Indirect and Cumulative Impacts Technical Report

Loop 336 from IH-45 to FM 1314

CSJ: 0338-11-059

Date: April 2017

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 16, 2014, and executed by FHWA and TxDOT.

Introduction

This Technical Report addresses potential indirect and cumulative impacts associated with the proposed expansion of Loop 336 from Interstate Highway (IH) 45 to Farm to Market Road (FM) 1314 in Conroe, Montgomery County, Texas. The project location is shown in **Figure 1**. The proposed project would create a divided 4-lane highway by constructing a 2 lane roadway to the south of the existing roadway. The new lanes would serve as the eastbound lanes with the existing lanes being converted to serve westbound traffic.

To aid the scoping process, TxDOT developed a Scope Development Tool to help determine if an Indirect and Cumulative Impacts analysis is necessary. Use of this tool, in conjunction with TxDOT's Induced Growth Impacts and Cumulative Impacts Decision Trees, determined that Indirect and Cumulative Impacts Analysis was warranted for the proposed project.

Project Description

Existing Facility

Existing Loop 336 (from East of Cypress Lane Boulevard to West of FM 1314) consists of one 13.5-foot-wide west bound travel lane and one, 12-foot-wide east bound travel lane with an 8-foot wide outside shoulder. The roadway lies within a 300-foot Right-of-Way (ROW). At FM 1314, existing Loop 336 consists of one 13.5-foot-wide and one 12-foot-wide westbound travel lanes, a center left turn lane, two 12-foot-wide eastbound travel lanes, and an 8-foot-wide outside shoulder.

Build Alternative

The proposed improvements would improve approximately 2.5 miles of Loop 336. The proposed Loop 336 westbound travel lanes would consist of one 13.5-foot-wide travel lane and one 12-foot-wide travel lane with an 8-foot-wide outside shoulder. The proposed eastbound travel lanes would consist of one 12-foot-wide travel lane, a 15-foot-wide shared lane. In addition, a sidewalk would be constructed on the south side of the eastbound lanes. The eastbound and westbound lanes would be separated by a median. At FM 1314, westbound travel lanes would consist of two 12-foot-wide travel lanes, and the inside and outside shoulders would vary in width. The eastbound travel lanes would consist of two 12-foot-wide left turn lanes, one 12-foot-wide travel lane, a 15-foot wide shared lane, and 12-foot-wide right turn lane. In addition, a sidewalk would be constructed on the south side of the eastbound lanes. The eastbound and westbound lanes would be separated by a median. A schematic drawing of the proposed Build Alternative is presented in **Figures 2a-c**.

No-Build Alternative

Under the No-Build Alternative, continued growth and development within the project area would be expected, driven by large-scale demographic and economic trends. Development of specific

properties in the vicinity of Loop 336 could be delayed if the inadequacy of the current facility made other properties more attractive by comparison.

Indirect Impacts

The Council on Environmental Quality (CEQ) defines indirect impacts as those "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR Section 1508.8). Indirect impacts differ from the direct impacts associated with the construction and operation of the proposed project in that, while they are still reasonably foreseeable impacts caused by the project, they occur later in time or at a location removed from the project location.

TxDOT's *Guidance: Indirect Impacts Analysis* (July 2016) calls for indirect impacts analysis to focus on a project's likelihood to induce growth and the effects of that growth; encroachment-alteration impacts of the proposed Loop 336 project on various resources were considered as part of the evaluations of direct impacts, but none were identified. The TxDOT guidance document incorporates approaches to this analysis described in The National Cooperative Highway Research Program (NCRHP) Report 466, *Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects* and the American Association of State Highway and Transportation Officials (AASHTO)'s *Practitioner's Handbook 12—Assessing Indirect Effects and Cumulative Impacts Under NEPA*. TxDOT's guidance document outline six steps that should be followed when conducting an Induced Growth Impacts Analysis. These steps include:

1. Define the methodology.
2. Define the area of influence (AOI) and the study timeframe
3. Identify areas subject to induced growth in the AOI.
4. Determine if growth is likely to occur in the induced growth areas.
5. Identify resources subject to induced growth impacts.
6. Identify mitigation (if applicable)

These six steps have been followed in the analysis of the proposed improvements to Loop 336.

<u>Step 1: Define the Methodology</u>

TxDOT's *Guidance: Indirect Impacts Analysis* describes several approaches to indirect impacts analysis as formulated by NCHRP in its Forecasting Report (part of Project 25-25, Task 2. Table 2 in Section 4.0 of the NCHRP report notes that the Planning Judgment approach is the best approach for a simple, low-cost project that anticipates little land use change. TxDOT's *Guidance: Indirect Impacts*

Analysis further notes that Planning Judgment has been the approach traditionally employed by TxDOT and is often the most expedient, as long as the project under analysis is not overly complex or controversial. For the proposed improvements to Loop 336, which affect a 2.5-mile road segment and would require no acquisition of new Right-of-Way, the Planning Judgment approach is appropriate.

The Planning Judgment approach involves gathering extensive data from local sources to analyze the development capacity, history and forecast trends for the indirect effects study area. It often involves more qualitative than quantitative determinations. The proposed project area, however, is located on the fringe of a fast-growing suburb. For this reason, some quantitative analysis is also employed.

TxDOT's guidance document notes that the Planning Judgment approach should not rely on pure judgment alone. For this reason, as well as the need for quantitative data for parts of the analysis, this induced growth analysis based on Planning Judgment is supported by the Cartographic Techniques approach, which employs Geographic Information System (GIS) data to analyze and quantify land use patterns in the project area. It has also been supported by consultation with Conroe's City Planner, Masood Malik (Malik 2016).

