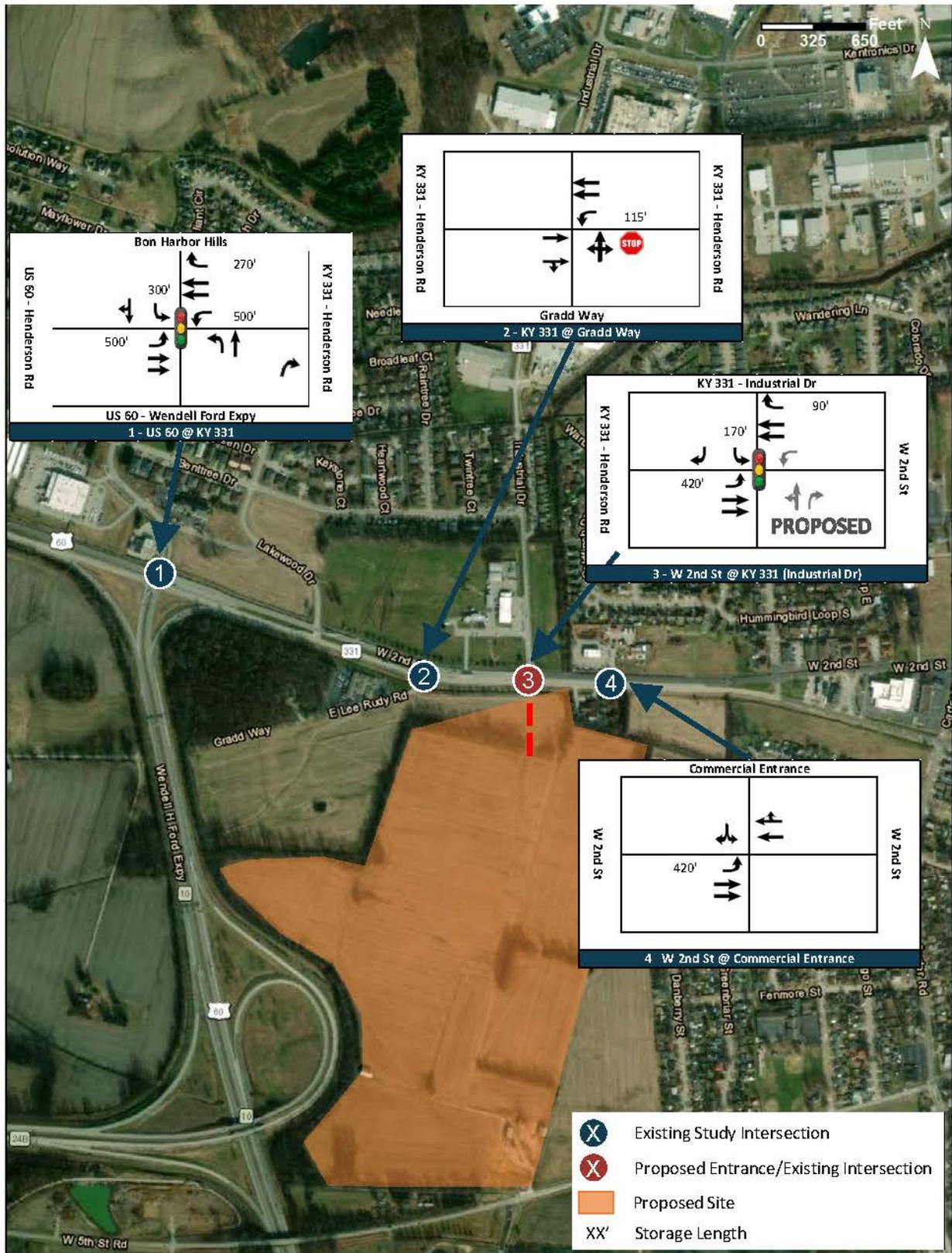
The new development will be located just east of US 60 and the entrance is proposed to become the south leg of the West 2nd Street and KY 331 (Industrial Drive) intersection with the future potential to provide a connection to West 5th Street Road to the south. The conceptual site plan is presented in **Appendix A**. As shown, the proposed Operations Center would not encompass the entire property. Any further development beyond what is discussed in this traffic impact study would require the study to be updated. Additionally, extending the proposed entrance to 5th Street Road will also require additional study. The proposed road is planned to be an extension of Industrial Road and would be a public road, and other internal roads in the site would be private. **Figure 1-1** shows the existing and proposed intersection configurations.

1.2 Study Area

The study area, as shown in **Figure 1-1**, was defined in coordination with the developer, KYTC District 2 and local agencies. Traffic data was collected at the following study intersections:

- US 60 at KY 331 / Bon Harbor Hills – signalized
- KY 331 at Gradd Way – unsignalized (spot count only)
- West 2nd Street / KY 331 (Industrial Drive) – signalized
- W 2nd Street at Commercial Entrance, East of Industrial Drive (containing Subway, Val-U Liquors West and Sturdi Built)- unsignalized (spot count only)

Figure 1-1 Study Area and Intersection Configuration



HMP DELIVERING QUALITY SOLUTIONS

Study Area and Intersection Configuration

Section 2

Existing (2022) Condition Analysis

This section describes the existing roadways in the vicinity of the proposed development and the turning movement count collection from the study intersection.

2.1 Existing Roadway Conditions

The consultant team collected intersection geometry as required for capacity analysis including approach lane configurations, departure lane configurations, number and length of turn lanes, presence of channelizing devices, type of traffic control, roadway approach grade, and existing signal timings.

Figure 1-1 shows the existing and proposed intersection configurations and storage lengths.

2.1.1 US 60 (Wendell Ford Expressway)

- US 60 is a divided four-lane urban freeway expressway that runs around the city of Owensboro. In the study area for this study, US 60 intersects with KY 331 in western Owensboro. The posted speed limit is 65 miles per hour (mph). It has 12' lanes, 10' paved outside shoulders, 2' paved inside shoulders with 2' earth, and a 36' grass median. At the intersection with KY 331, US 60 turns west continuing toward Henderson as a four-lane divided minor arterial and a 55 mph speed limit.
- The AADT for US 60 was 17,089 vehicles per day (vpd) in 2019 according to KYTC Traffic Data. The location for this count was between KY 331 and the Audubon Parkway.
- The study intersection of US 60 at KY 331 and CR 1342 (Bon Harbor Way) is a four-legged, signalized intersection at the western end of the study area. The northbound approach includes separate left and thru lanes, and a channelized right lane removed from the signal that merges with KY 331 eastbound. The southbound approach includes a shared southbound thru/right lane and one southbound left lane. The eastbound approach includes two eastbound thru lanes, one eastbound left lane with approximately 500' storage, and a channelized right turn lane removed from the intersection. The westbound approach includes two westbound thru lanes, one westbound left lane with 500' storage, and one westbound right lane with 270' storage. The intersection was upgraded in 2021 to include an increase in westbound left storage and permitted-protected left turns for each approach which is reflected in each scenario.