Step 2: Define the Area of Influence (AOI) and Study Timeframe

An Area of Influence (AOI) of expected indirect impacts was established based on expected traffic patterns in the general vicinity of the project area, and is shown in **Figure 3**. As the purpose of the proposed project is to improve circulation in the project area, regional mobility was not considered to be a major factor in the development of the AOI. Instead, the indirect impacts AOI extends only to limits beyond which effects of other roadways and their associated development become the dominant drivers of growth. The AOI's northern and southern boundaries are defined by the next significant arterial street in each direction: Foster St. and Avenue M Extended on the north (connected by FM 1314) and Crighton Rd. on the south. These streets run parallel to Loop 336; as such, any eastbound or westbound traffic generated by future development along or beyond these boundaries is more likely to use these roadways, or others beyond them, rather than Loop 336. Similarly, the eastern boundary is defined as FM 3083, the next north/south roadway beyond FM 1314. While the proposed improvements to Loop 336 may make land along Loop 336 between FM 1314 and FM 3083 more attractive to developers, FM 3083 is over two miles beyond the project area from its eastern terminus. Beyond this distance, it is less likely that developers would consider the improved segment of Loop 336 as a factor in their decisions on whether and where to develop, particularly with Highway 105 offering a closer and shorter connection to IH-45 than Loop 336 for much of this area.

The western boundary of the AOI is formed by US 75/S. Frazier St., joined by IH-45 south of the project area. Unlike the other three boundaries, this roadway is immediately adjacent to the proposed project area. The rationale for its selection as an AOI boundary is that lands beyond it to the west are either already completely developed (north of Loop 336) or, in areas south of Loop 336, development is

already planned (336 Market) or underway (Grand Central Park). These properties are thus not subject to induced development attributable to the proposed project. As such, the combined US 75/S. Frazier St./IH-45 segment was determined to be a logical boundary for consideration of induced growth.

The AOI covers approximately 4,555 acres and was established for the indirect effects analysis to encompass these roadways and nearby lands, which are largely undeveloped.

Temporal boundaries for the indirect impacts analysis extend from the time of construction of the proposed project to 2040 (the end of the current MTP planning cycle).

Step 3: Identify Areas Subject to Induced Growth in the AOI

Figure 3 depicts a breakdown of the AOI into several broad categories of land use. Geographic Information System (GIS) analysis of this breakdown indicates that there are approximately 3,154 acres of undeveloped property in the AOI, almost all of which is pine forest. Approximately 824 acres of this total occur in mapped floodplain areas, however, and are thus unlikely to be developed; the remaining undeveloped areas, however, are considered developable. In addition, undeveloped lots totaling 694 acres are currently for sale, indicating that development of these properties will likely occur at a more rapid rate. As a result, it appears there are approximately 1,636 acres of currently undeveloped land subject to project-induced development within the AOI. According to Conroe's City Planner, these undeveloped areas have not been platted; as such, they may be less likely to be developed at all, or developed at an accelerated rate, compared to tracts currently for sale. The tracts subject to project-induced development primarily consist of wooded areas, in addition to a few areas cleared for agricultural purposes, some of which have since revegetated with grasses.

Most of the existing developed tracts in the AOI consist of residential subdivisions, religious or educational facilities, or parkland, of which redevelopment is very unlikely. The small number of individual commercial or industrial properties in the AOI encompass approximately 186 acres, or approximately 4 percent of the AOI, and have been completely cleared of vegetation. They are also unlikely to be redeveloped as a result of the proposed improvements to Loop 336, and were such redevelopment to occur, they would either remain completely cleared or would incorporate natural areas that would represent a minor beneficial impact on resources in the AOI. As such, redevelopment was not further considered in this analysis.

Step 4: Determine If Growth Is Likely in Induced Growth Areas

The City of Conroe maintains a Comprehensive Plan that serves as guidance, but not legally enforceable regulation, to manage future growth. The City has also established ordinances and codes for specific aspects of development, such as its Floodplain Ordinance, which prohibits most new construction in floodplains; its Unit Development Ordinance, which governs development of tracts of

less than 5,000 square feet; and its Tree Canopy Ordinance, which aims to establish minimum standards for preservation and planting of trees. It does not, however, have a zoning ordinance, and according to its City Planner (Malik 2016), broad-scale development patterns are determined by market forces rather than regulation and are thus largely determined by developers.

The Growth Scenario Map (see **Figure 4**) from the Comprehensive Plan indicates that most of the currently undeveloped areas within the AOI are expected to be developed as residential, commercial, and industrial uses. If current demographic trends continue, as is expected, it can be assumed that development is going to occur. It is possible that such development may occur more rapidly as a result of the proposed project, however. As such, the most likely indirect impact of the proposed project is an acceleration of foreseeable growth, rather than inducement of new growth that would not have happened without the proposed project. Growth since the adoption of the Comprehensive Plan in 2007, and foreseeable development patterns, are generally consistent with the Plan.

Based on information obtained from the Conroe City Planner (Malik 2016), development is anticipated in the area of influence but may occur more rapidly with the implementation of the proposed project. He further indicated that it is currently anticipated that most of the development in the AOI will be undertaken to satisfy the market demand for single-family residences. Water and sewer utilities are already accessible from all of the undeveloped, but developable, lands that make up approximately 36 percent of the indirect effects area of influence. Additionally, the improvements to Loop 336 could attract developments that would otherwise have located along less-improved roadways in the area; in such cases, however, the net effect on resources would be the same, even as the location of the impacts changed slightly.

Conroe has been growing rapidly since at least 2000. Its population has nearly doubled since 2000, as shown in **Table 2**, and is expected to increase by another 57 percent by 2040. The growth rate since 2000 exceeds that of both Montgomery County (71 percent) and the State of Texas (27 percent), while projected growth by 2040 exceeds that of Texas (42 percent) but is lower than that of the County (102 percent). With this population growth comes demand for residential land uses, reflected in the numerous new subdivisions in the AOI and throughout Conroe, as well as new retail and commercial land uses supporting these new populations.

Table 2: Historic and Projected Populations

Year: / Area	2000[a]	2010[a]	2015[b]	2020[c]	2030[c]	2040[c]
Conroe	36,811	56,207	68,602	77,926	93,516	107,457
Montgomery County	293,768	455,746	502,586	627,917	811,252	1,019,278
Texas	20,851,820	25,145,561	26,538,614	29,510,184	33,628,653	37,736,338

Sources: (a) US Census Bureau Decennnial Census data, (b) U.S. Census Bureau Population Estimates Program, (c) Texas Water Development Board 2016 Regional Water Plan Population Projections 2020-2070

Building trends have shown varying degrees of growth but appear to be closely tied to economic cycles. The number of new building permits issued in Conroe peaked between 2004 and 2006. Although rates for issuance of new permits have slowed since that time, construction of new homes has continued, and as of 2014 had returned to 2004-2006 levels. These trends in new home construction are shown in **Table 3**.

Table 3: New Home Construction in Conroe

Year	Single-family New House Building Permits Issued	Year	Single-family New House Building Permits Issued
2000	44	2008	345
2001	122	2009	261
2002	149	2010	237
2003	413	2011	194
2004	603	2012	352
2005	800	2013	610
2006	852	2014	871
2007	605		

Source: www.city-data.com, accessed 9/14/16

The data presented in **Tables 2 and 3** show continuous growth in population and development in Conroe, even during periods of economic downturn, with continued growth forecast. Even if the proposed expansion of Loop 336 were not undertaken, it seems likely that these trends would still result in the gradual infilling of undeveloped properties in the AOI.

No development models are available to accurately portray expected growth. The Houston-Galveston Area Council (H-GAC) long-range Regional Transportation Plan, however, indicates that the population and employment numbers for the city, county and region are expected to increase substantially over the next 20+ years (H-GAC 2016a).

The proximity of existing development would likely influence future development. Existing Loop 336, IH-45, FM 1431, FM 3083, and Ed Kharbat Drive provide easy access to all undeveloped areas and would support urban development. The City of Conroe's 2035 Thoroughfare Plan indicates plans for transportation system improvements that would also likely foster growth in the AOI. It includes extension of Foster St. eastward to Loop 336, expansion of Crighton Rd., and a planned principal arterial extending from IH-45 to FM 3083. These planned improvements further suggest that development in much or all of the AOI is likely.

Step 5: Identify Resources Subject to Induced Growth Impacts

As noted in TxDOT's *Guidance: Indirect Impacts Analysis*, transportation projects can provide new or improved access to adjacent land or reduce the time-cost of travel, making surrounding land more attractive to developers and consumers. As a result, such projects can lead to development of undeveloped land or redevelopment to more intensive uses. Such changes in land use are characterized as induced growth effects.

Not all resources are impacted by induced growth. Several resources in the Loop 336 AOI would not be substantially impacted. Those resources, and the reasons impacts on them would not be substantial, include the following:

- Floodplains: Development in floodplain areas is restricted by City of Conroe ordinances and requires that new structures be built at least 12 inches above the base flood elevation. The City also participates in the H-GAC Hazard Mitigation Plan. As such, no development in floodplains within the AOI is anticipated.

- Soils: Although some prime farmland soils occur in the area, no land dedicated to crop cultivation is expected to be developed as an indirect result of the project.

- Cultural resources: Any historic properties in the AOI are protected by the National Historic Preservation Act. Unrecorded archeological sites on private property the AOI may be impacted, but no regulatory protection is available.

- Air quality: The proposed project is included in the 2017-2020 TIP and 2040 RTP, found to conform with the approved SIP in April 2016. Although the AOI is part of the EPA-designated 8-county area of marginal non-attainment for ozone, it is currently in attainment for all other NAAQS pollutants, and no change in attainment status is anticipated within the AOI area as the result of emissions associated with the proposed project.

- Socioeconomic concerns: The proposed project would benefit all users of Loop 336, including poor, minority, and Limited English Proficiency populations. Its insubstantial and largely temporary adverse impacts would not disproportionately impact these populations.

- Community cohesion: The proposed improvements would not divide any existing community. Accelerated growth in currently undeveloped areas within the AOI would have no impacts on neighborhood cohesion and stability and would have positive benefits on traffic patterns, access to public facilities, and pedestrian mobility. Induced development would not conflict with existing or planned development.

Some habitat fragmentation or other ecological effects could occur as wooded areas are cleared as a result of the accelerated development induced by the proposed project. The riparian woodlands alongside Silverdale, Stewarts, and Little Caney Creeks, which comprise the entirety of the riparian woodlands in the AOI, occur within 100-year floodplains and are thus be unlikely to be developed. These areas would continue to offer woodland habitat, even as other wooded areas are cleared for development. As trees are desirable for residential properties, it is expected that removal of trees during residential development will be minimized to the extent possible.

The current and anticipated development within the area could lead to negative indirect impacts on water resources in the watersheds of the three streams in the AOI. The National Wetlands Inventory (NWI) map shows approximately 38.5 acres of potential wetlands on undeveloped parcels in the AOI at which development is not yet planned. Continued development within these watersheds could lead to an increase in impervious cover, contributing to larger amounts of direct runoff from roadways, parking lots and driveways. Runoff from these areas could contain traces of motor oil, rubber, windshield fluid, gasoline and other automotive agents. Water quality within the watersheds could be impacted by heightened development due to the proposed project. While development is likely to occur whether the proposed project is implemented or not, with similar impacts on water quality in the watersheds in either case, impacts may occur sooner or at a faster rate if the proposed improvements are undertaken.

The conversion of pine woodlands in the AOI to developed areas has the potential to impact habitat for the endangered Red-Cockaded Woodpecker (*Picoides borealis*) (RCW). This species requires mature pines for nesting in cavities it carves in older pine wood. It is known to occur in W.G Jones State Forest, approximately 7 miles southwest of the project area, so its presence in the AOI is possible. Developers and the municipal and regulatory entities by whom their permits are issued, however, will be responsible for compliance with the Endangered Species Act prior to development.