2.1.2 KY 331 (Henderson Road / Industrial Drive)

- KY 331 is a divided urban minor arterial four-lane road that runs east-west in the study area as Henderson Road until it meets West 2nd Street where it turns into Industrial Drive to the north at the intersection. It has a posted speed limit of 55 mph until it turns into Industrial Drive where it lowers to 35 mph. It has 12' lanes, 10' paved outside shoulders, 3' paved inside shoulders, and a 15' raised mountable median. KY 331 begins at the intersection with US 60 and turns north along Industrial Drive. The east-west portion becomes West 2nd Street as it crosses Industrial Drive, and the speed limit reduces to 45 mph.
- The AADT for KY 331 was 13,403 vpd in 2018 between US 60 and Industrial Drive. The AADT for US 60 to the west was 7,756 vpd in 2018.

- The study intersection of West 2nd Street at KY 331 (Industrial Drive) is currently a three-legged, signalized intersection. The southbound approach includes one southbound left lane and one southbound right lane. The eastbound approach has two eastbound thru lanes and one eastbound left lane with 420' of storage. The westbound approach includes two westbound thru lanes and one westbound right lane with 90' of storage.
- The proposed main entrance for the development is across KY 331 (Industrial Drive) and will become the northbound leg of the intersection. This study will determine the lane configuration for the new leg, if the existing configuration will need to be modified, and potential signal timing modifications.

2.1.3 Gradd Way and Commercial Entrance

- Gradd Way is a county road that borders Joe Ford Nature Park and serves as the entrance for the Green River Area Development District (GRADD). The Joe Ford Nature Park also serves as a trailhead for the Adkisson Greenbelt West Trail, a multi-use trail that winds through western Owensboro.
- The intersection of Gradd Way and KY 331 is a three-legged intersection. The northbound approach is stop controlled and has one shared left/ right lane. The eastbound approach includes one thru lane and one shared thru/right lane. The westbound approach has two thru lanes and one left lane with 110' of storage. This intersection lies between US 60/KY 331 and KY 331/Industrial Drive intersections.
- The commercial entrance east of Industrial Drive was also considered due to its close proximity to the proposed site entrance. It serves as access for Subway, Val-U Liquors West and Sturdi Built. There are no turn lanes from the mainline into the entrance and vehicles turning left into the entrance use the raised mountable median to do so.

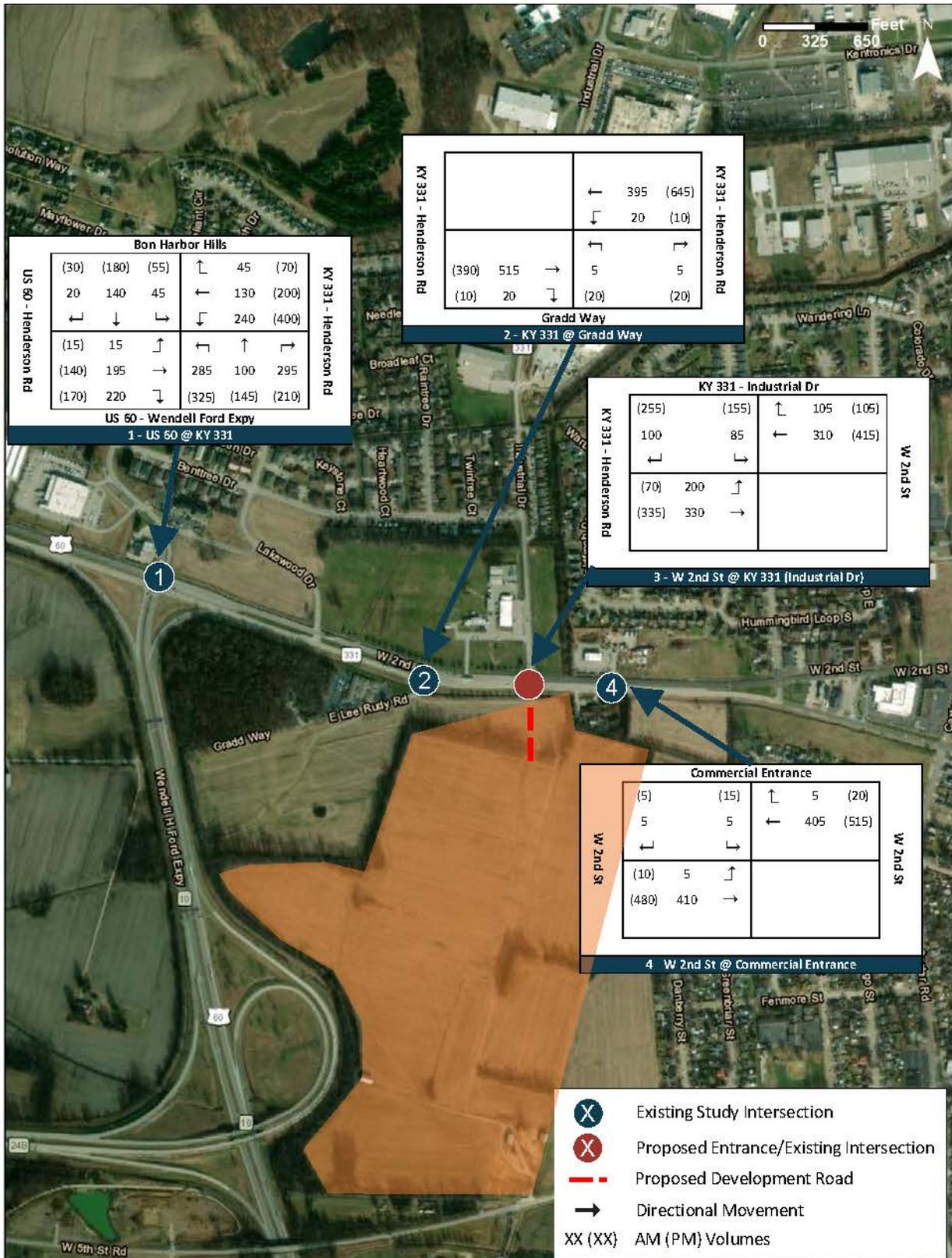
2.1.4 Bon Harbor Hills

- Bon Harbor Hills is a local road that sits opposite of US 60 at the intersection with KY 331 as a two-lane southbound approach. It consists of two 11' lanes and a 14' TWLTL median. At the intersection, there is a left and a shared through/right lane with 300' of storage. It provides access to a post office, Sleep Inn, Shell gas station, and a neighborhood of single-family homes.

2.2 Existing Turning Movement Data

Turning movement counts (TMCs) were collected by Cummins Consulting Services on a typical weekday while school was in session (Tuesday, January 27, 2022) for the peak hours of 6:30 – 8:30 AM and 3:00 – 5:30 PM to determine the AM and PM peak period volumes for the two signalized intersections noted in Section 1. The AM peak period was determined to be from 6:45 AM – 7:45 AM and the PM peak period was from 3:30 PM – 4:30 PM. The peak hour data collected is presented in **Appendix B**. Beyond the two signalized intersections, spot counts were conducted at Gradd Way and the commercial entrance to approximate traffic data at these locations. In addition to the TMCs, the detailed hourly counts were collected from KYTC for four count stations, two AADT count stations on KY 331, one on US 60, and one on W 4th St/W 2nd St. These were compared against the collected TMCs. This is primarily considered to determine what the potential effects the ongoing pandemic may have on traffic volumes where the count would be lower than typically observed; however, the collected TMCs showed volumes within the range of prior counts and therefore were considered suitable for use without any additional increase necessary. 2022 peak hour volumes are shown on **Figure 2-1** for the AM and PM peak periods.

Figure 2-1. 2022 Existing AM and PM Peak Hour Traffic Turning Movement Volumes



2.3 Level of Service Criteria

Level of service (LOS) is a term used to represent different traffic conditions and is defined as a “qualitative measure describing operational conditions within a traffic stream, and their perception by motorists or passengers”. Level of Service varies from Level A, representing free flow, to Level F, where traffic breakdown conditions are evident. Level B represents good progression with minimal congestion. At Level C, the number of vehicles stopping is significant, although many still pass through the intersection without stopping. Level D represents more congestion, but the overall operations are generally considered acceptable by most agencies. At Level E, freedom to maneuver within the traffic stream is more difficult with driver frustration being higher.

For signalized intersections, service levels pertain to each approach as well as an overall intersection. The unsignalized intersection analysis method in the *Highway Capacity Manual 6th Edition (HCM 6th)* assigns LOS values for each movement that yields the right-of-way, but not to the overall intersection. This movement is generally a secondary movement from a minor street. At an unsignalized intersection, the primary traffic on the main roadway is virtually uninterrupted. Therefore, the overall level of service is usually much better than what is represented by the results of the minor street movements. With the current method of reporting levels of service for unsignalized intersections, it is not uncommon for some of the minor street movements to be operating at LOS F during the peak hours. The delay thresholds for Level of Service are higher for signalized intersections since drivers know that their turn is coming and are willing to wait longer and they also don’t have to constantly be looking for a gap to proceed through the intersection. **Table 2-2** displays the current LOS criteria for signalized and unsignalized intersections.

Table 2-2. Level of Service Criteria for Signalized and Unsignalized Intersections

Level of Service	Description	Average Control Delay (sec/veh)	
		Signalized Intersections	Unsignalized Intersections
A	Little or no delay	≤ 10	≤ 10
B	Short traffic delay	>10 – 20	>10 – 15
C	Average traffic delay	>20 – 35	>15 – 25
D	Long traffic delay	>35 – 55	>25 – 35
E	Very long traffic delay	>55 – 80	>35 – 50
F	Unacceptable delay	>80	>50

Source: Highway Capacity Manual, 6th Edition, Transportation Research Board

Level of service (LOS) and delay was analyzed for each intersection using methods outlined in the *HCM 6th Edition* and calculated using *Highway Capacity Software Version 7.9.6*. Calibration to existing conditions was conducted by observing queues and delays in the field. The observed queues and delays at the unsignalized intersections and the signalized intersection of W 2nd Street at KY 331 (Industrial Drive) were in line with the results reported by HCS, and therefore no adjustments were made. Those intersections perform well with low levels of service and resulted in 95th percentile queues of 1 to 2 vehicles which was seen in the field. However, the intersection of US 60 at KY 331, HCS results were overestimating the westbound delays and queues. A delay study was conducted on March 10, 2022, for this intersection during the AM peak for 15 minutes from 6:45 AM to 7:00 AM and can be found in **Appendix F**. HCS was reporting that the westbound left delay on KY 331 was 23.8 seconds with a 95th percentile queue of 6.2 vehicles. The overall approach delay was 22.6 seconds. The delay study resulted

in a westbound left delay of 16.5 seconds and a max queue of 4 vehicles. One HCS adjustment option is to change the headway. While this can greatly impact delays for unsignalized intersections, lowering the headway just barely affected results for this signalized intersection. The headway change would only have affected the permitted left turns according to HCS. Another option was to change the vehicle Arrival Type, and this was found to affect the results enough to make a difference towards reaching the observed results. The Arrival Type is used to describe the quality of signal progression for the corresponding movement group, and it controls the randomness of vehicles arriving to the signal. It ranges from 1 to 6, with type 1 representing poor progression and more random vehicle arrivals and type 6 representing excellent progression with more than 80 percent of the movement group volume in a dense platoon arriving during the green interval. Since this intersection is closely spaced to the intersection of W 2nd Street at KY 331 (Industrial Drive), it was deemed appropriate to assume that vehicles would be in platoons as they reach the green phase interval at this intersection. Therefore, the Arrival Type for the westbound direction was changed to Arrival Type 5. Arrival Type 5 was selected instead of Arrival Type 6 to be conservative and since these intersections are not coordinated with each other. This adjustment lowered the westbound left delay to 21.4 seconds and a 95th percentile queue of 5.5 vehicles.

Another HCS adjustment that can be made is the Upstream Filtering Factor which accounts for the effect of “filtered” arrivals from upstream signals on delay, similar to the Arrival Type. It ranges from 0.09 to 1.00. A factor of 1.00 is for locally isolated signals. Since this is not a locally isolated signal due to the nearby signal at KY 331 (Industrial Drive), it was deemed appropriate to reduce this factor. Usually, this factor is calculated automatically when in a coordinated signal system, however these signals are uncoordinated. The Upstream Filtering Factor for the westbound approach was reduced to 0.25. Making this adjustment further lowered the reported westbound left delay to 18.6 seconds and the overall westbound approach delay to 16.2 seconds. The 95th percentile queue was lowered to 4.2 vehicles. These adjustments made the delay and queue results closer to those observed in the field. These same adjustments were made for all scenarios.

To assist in calibration of the roadway network, inputs such as Peak Hour Factor (PHF), Truck Percentages, Approach Speed Limits, Right Turns on Red (RTOR), Storage Lengths, and Signal Timing and Phasing were reviewed and adjusted as needed to simulate existing conditions. Existing signal timing was utilized for the 2022 Existing analysis but was optimized in the 2024 and 2034 future year analyses to reflect a more realistic comparison of operations. The PHF for all scenarios was left as the HCS default of 0.92 providing a better comparison between years and all Build and No Build scenarios.

2.4 Existing Conditions Analysis

Table 2-3 displays the 2022 Existing LOS and delay for the study intersections. The Existing and No Build HCS outputs can be found in **Appendix C**. The reports include 95th percentile queueing, volume to capacity (v/c) ratios, individual movement results, and other details in addition to the LOS and delays presented in the tables.

The PM peak contained the highest volumes. Therefore, the PM Peak analysis results in the highest delays and LOS for each scenario. The intersection of US 60 at KY 331 operates overall at LOS C in the AM and LOS D in the PM. The West 2nd Street at KY 331 (Industrial Drive) operates at LOS A and LOS B in the AM Peak and PM Peak, respectively. No queuing problems exist at this location or the two unsignalized intersections.