Step 6: Assess Consequences and Consider/Develop Mitigation (when appropriate)

An increased rate of development resulting from the project could occur within the indirect effects AOI. However, affected areas are already planned for primarily residential use, with small tracts also devoted to commercial or industrial use. In addition, demographic trends suggest that Conroe would likely attract development whether Loop 336 was widened or not, although induced growth impacts in the AOI may be accelerated somewhat as a result of the proposed project. No specific mitigation to possible impacts of the improvements to Loop 336 is proposed. In general, however, possible mitigative measures that could or presumably will be undertaken by the City or developers include the following:

Vegetation and Wildlife- Conroe's Tree Canopy Ordinance aims to preserve trees from, and replace trees lost to, the impacts of development. It exempts road construction projects such as the proposed

improvements to Loop 336, and TxDOT otherwise has neither the power nor responsibility to manage development beyond direct construction of roads. Compliance with this ordinance by other entities developing property within the AOI, however, will mitigate against impacts on vegetation. The City has the power to obtain and preserve undeveloped lands as parklands and green space to further mitigate against vegetation and wildlife habitat loss if it chooses.

Water resources- The use of Best Management Practices during construction projects serves to mitigate against sedimentation and siltation of waterways receiving runoff from construction sites. Any loss of wetlands is subject to mitigation via mitigation banking or other means as required by Section 404 of the Clean Water Act. The Texas Commission on Environmental Quality (TCEQ) has established Total Maximum Daily Loads (TMDLs) for Stewarts and Little Caney Creeks; these measures should further serve to improve and protect water quality in the AOI and beyond.

Red-cockaded woodpecker: Development in the AOI is subject to the requirements of the Endangered Species Act; compliance with the Act will mitigate against habitat losses due to development.

The development of land in Conroe would be guided by the goals of the Comprehensive Plan and would be undertaken in compliance with applicable City ordinances. Any mitigation required by the City would be the responsibility of the developer.

Cumulative Impacts

FHWA describes consequences of an action as falling into two broad categories: those that are "direct and observable" and those that are "indeterminate and not easily recognized" (FHWA, 1992). This second category is called "indirect and cumulative impacts." In general, indirect and cumulative impacts include those consequences of the proposed action that are not direct and may not be readily observable.

Specifically, indirect effects are "those that are caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable" (40 CFR 1508.8). Cumulative impacts are defined as "those which result from the incremental consequences of an action when added to other past and reasonably foreseeable future actions" (40 CFR 1508.7). Indirect and cumulative impacts are less defined than direct impacts; however, they can generally be described when they are foreseeable.

Growth and development are the principal secondary impacts related to highway improvement projects. By definition, cumulative impacts are incremental in nature and tend to be less defined than indirect impacts. A typical example of a cumulative impact may be an incremental take of a wetland first with minor portions of the wetland filled for highway use, potentially followed by further loss of the wetland as land use transitions occur.

TxDOT's *Cumulative Impacts Analysis Guidelines* notes that if a project does not directly or indirectly affect a resource, it will not contribute to the cumulative effects on that resource, and that that resource need not be addressed in the analysis of cumulative impacts. Other resource-specific Technical Reports addressing the proposed Loop 336 project found that there would be no direct impacts on prime farmland, environmental justice, community impacts, historic resources, archeological resources, parkland, floodplains, and air quality. In addition, Step 5 of the Induced Growth impacts analysis above notes that there would be no adverse indirect impacts on these resources. As such, all have been eliminated from this Cumulative Impacts analysis. As such, the impacts considered in this analysis are those affecting vegetation, wildlife, water resources, and RCW habitat.

TxDOT's *Cumulative Impacts Analysis Guidelines* document outlines five steps that should be followed when conducting a Cumulative Impacts Analysis. These steps include:

1. Resource Study Area, Conditions and Trends
2. Direct and Indirect Effects on each Resource from the Proposed Project
3. Other Actions – Past, Present and Reasonably Foreseeable – and their Effect on each Resource
4. The Overall Effects of the Proposed Project Combined with other Actions
5. Mitigation of Cumulative Effects

These five steps have been followed in the analysis of cumulative impacts of the proposed improvements to Loop 336 and other development on the resources noted above.

Step 1: Resource Study Area, Conditions, and Trends

As noted above, resources on which cumulative impacts are possible, and to which the proposed Loop 336 improvements might contribute, are vegetation, wildlife, water resources, and habitat for the endangered red-cockaded woodpecker. Resource Study Areas (RSA's) and general conditions and trends of these resources are as follows:

Vegetation and wildlife. Although separate individual resources, they are closely tied together when impacts of development are considered, in that clearing of one for development is equivalent to clearing of the other. For this study, the RSA for both vegetation and wildlife is the watersheds of Silverdale, Stewarts, and Little Caney Creeks (**Figure 5**). It was determined that this RSA would provide a suitable frame of reference for examining the availability of biological resources in the surrounding area, and for serving as a baseline for assessing cumulative impacts. A watershed represents a bounded hydrologic system wherein natural resources are interconnected and integrated through a common water course.

Both of these resources have become fragmented in large portions of the RSA as Conroe and surrounding areas have grown. The high growth forecast for the area indicates that this trend will likely continue.

Water resources: The same watersheds used as the RSA for vegetation and wildlife form the RSA for water resources (see Figure 5). The reasons for use of watershed boundaries for a water resources RSA are straightforward, in that the physical features that define a bounded watershed serve to concentrate effects of development on the watershed's drainage and simply define an area on which any necessary mitigation efforts can focus.

Previous development has already adversely impacted water quality in the RSA's. Stewart's Creek is a designated stream segment (Segment 1004E) and is impaired due to elevated bacteria. It and Silverdale Creek drain to Segment 1004, the West Fork of the San Jacinto River, which is also impaired due to bacteria. Little Caney Creek drains to Caney Creek, Segment 1010, which is impaired due to bacteria. The Texas Commission on Environmental Quality has implemented Total Maximum Daily Loads for these waterways in an attempt to reverse these trends. Continued growth in the RSA's will likely continue to place stresses on water quality that will require continual monitoring.