Table 2-3. Intersection Level of Service and Delay Summary – 2022 Existing Conditions

Intersections and Approaches	2022 Existing			
	AM Peak		PM Peak	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
1 - US 60 @ KY 331 / Bon Harbor Hills - Signalized				
<i>Eastbound</i>	D	38.4	E	58.7
<i>Westbound</i>	B	16.2	B	19.7
<i>Northbound</i>	C	27.1	D	48.3
<i>Southbound</i>	D	38.0	E	55.9
Overall Intersection	C	27.3	D	38.5
2 - KY 331 @ Gradd Way - TWSC				
<i>Eastbound</i>	-	-	-	-
<i>Westbound Left</i>	A	8.7	A	8.3
<i>Northbound</i>	B	12.1	B	12.0
Overall Intersection	-	-	-	-
3 - W 2nd St @ KY 331 (Industrial Dr) - Signalized				
<i>Eastbound</i>	A	7.0	A	6.8
<i>Westbound</i>	A	5.3	A	6.0
<i>Southbound</i>	B	18.7	C	22.0
Overall Intersection	A	8.0	B	10.9
4 - W 2nd St @ Commercial Entrance - TWSC				
<i>Eastbound Left</i>	A	8.3	A	8.7
<i>Westbound</i>	-	-	-	-
<i>Southbound</i>	B	11.2	B	13.3
Overall Intersection	-	-	-	-

Section 3

2024 and 2034 No Build Scenario Analysis

3.1 Traffic Volume Projections

The expected Open Year for the proposed development is 2024. Based on historical KYTC count data along roadways in the study area, an annual growth factor of one-half percent (0.50%) was applied to traffic volumes to account for the expected ambient traffic growth between the Existing Year (2022), Open Year (2024) and Design Year (2034). The Swedish Match Traffic Study (March 2021) was reviewed, and 80 percent the site generated trips were extracted and added to the 2024 and 2034 background traffic. This estimate is based on the project percent complete.

Figure 3-1 displays the 2024 No Build turning movement volumes and **Figure 3-2** displays the 2034 No Build turning movement volumes.

3.2 Level of Service Analysis

Intersection level of service analysis was performed for a typical weekday peak hour using HCS. **Tables 3-1** and **3-2** display the 2024 and 2034 No Build LOS and delay for the study intersections. The Existing and No Build HCS outputs can be found in **Appendix C**. The No Build analyses were based on existing roadway geometry.

Similar to the Existing Condition, the PM Peak analysis results in the highest delays and LOS for each scenario. The intersection of US 60 at KY 331 continues to operate at LOS C in the AM and LOS D in the PM for both 2024 and 2034. The intersection of West 2nd Street at KY 331 (Industrial Drive) operates at LOS A and LOS B in the AM Peak and PM Peak, respectively. No queuing problems exist at this location or the two unsignalized intersections.

Figure 3-1. 2024 No Build AM and PM Peak Hour Traffic Turning Movement Volumes

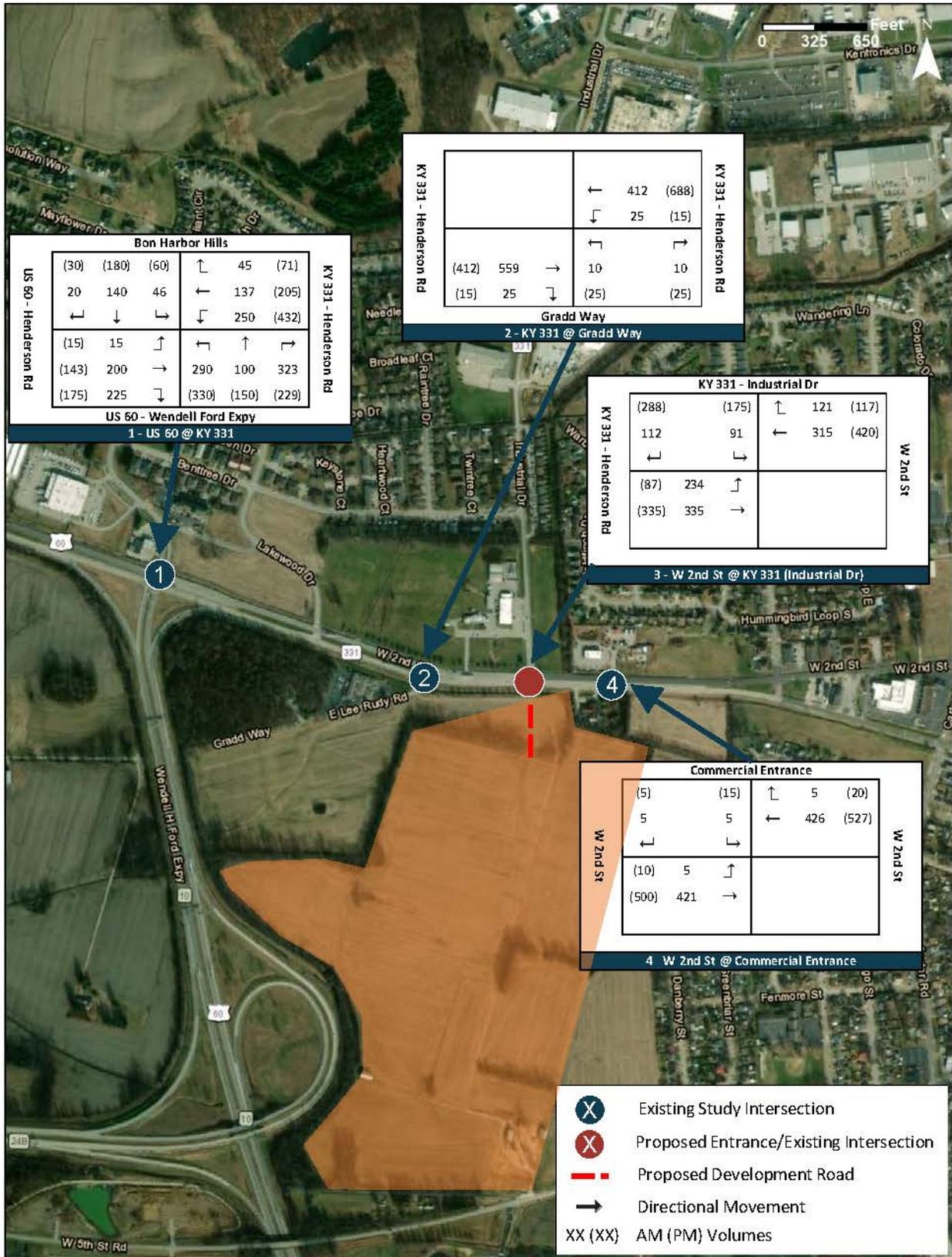


Figure 3-2. 2034 No Build AM and PM Peak Hour Traffic Turning Movement Volumes

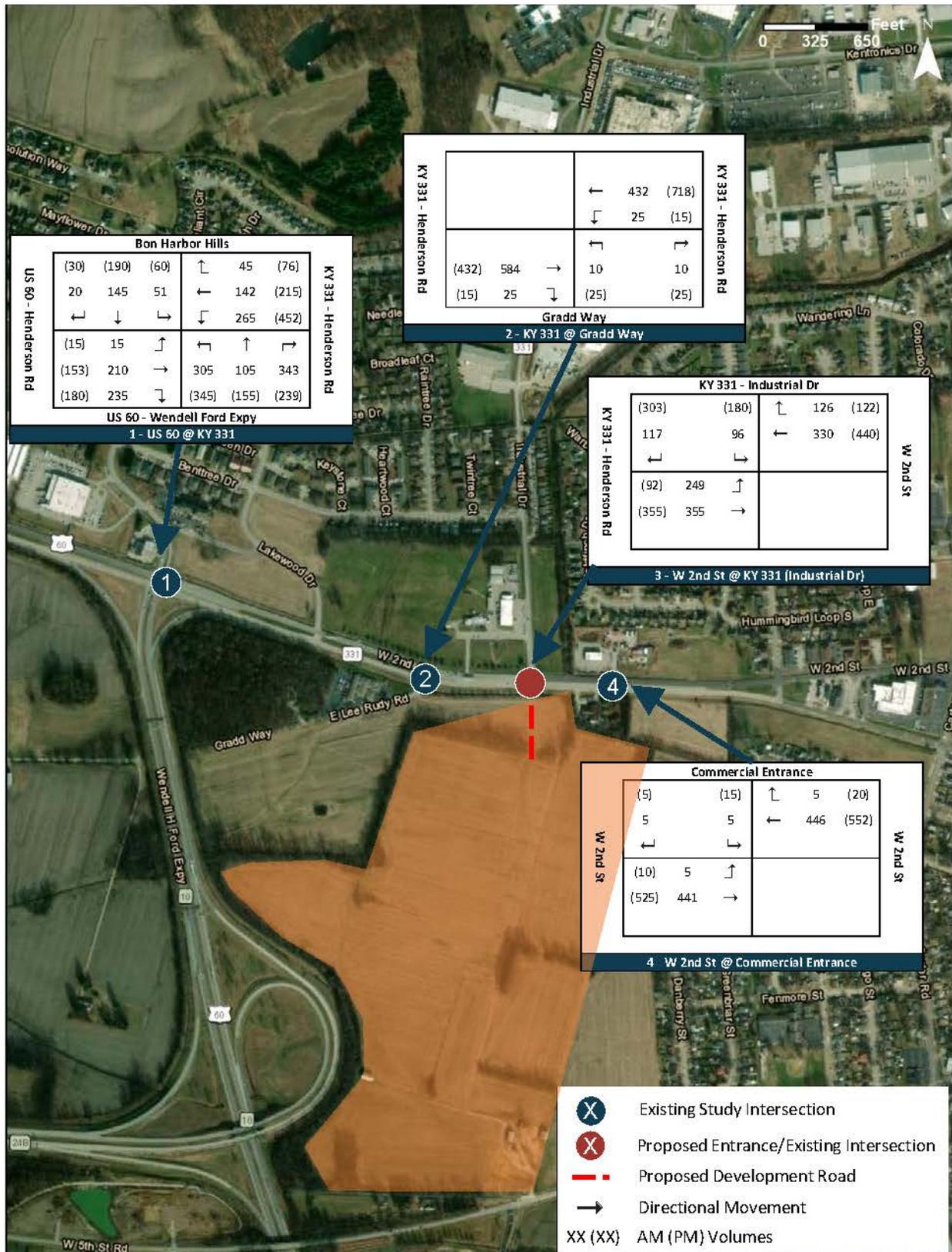


Table 3-1. Intersection Level of Service and Delay Summary – 2024 No Build Conditions

Intersections and Approaches	2024 No Build			
	AM Peak		PM Peak	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
1 - US 60 @ KY 331 / Bon Harbor Hills - Signalized				
<i>Eastbound</i>	D	39.0	E	61.4
<i>Westbound</i>	B	16.3	C	20.9
<i>Northbound</i>	C	27.6	E	56.4
<i>Southbound</i>	D	38.8	E	58.5
Overall Intersection	C	27.6	D	41.9
2 - KY 331 @ Gradd Way - TWSC				
<i>Eastbound</i>	-	-	-	-
<i>Westbound Left</i>	A	9.0	A	8.4
<i>Northbound</i>	B	12.7	B	12.5
Overall Intersection	-	-	-	-
3 - W 2nd St @ KY 331 (Industrial Dr) - Signalized				
<i>Eastbound</i>	A	7.5	A	7.7
<i>Westbound</i>	A	5.4	A	6.6
<i>Southbound</i>	B	18.7	C	23.4
Overall Intersection	A	8.4	B	12.1
4 - W 2nd St @ Commercial Entrance - TWSC				
<i>Eastbound Left</i>	A	8.3	A	8.8
<i>Westbound</i>	-	-	-	-
<i>Southbound</i>	B	11.3	B	13.5
Overall Intersection	-	-	-	-

Table 3-2. Intersection Level of Service and Delay Summary – 2034 No Build Conditions

Intersections and Approaches	2034 No Build			
	AM Peak		PM Peak	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
1 - US 60 @ KY 331 / Bon Harbor Hills - Signalized				
<i>Eastbound</i>	D	40.5	E	62.2
<i>Westbound</i>	B	17.0	C	20.6
<i>Northbound</i>	C	28.8	E	79.1
<i>Southbound</i>	D	40.3	E	59.5
Overall Intersection	C	28.8	D	48.8
2 - KY 331 @ Gradd Way - TWSC				
<i>Eastbound</i>	-	-	-	-
<i>Westbound Left</i>	A	9.1	A	8.4
<i>Northbound</i>	B	13.0	B	12.7
Overall Intersection	-	-	-	-
3 - W 2nd St @ KY 331 (Industrial Dr) - Signalized				
<i>Eastbound</i>	A	7.8	A	8.1
<i>Westbound</i>	A	5.4	A	6.9
<i>Southbound</i>	B	18.8	C	23.5
Overall Intersection	A	8.5	B	12.4
4 - W 2nd St @ Commercial Entrance - TWSC				
<i>Eastbound Left</i>	A	8.4	A	8.8
<i>Westbound</i>	-	-	-	-
<i>Southbound</i>	B	11.5	B	13.8
Overall Intersection	-	-	-	-

Section 4

Trip Generation and Traffic Assignment

The proposed new site access point will be located on KY 331 across from Industrial Drive. Estimated trip generation and distribution were derived using information from the applicant, existing traffic patterns, and knowledge of the study area roadways.

4.1 Trip Generation

Trip generation was conducted using information from the applicant and assessed with the *ITE Trip Generation Manual (11th Edition, Institute of Transportation Engineers)*. A conceptual site layout was provided by the applicant detailing the proposed plan being considered for the site. The conceptual site layout is shown in **Appendix A**.

ITE land use codes 710 (Office) and 150 (Warehousing) were used based on information from the applicant. The total generated site trips as well as their components are detailed in **Table 4-1**. In total, the development is projected to generate 146 total external AM peak hour trips and 150 external PM peak hour trips.

Table 4-1. Site Generated Trips

ITE Land Use Code (LUC)	Land Use Description	Size	Units	Daily Trips	AM Peak			PM Peak		
					Total	In	Out	Total	In	Out
710	Office	52.71	1,000 Sq Ft	665	97	85	12	98	17	81
150	Warehousing	209.62	1,000 Sq Ft	369	49	38	11	52	14	38
Site Generated Project Trips				1,034	146	123	23	150	31	119
Total External Project Trips				-	146	123	23	150	31	119

4.2 Trip Distribution and Assignment

Figure 4-1 depicts the estimated external peak hour trip distribution percentages. The trip distribution was estimated by using information from the applicant, existing traffic patterns, and knowledge of the study area. 67% of the trips are predicted to come from the west and south via US 60, 30% from the east, 3% from the north on Industrial Drive, which is mostly a manufacturing and warehouse area, and 2% from Bon Harbor Hills. **Figure 4-2** shows the trip assignment for the proposed development.