RCW habitat. The RSA for red-cockaded woodpecker habitat was identified through aerial photography by beginning at the Loop 336 project area and extending outwardly until a significant barrier to movement, in the form of a major highway, a large break in pine forest, or a large body of water was encountered. Such barriers occur almost immediately north and west of the project area and consist of the developed area of Conroe and IH-45 corridor, respectively. The southern RSA boundary begins at Crighton Rd. and then extends to the east for approximately two miles to the edge of the Crighton Woods subdivision at Little Caney Creek, where it turns south and then follows boundaries of currently cleared areas or areas that were cleared within the past few decades and thus do not exhibit the mature pine forests required by the RCW. The northern boundary encompasses a small portion of forested land inside Loop 336 and then extends eastward in a haphazard manner, extending as far north as the Woolridge Estates subdivision north of Avenue M Extended in one reach before turning south and eventually east again, until reaching properties on the east side of FM 2083 that have been cleared for commercial and agricultural uses. The total area of the RSA is approximately 6,107 acres. The RSA for RCW habitat is shown in **Figure 6**.

No RCW survey specific to the RSA has been undertaken, but Montgomery County represents the westernmost portion of this species' historical range. As of 1998, at least 10 RCW groups were known in the County (Shackelford and Reid 2001). The Texas Natural Diversity Database also lists 10 RCW occurrences on USGS 7.5-minute quadrangles surrounding the Conroe quadrangle. This species has become endangered through time throughout its entire range due to loss of habitat through clearance and suppression of fires, which controlled the undergrowth that shelters nest predators. Such

measures would have threatened RCW populations in the RSA as well. The RCW has been listed as Endangered since 1970, and is expected to be listed as such for the foreseeable future. The U.S. Fish and Wildlife Service has implemented a Regional Habitat Conservation Plan for the RCW on private lands in east Texas in an attempt to aid in the recovery of this species.

The temporal boundaries of the Cumulative Impacts analysis extend from 1991 to 2040. 1991 was selected because it was the beginning of the City of Conroe's planning period that predates the current one, which commenced with the release of the current Comprehensive Plan in 2007. In 1991 the population of Conroe was almost exactly half that identified in the most recent census (2010), and the period from 1991 to 2007 saw significant development that contributes to cumulative effects, including that of the Stewarts Forest and Crighton Woods subdivisions in the immediate vicinity of Loop 336, not all of which would be captured by beginning an analysis with 2007.

Step 2: Direct and Indirect Effects on Each Resource from the Proposed Project

The No-Build Alternative would not create direct or indirect impacts on resources. Implementation of the Build Alternative could result in the following impacts:

Direct Impacts: The proposed project would add one foot of gutter, two 12-foot travel lanes, a 15-foot shoulder, a 10-foot grassy strip, and a 10-foot pedestrian/bicycle path; as such, it would result in the conversion of 60 feet of currently vegetated areas along approximately 9,950 feet (1.9 miles) of the project corridor. The project would thus result in direct conversion of 13.7 acres of vegetated area to roadway or maintained grasses. The new roadway would be constructed along a corridor already cleared of trees, however; the area that would be converted is already grassland, so neither woodland vegetation nor RCW habitat would be impacted. The proposed project is not expected to fragment or otherwise alter any existing wildlife habitats within the project limits because wildlife areas are already fragmented by the existing roadways.

Field studies identified 0.32 acres of potential jurisdictional wetlands and an additional 625 linear feet of waters of the U.S. that would be affected by the project. These findings were documented in a separate Technical Report addressing Water Resources.

Indirect Impacts: Indirect development may occur as a result of the Build Alternative and could affect ecosystem and socioeconomic resources within the RSA, resulting in long-term land use changes to the landscape along Loop 336. The proposed improvements could enhance land development opportunities that benefit from the improved driving conditions along Loop 336.

For this proposed project, "induced growth is attributed to changes in accessibility caused by the project, which influences where development occurs" (NRC, 2002). The degree to which indirect development may occur is dependent on many variables and is difficult to predict. Based on past

development trends, indirect development would likely include a mix of residential subdivisions, retail centers, individual commercial facilities, and office complexes. Short-term construction impacts, including dust, traffic delays, and rerouting of traffic, may result as these developments are built. In the long term, these new developments would provide services, offices, and some housing for residents in the RSA. In addition, indirect effects may include an increase in the density of existing residential areas as well as increases in utility and social service demands and the conversion of rangeland, cropland, and/or undeveloped land to additional residential or other urban forms of land use.

Indirect development and potential community change can be perceived as positive or negative. To some, this change is unwanted, and the conversion of undeveloped land to residential and commercial uses is undesirable; however, for others, new development often means new jobs and increased economic vitality.

Indirect effects could stem from the conversion of undeveloped land to developed land uses at a faster rate than may otherwise occur. Due to the construction of the Build Alternative, approximately 1,636 acres of undeveloped land (36 percent of the AOI) has the potential to be developed, resulting in decreased habitat value in areas of increased commercial and residential development. Development of currently wooded tracts could affect habitat of the red-cockaded woodpecker as pine forest is cleared. The intensity and extent of new development in the AOI will likely be based on local economic conditions, adequate utilities, and supportive local land development regulations and policies.

The portion of the AOI subject to accelerated development includes approximately 38 acres of wetlands mapped by the National Wetlands Inventory. Induced growth could include wetland loss and potential degradation of wetland quality and function. Development could result in adverse effects to water resources through degradation of surface water through rapid discharge to stormwater and additional pollutant loadings of waterways and increased sedimentation of wetlands. As the topography and hydrology are altered, hydrological conditions associated with runoff and drainage flow will also change.as well as increasing the likelihood of non-point-source pollution of water resources.

Step 3: Other Actions- Past, Present, and Reasonably Foreseeable- and Their Effect on Each Resource

In addition to the direct and indirect effects of the Build Alternative, several other actions have affected, or are likely to affect, resources of concern within the RSA's. A great deal of residential and commercial development has occurred to accommodate the growth in Conroe since 1991; growth since 2000 was shown previously in Tables 2 and 3. Specific instances of development in this time frame in just the immediate project area include the construction of the Crighton Ridge subdivision in 2004 and Stewart's Forest subdivisions in 2005.

Current development trends indicate development along IH 45, Loop 336, and other major roadways within the RSAs. Because the City of Conroe does not have a zoning ordinance, the nature of development of most of these properties will be decided by the developer, within the constraints of other City ordinances. **Table 4** lists properties of 10 more acres within the RSA that currently listed as being for sale, and at which development is thus reasonably foreseeable. As shown in the table, reasonably foreseeable development in this area encompasses approximately 1,438 acres.