Figure 4-1. External Trip Distribution Percentages

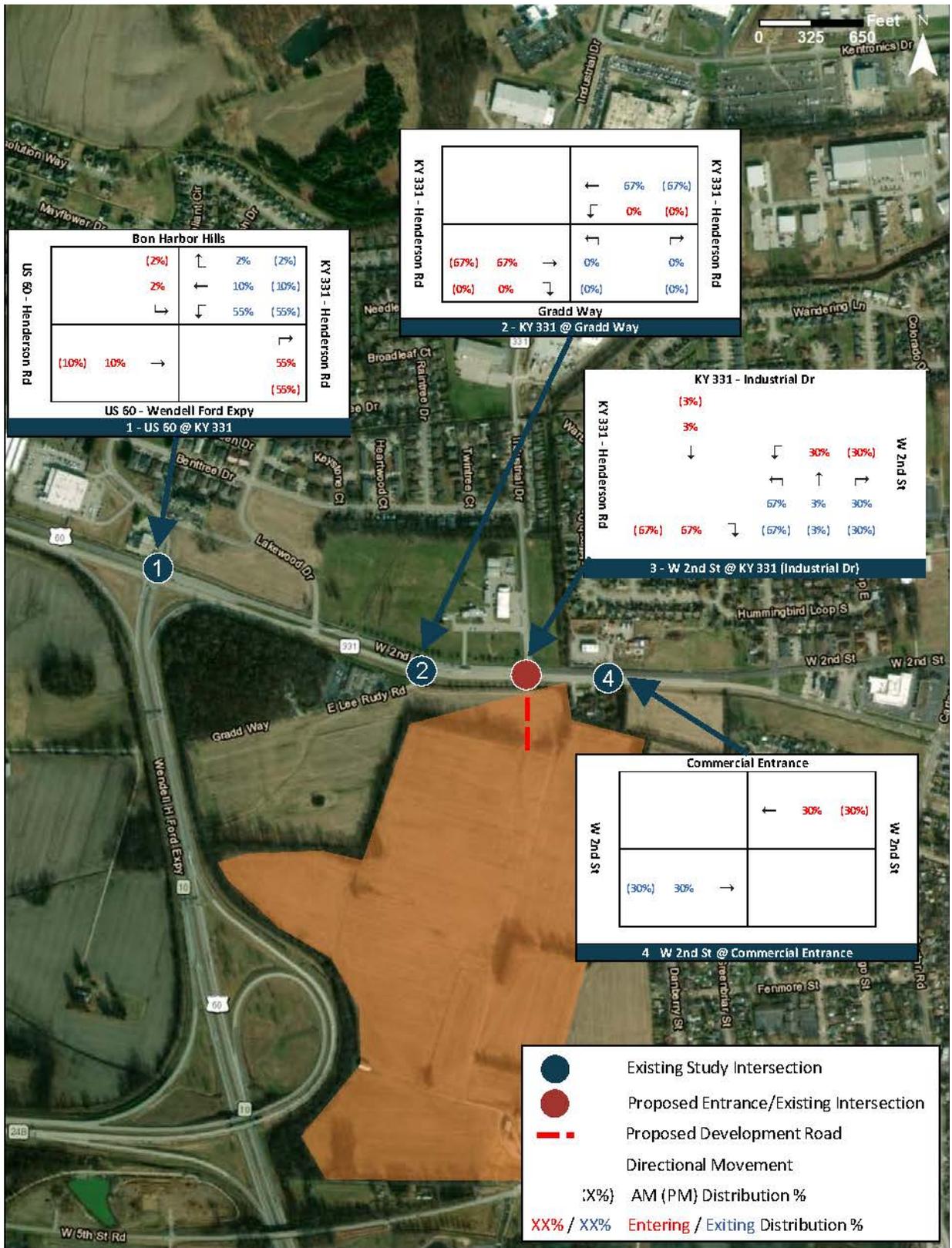
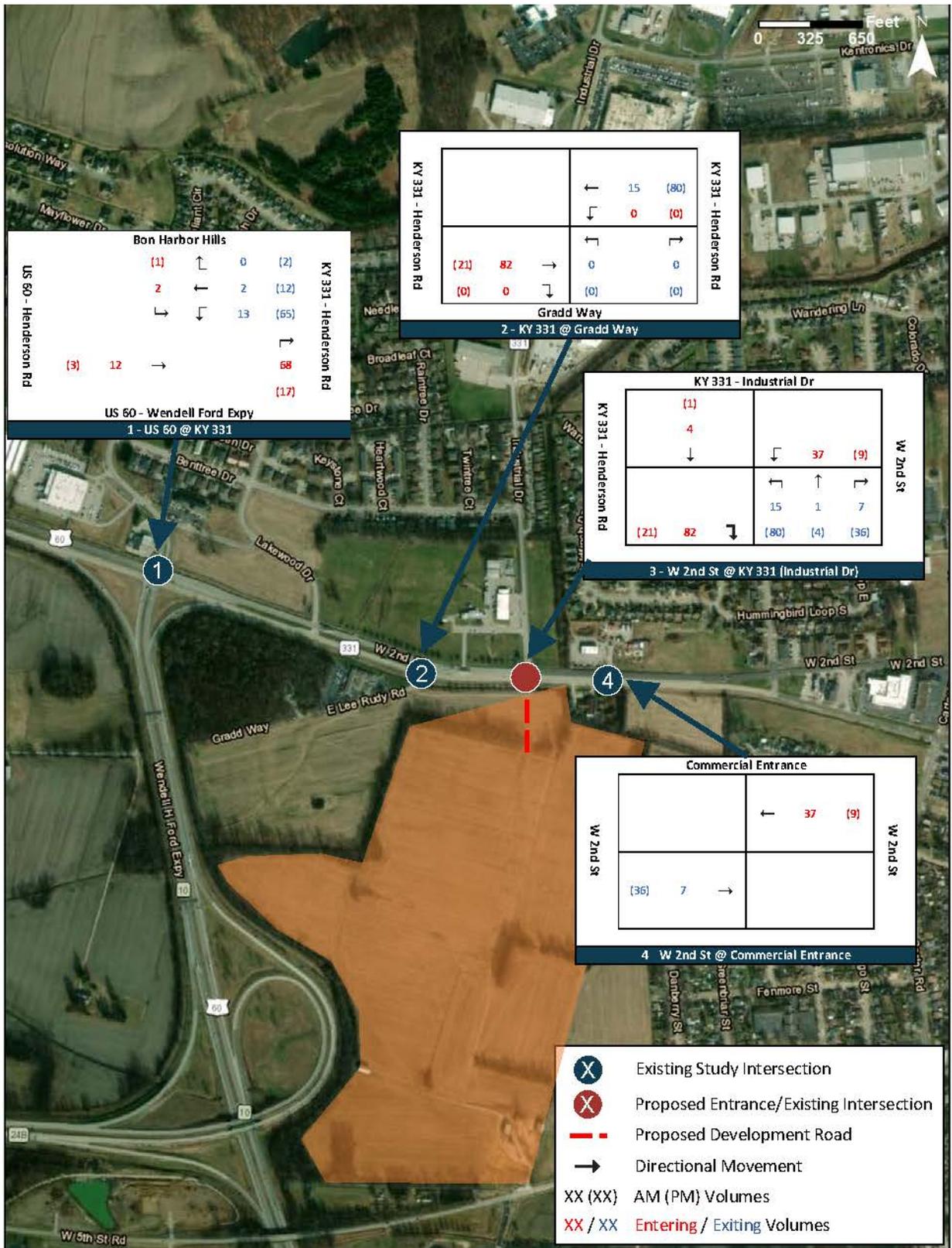


Figure 4-2. AM and PM Peak Total External Site Generated Trips



Section 5

2024 and 2034 Build Condition Analysis

The Build analyses included the No Build traffic as described in Section 3 with the addition of the estimated external site generated trips from the proposed development as described in Section 4. The 2024 and 2034 Build analyses were evaluated using the proposed roadway geometry discussed in Section 1. Signal timings were also optimized as they were in the No Build analyses.

5.1 Build Level of Service Analysis

As shown in **Tables 5-1 and 5-2**, minor increases in delay and no change in LOS occur when compared to the No Build, except at US 60 and KY 331, where LOS changes from D to E in 2034 during the PM Peak due to an increase in overall delay of 12.1 seconds per vehicle. No queues exceed storage, including at the proposed entrance. The westbound left queue at the proposed entrance will not exceed one vehicle; therefore, there is no concern with interference with the commercial entrance to the east.

5.2 KY 331 & Industrial Drive Right Turn Lane Assessment

An assessment of an eastbound right turn lane from KY 331 into the proposed entrance across from Industrial Drive was conducted. KYTC-provided spreadsheets were used to determine if a turn lane is warranted. These spreadsheets are meant for unsignalized intersections according to HD-902 in the KYTC Highway Design Manual and is therefore supplemental. For signalized intersections, capacity analysis should be used to evaluate the need for right turn lanes, and the analysis in this study shows there is not a need for a right turn lane. For the 2034 AM Peak, there are 82 vehicles making the right turn with 437 advancing vehicles. Based on these volumes, a right turn lane is not warranted. Both AM and PM peak hours were evaluated for the open year and design year build scenarios. These analyses can be found in **Appendix E**.

5.3 KY 331 at W 2nd Street Left Turn Phasing Analysis

The current phasing of the intersection of West 2nd Street at KY 331 (Industrial Drive) is a two-phase system. According to the KYTC Traffic Operations Guidance Manual, left-turn phasing should be considered on an approach if the cross product of the left-turning and opposing volumes exceed 100,000 during any hour on a four-lane highway or 50,000 on a two-lane highway. Since the eastbound left turning and opposing volumes' cross product meets this requirement for this intersection in the build scenario for 2034, it could be considered for protected-permissive phasing for the eastbound left turn; however, all scenarios were analyzed as permitted only and continued to operate with acceptable LOS.