Table 4: Non-Transportation Projects Within the RSA

Development	Total Acres
Crighton Park*	324
I-45 & Loop 336*	300
1913 S. 7th Ste.	15
1108 Miracle Dr.	20
1776 E. Davis	140
Sgt. Ed Holcomb at Gladstell St.	14
Gladstell St. at Kirk Rd.	10
3609 S. Loop 336	20
I-45 at River Plantation	38
Hwy. 105 at White Oak Terrace:	26
14296 Creighton Rd.	17
N. Loop 336 at FM 3083	11
1326 FM 3083	12
Teas Rd. E of SH 75	36
I-45 N of FM 3083	113
I-45 at League Line Rd. (E of I-45)	40
I-45 at League Line Rd.	45
League Line Rd. at SH 75	63
League Line Rd. Extension	133
10436 League Line Rd.	61
TOTAL REASONABLY FORESEEABLE DEVELOPMENT:	1,438

*Within indirect impacts AOI

The properties listed in Table 4 are being advertised as suitable for a variety of uses, with more than one type suggested for many. The large properties in the immediate vicinity of the project area (Crighton Park and I-45 at Loop 336), for example, are being advertised for mixed-use development. As previously noted, development in Conroe is largely left to market forces, meaning property owners can develop their properties as they see fit (subject to applicable City ordinances and codes). As such, the future use of any particular property cannot be

determined with certainty, but it is expected that properties along large thoroughfares would tend to be developed as commercial or multi-family residential properties, properties adjacent to heavily commercial or industrial areas would be converted to similar uses, and areas of large undeveloped tracts would feature residential development and attendant schools and parks.

Transportation projects are also planned within or adjacent to the RSA. These include:

FM 2854 from Loop 336 to IH-45: TxDOT proposes to reconstruct FM 2854 from two lanes to a four lane divided roadway with curb and gutter between W. Loop 336 and IH-45 (H-GAC, 2016b).

SH 75 from Gladstell St. to the IH-45 underpass: TxDOT proposes to widen SH 75 to a four-lane undivided road with bicycle accommodations from Gladstell St. to it underpass at IH-45 (H-GAC, 2016b).

Step 4: The Overall Effects of the Proposed Project Combined with other Actions

The Build Alternative, in combination with other past, present, and reasonably foreseeable future actions discussed above, could cumulatively impact vegetation, wildlife habitat, water resources, and one endangered species (the red-cockaded woodpecker). Past developments that contribute to cumulative impacts include the development of various residential subdivisions and commercial business parks within the greater Conroe area. These developments would be attributed to both the Build Alternative as well as the No-Build Alternative, as the development is not related to the project being constructed. Current development trends within the RSAs indicate continuation of these development patterns. As such, impacts associated with the Build Alternative would contribute cumulatively in conjunction with impacts of other current and reasonably foreseeable projects.

(a) Vegetation and Wildlife Habitat

Conroe shows a trend of increasing population and urbanization (Table 2). Commercial and residential developments have continued to increase steadily over the past several decades in the RSA, which is combined watersheds of Silverdale, Stewarts, and Little Caney Creeks. See **Figure 5** for the Land Use RSA map. Aerial photographs indicated that from 1991, the beginning of the time period for this cumulative impacts analysis, up until the present, approximately 6,961 acres of formerly vegetated areas in the 41,050-acre RSA (17%) have been developed.

As previously noted, clearing of vegetated land is equivalent to clearing of wildlife habitat; in the RSA, a large majority of vegetated land subject to development is upland woodland habitat, with smaller areas of grassland habitat developable as well. Direct impacts of the proposed project are estimated at 13.7 acres of undeveloped land being converted to roadway, although much of this area is a corridor

previously cleared of trees and is thus grassland. It is estimated that indirect impacts could result in approximately 1,636 acres of development in the indirect impacts AOI, and, as shown above, foreseeable development on land currently for sale encompasses approximately 1,438 acres of undeveloped land. With 624 acres of this total occurring within the indirect impacts AOI, and thus already considered; the net result is that approximately 814 acres of land outside the AOI but within the RSA is for sale, and its development would thus be considered reasonably foreseeable.

In summary, total clearing of vegetated land in the RSA includes 6,961 acres due to past actions, approximately 14 acres due to direct impacts of the project, 1,636 acres due to induced growth, and 814 acres as a result of reasonably foreseeable development. In total, it is thus estimated that the cumulative impact of clearing of land, and the equivalent loss of vegetation and wildlife habitat, in the RSA totals approximately 9,605 acres. Future losses due to induced growth and reasonably foreseeable development may occur at a faster rate as a result of the proposed improvements, although it is likely that they would ultimately occur whether or not the improvements are implemented.

(b) Water Resources

The combined watersheds defining the RSA for water resources encompass approximately 41,050 acres. Because a watershed represents a bounded hydrologic system wherein natural resources are interconnected and integrated through a common water course, it was determined that this RSA would provide a suitable frame of reference for examining the availability of water resources in the surrounding area, and for serving as a baseline for assessing cumulative impacts. See **Figure 6** for the Water Resources RSA map.

As noted above, approximately 6,961 acres of previously undeveloped lands have been cleared within the RSA since 1991. While the impact on water quality of such development cannot be quantified, it is likely that this development has contributed to the degradation of water quality in nearby waterways over time. In addition, a comparison of historical aerial photography from 1991, current aerial photography, and the NWI map of the watersheds indicates that approximately 408 acres mapped as wetlands by the NWI have been developed during this time.

During field surveys, three waters of the U.S., including wetlands, were identified within the proposed project area. A total of 625 linear feet of streams classified as jurisdictional waters of U.S. and 0.32 acre of wetlands subject to Section 404 of the Clean Water Act are located within the project footprint. Within the overall RSA, there are approximately 24.3 miles of TCEQ-classified streams and 3,615 acres of wetlands mapped on the National Wetlands Inventory.