Figure 5-1. 2024 Build AM and PM Turning Movement Volumes

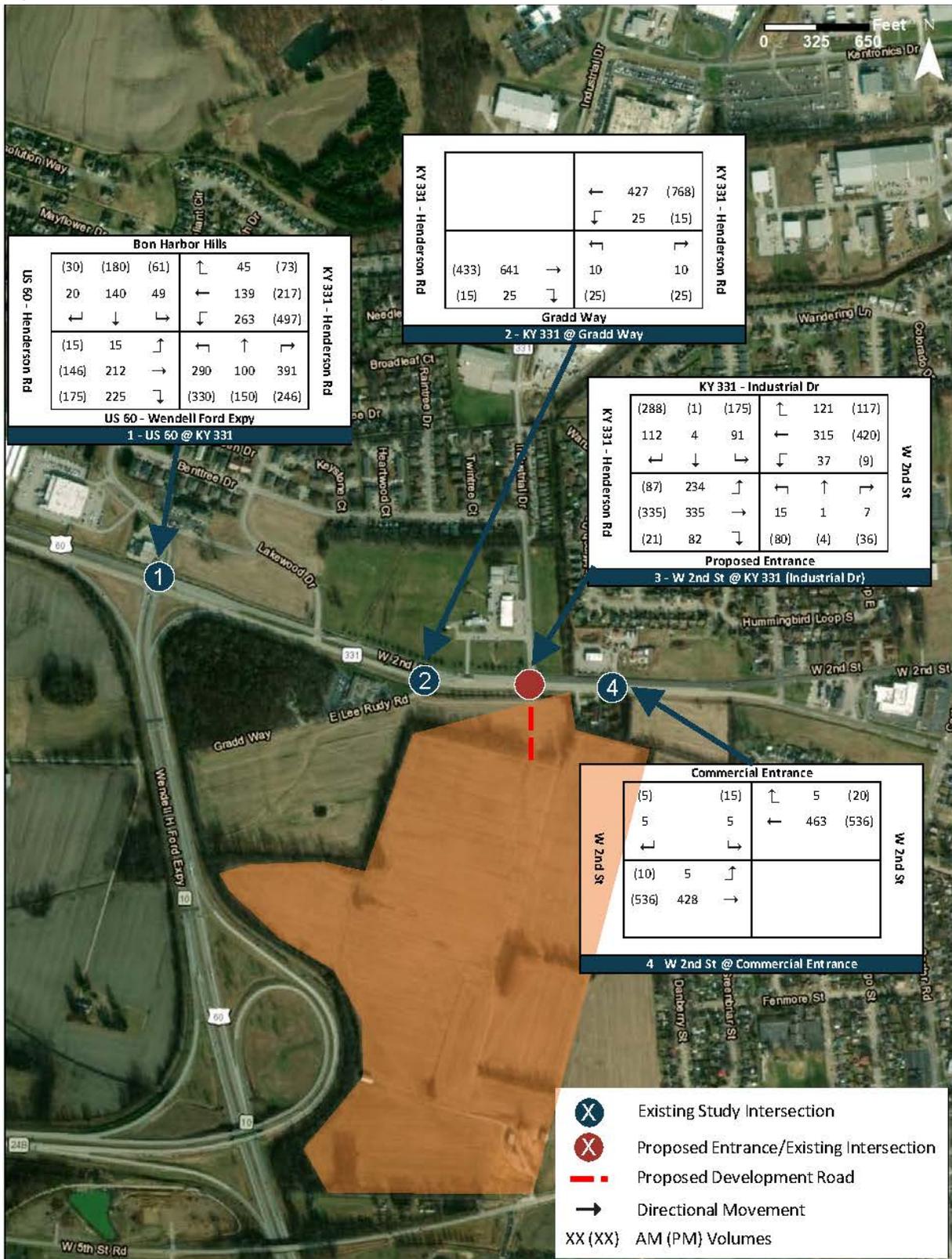


Figure 5-2. 2034 Build AM and PM Turning Movement Volumes

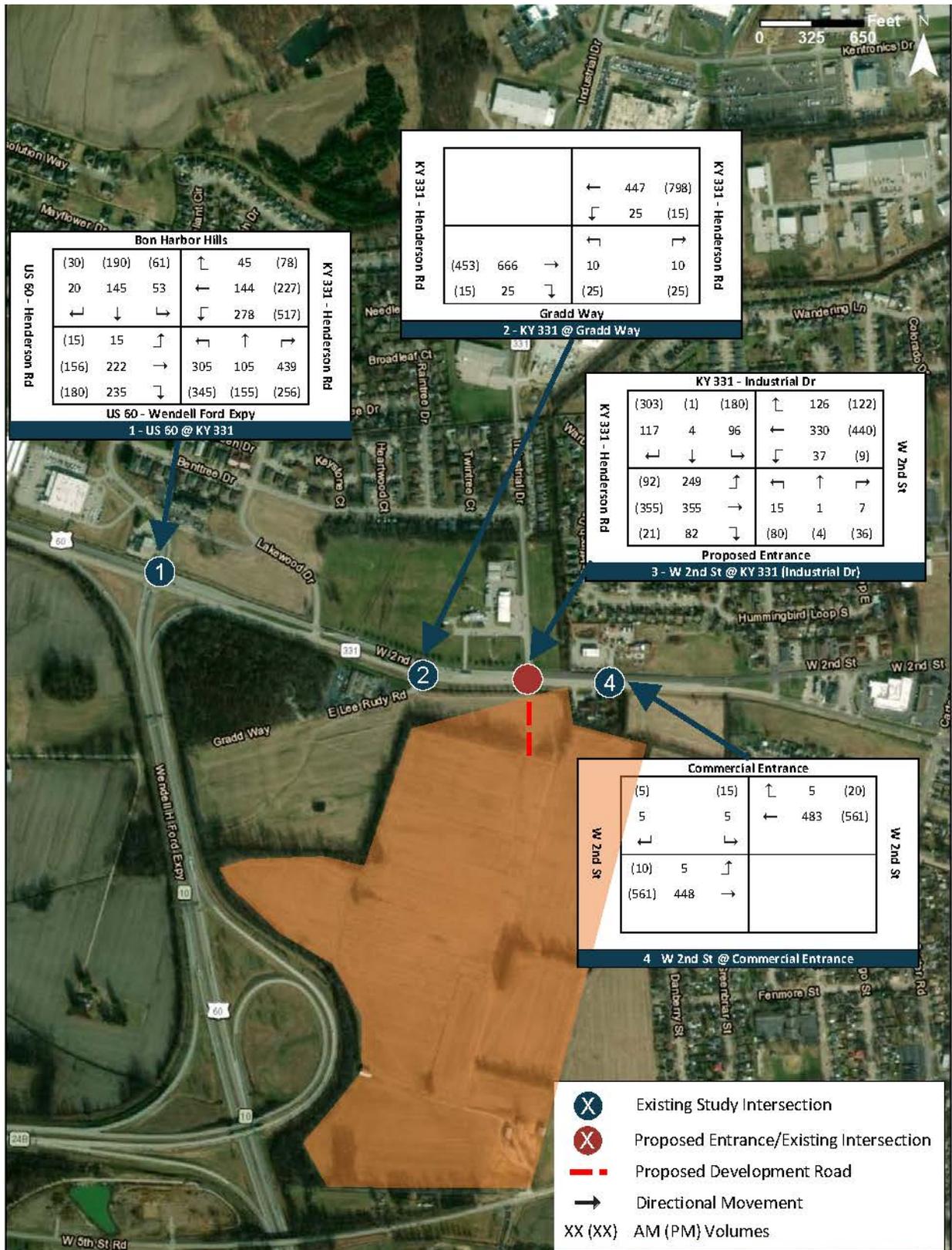


Table 5-1. Intersection Level of Service and Delay Summary – 2024 Build Conditions

Intersections and Approaches	2024 Build			
	AM Peak		PM Peak	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
1 - US 60 @ KY 331 / Bon Harbor Hills - Signalized				
<i>Eastbound</i>	D	39.3	E	68.3
<i>Westbound</i>	B	16.4	C	21.7
<i>Northbound</i>	C	28.2	F	84.0
<i>Southbound</i>	D	39.3	E	66.6
Overall Intersection	C	28.0	D	51.3
2 - KY 331 @ Gradd Way - TWSC				
<i>Eastbound</i>	-	-	-	-
<i>Westbound Left</i>	A	9.3	A	8.4
<i>Northbound</i>	B	13.5	B	12.8
Overall Intersection	-	-	-	-
3 - W 2nd St @ KY 331 (Industrial Dr) - Signalized				
<i>Eastbound</i>	A	7.1	A	6.4
<i>Westbound</i>	A	5.5	A	6.0
<i>Northbound</i>	B	17.3	B	17.7
<i>Southbound</i>	B	18.8	C	21.6
Overall Intersection	A	8.3	B	11.2
4 - W 2nd St @ Commercial Entrance - TWSC				
<i>Eastbound Left</i>	A	8.5	A	8.8
<i>Westbound</i>	-	-	-	-
<i>Southbound</i>	B	11.6	B	13.7
Overall Intersection	-	-	-	-

TWSC = Two-Way Stop Control

Table 5-2. Intersection Level of Service and Delay Summary – 2034 Build Conditions

Intersections and Approaches	2034 Build			
	AM Peak		PM Peak	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
1 - US 60 @ KY 331 / Bon Harbor Hills - Signalized				
<i>Eastbound</i>	D	40.9	E	75.2
<i>Westbound</i>	B	17.3	C	23.1
<i>Northbound</i>	C	29.5	F	109.3
<i>Southbound</i>	D	41.0	E	73.1
Overall Intersection	C	29.2	E	60.9
2 - KY 331 @ Gradd Way - TWSC				
<i>Eastbound</i>	-	-	-	-
<i>Westbound Left</i>	A	9.4	A	8.5
<i>Northbound</i>	B	13.7	B	13.1
Overall Intersection	-	-	-	-
3 - W 2nd St @ KY 331 (Industrial Dr) - Signalized				
<i>Eastbound</i>	A	7.3	A	6.8
<i>Westbound</i>	A	5.6	A	6.3
<i>Northbound</i>	B	17.3	B	17.4
<i>Southbound</i>	B	18.9	C	21.5
Overall Intersection	A	8.5	B	11.3
4 - W 2nd St @ Commercial Entrance - TWSC				
<i>Eastbound Left</i>	A	8.7	A	8.9
<i>Westbound</i>	-	-	-	-
<i>Southbound</i>	B	11.7	B	14.0
Overall Intersection	-	-	-	-

TWSC = Two-Way Stop Control

Section 6

Conclusions

There are minimal changes in LOS and delay between the No Build and Build scenarios, with the exception of the US 60 intersection during the 2034 PM Peak. Due to the heavy westbound left turn volume, this intersection operates at LOS D for the 2034 PM Peak No Build and with the additional traffic, delay increases 12.1 seconds per vehicle resulting in LOS E for the 2034 PM Peak Build. This lower LOS is primarily driven by shift change at several nearby manufacturing facilities and occurs earlier than a typical PM Peak Hour. Looking specifically at the westbound left turn volume, the higher traffic volumes are limited to 3:30-3:45 where the movement volume is 60 percent higher than any other 15-minute period. While this intersection should be monitored long term, improvements were made at this location in 2021, and further improvements are not warranted at this time.

At the proposed entrance, the eastbound right turn lane was not warranted, and a westbound left turn lane can be accommodated in the existing median. The median is currently a raised mountable median, and it is recommended that this be converted to a flush left turn with minimum storage required for a left turn lane, especially since it is a signalized intersection. This is to prevent safety and traffic delay issues of vehicles and trucks pulling on and off the mountable median. According to the KYTC Median Type Guidelines, traversable raised medians are not recommended since they neither facilitate left turns or provide positive control over left turn movements. The raised mountable median may have been placed as a safety feature for cross-over crashes and prior to the increased development in the area and the signalization of the Industrial Drive intersection at the proposed entrance. Overall, LOS operates at LOS B or better and no queuing concerns were identified.

The analysis and conclusions from this traffic study are for the development plan and site use as currently provided by the applicant. If substantial alterations to either the development plan or site use change, including developing the remaining property and/or providing the connection to 5th Street Road, additional study may be required.