Indirect impacts on water resources from the proposed project could also result from commercial and residential development that may occur because of the roadway's improved condition.

Current real estate listings within the watersheds that make up the RSA indicate that approximately 81.7 acres of wetlands are present in these areas in which development is anticipated. Another 38.4 acres are mapped in the Indirect Impacts AOI, although no development is currently planned. Based on the direct, indirect, and potential impacts of the listed foreseeable actions, 120.4 acres of waters and wetlands could potentially be affected at an accelerated rate of existing development trends leading to increased stormwater runoff, although it is likely that these effects would ultimately occur whether or not the improvements are implemented. Under either the Build or No-Build Alternatives, undeveloped land would continue to be developed, which would also increase the amount of impervious cover/runoff.

The analysis above estimates that 408 acres of mapped wetlands were impacted as a result of past actions, the proposed project would impact approximately 0.32 acres, and 120.4 acres could potentially be impacted by induced growth and other reasonably foreseeable third-party actions, resulting in a cumulative impact of approximately 529 acres on potential wetlands; as noted above, however, the impacts due to induced growth and other reasonably foreseeable actions will likely occur whether or not the project is undertaken, although they may occur at a faster rate as a result of the project. In addition, non-point sources of pollution associated with construction projects could also further impact the water bodies in the RSA already impaired by excess bacteria. As the area develops, the amount of impervious cover/runoff would increase. Runoff from impervious areas is subject to the aforementioned pollutants, as well as materials from garbage and from commercial or industrial sites that may develop in the area. The possibility of concentrated contamination may be greater from one of these sites than it is from roadway runoff. In addition, these sites would likely discharge various levels of treated wastewater. Increased development would also contribute to increased runoff into Silverdale, Stewarts, or Little Caney Creeks. The network of future roadways and subdivision streets associated with indirect development could contribute both to direct and indirect effects; however, the density and type of future development within the RSA would determine the amount and type of runoff. For any given watershed, additional development could have a substantial effect depending on the water quality of the streams receiving additional runoff.

(c) Endangered Species

The RSA for RCW habitat (see **Figure 6**) occurs within the Pineywoods Ecoregion of Texas. The pine forests that define the region are inhabited by the federally-endangered red-cockaded woodpecker. Throughout much of the twentieth century, contiguous stands of quality old-growth pine forest for nesting, as well as foraging habitat, were lost to short-term rotation timber management on Federal, state and private lands, has had (USFWS 1995, Campbell 2003). Loss of mature pines to pine beetle infestation has also contributed to the loss of quality cavity trees, particularly during epidemics (Campbell 2003).

As shown in Tables 2 and 3, Conroe has experienced, and will likely continue to experience, rapid growth. Similar growth is mirrored throughout the northern portion of the Houston-Galveston metropolitan area, which includes the RSA. Since 1991, approximately 515 acres of the total 6,107-acre RSA for RCW habitat have been cleared.

In addition, approximately 624 acres of forested lands in the RSA are currently for sale, indicating that their development in the near future is very likely. Growth may also be induced at a faster rate in the remaining 965 acres of potential RCW habitat in the induced growth AOI (1,636 undeveloped acres total – 624 acres already accounted for as being for sale – 47 acres of non-RCW habitat). The combined total results in potential cumulative impacts on 2,104 acres of potential RCW habitat, although it is likely that impacts due to induced growth and other reasonably foreseeable development would ultimately occur whether or not the proposed improvements are implemented.

Further clearing of RCW habitat will put further stress on the health of the species overall. There may be adverse cumulative impacts on this species resulting from growth in its native areas.

Step 5: Mitigation of Cumulative Effects

Every effort has been made in the selection of alternative alignments and the Build Alternative alignment to avoid or minimize adverse effects to sensitive resources. During the construction phase, short-term adverse effects related to dust and noise would be minimized. Traffic delays would be minimized through coordination among TxDOT, contractors, and affected neighborhoods or landowners, and by developing a construction schedule that would allow for a minimum delay for movement across the proposed ROW. Also, efforts would be made to provide appropriate construction detours, informative signage, and maintenance of access to residences, farms, businesses, and community facilities where practicable.

Vegetation and Wildlife: As TxDOT does not have the authority to implement zoning or planning regulations, mitigation for cumulative effects on vegetation and wildlife or continued conversion of undeveloped land to developed land would require the collaborative efforts of local, county, and regional planners, the public, and private developers.

Local governments such as the City of Conroe that have not adopted land use plans to deal with the orderly growth within their jurisdiction should consider taking such steps to minimize future adverse effects of unplanned growth. These plans could include provisions to protect green space in new residential and multi-use developments. An example would be local governments requiring developers to dedicate 30 percent of their total development to open space.

Certain trust organizations may be interested in preservation opportunities within the RSA. Such organizations involve a local, state, or regional non-profit organization directly involved in protecting land for its natural, recreational, scenic, historical, or productive value. Preservation opportunities

could involve land donations, fee acquisition, mitigation banks, land leases, or conservation easements.

Water Resources: Water quality-related mitigation initiatives that may address cumulative effects in certain portions of the RSA include various programs implemented by the Texas State Soil and Water Conservation Board, TCEQ, the River Authorities, and local governments. The TCEQ's program for development of Total Maximum Daily Loads for waterbodies listed as impaired on the CWA 303(d) list may potentially result in mitigation programs affecting watersheds within the RSA.

Water quality mitigation for cumulative effects could potentially include collaboration among agencies to minimize impacts to the surface and groundwater resources. Regulatory compliance at the federal, state, and local level during continued development within the RSA could stabilize or prevent additional impacts to surface and groundwater supply or decline in water quality. Compliance with local regulations in watersheds and encouragement of setback standards to prevent increased sedimentation or low quality water intrusion of waterbodies could be adopted in order to preserve this resource.

Specific impact minimization to wetland areas may include: the design (use of bridge crossings instead of filled embankment); the use of retention basins and vegetated swales to minimize runoff, sedimentation, turbidity, leaching of soil nutrients, and leaching of chemicals from petroleum products, pavement, and waste material; and alleviating flow alterations due to structures that change established wetland drainage or flooding patterns.

Red-Cockaded Woodpecker: No specific mitigation related to the red-cockaded woodpecker is proposed. Proponents of development in areas of potential RCW habitat in the RSA, however, will still be responsible for compliance with the Endangered Species Act. Impacts resulting from projects that result in taking of habitat may be mitigated through development of Habitat Conservation Plans or conservation banks.

In summary, the proposed project would contribute to cumulative effects on vegetation, wildlife, water resources, and habitat for the endangered red-cockaded woodpecker within the respective RSA's for each resource. In general, however, the contribution of the impacts attributable to the proposed project is small compared to that from all other current and reasonably foreseeable projects. While it is possible that growth in the project area may be accelerated somewhat as a result of the proposed improvements to Loop 336, this area would likely ultimately attract development whether the roadway was widened or not. As a result, no specific mitigation is proposed based on cumulative impacts on these resources. The development of land in Conroe would be guided by the City's Comprehensive plan and governed by city ordinances and codes. Any mitigation required by the City would be the responsibility of the developer.

REFERENCES

Campbell, L. 2003. *Endangered and Threatened Animals of Texas: Their life history and management.* Endangered Resources Branch, Texas Parks and Wildlife Department, Austin.

Houston-Galveston Area Council. 2016a. *Bridging Our Communities: Regional Transportation Plan 2040*. http://www.h-gac.com/taq/plan/2040/docs/2040-RTP-revised-April-2016.pdf

Houston-Galveston Area Council. 2016b. *Bridging Our Communities: Transportation Improvement Program 2017-2020*. http://www.h-gac.com/taq/tip/docs/2017-2020/0-HGAC-2017-2020-TIP-final-document.pdf

Malik, M. 2016. Personal communication with B. Hamer, AmaTerra Environmental, 11/9/2016

Shackelford, C. and Reid, J. 2001. The Endangered Red-Cockaded Woodpecker and Modern Forestry in Texas: Living in Harmony. Texas Parks and Wildlife Department Book W7000-361.

U.S. Fish and Wildlife Service. 1995. Threatened and Endangered Species of Texas (Revised). U.S. Fish and Wildlife Service, Austin. June 1995.

FIGURES

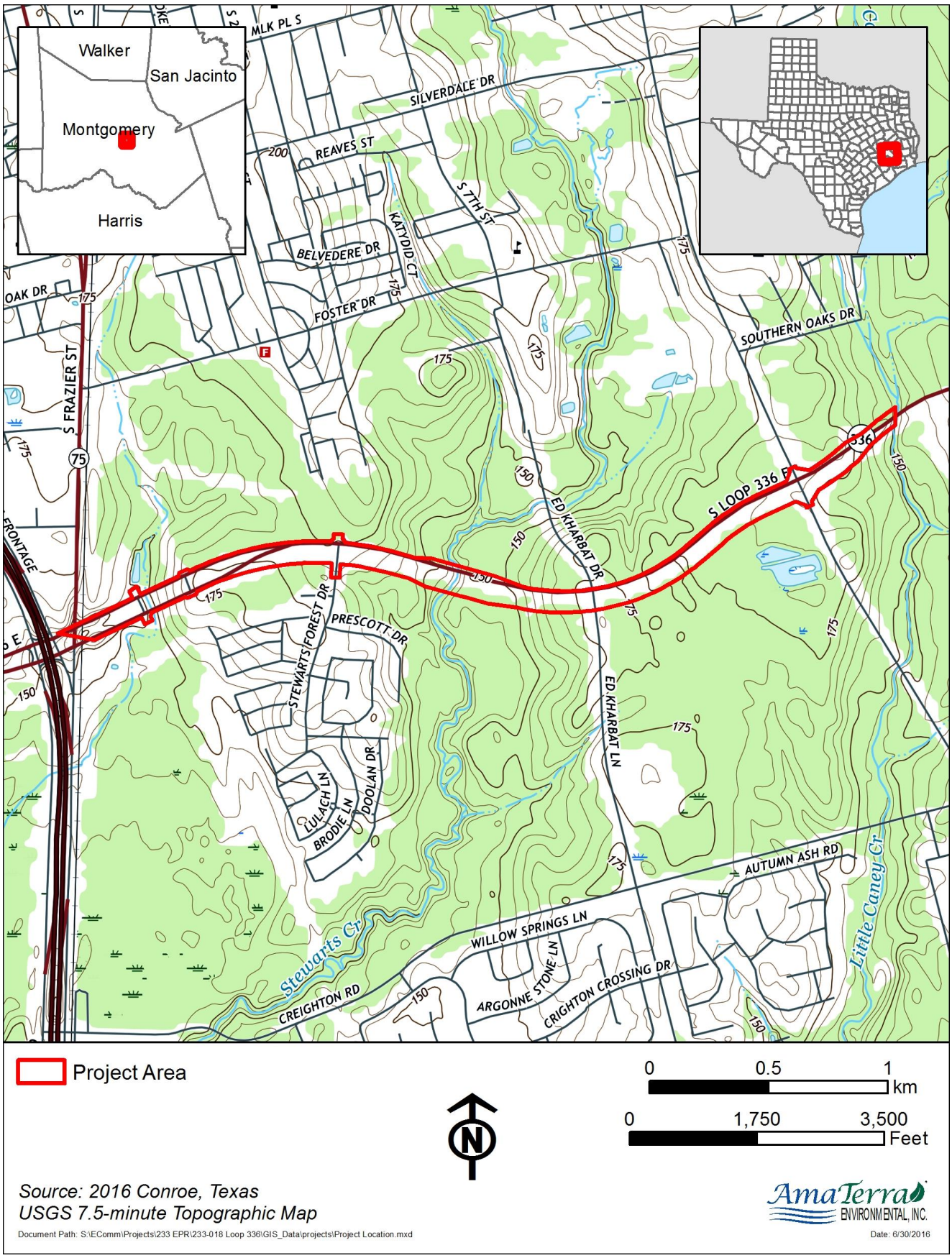

Figure 1. Project Location Map

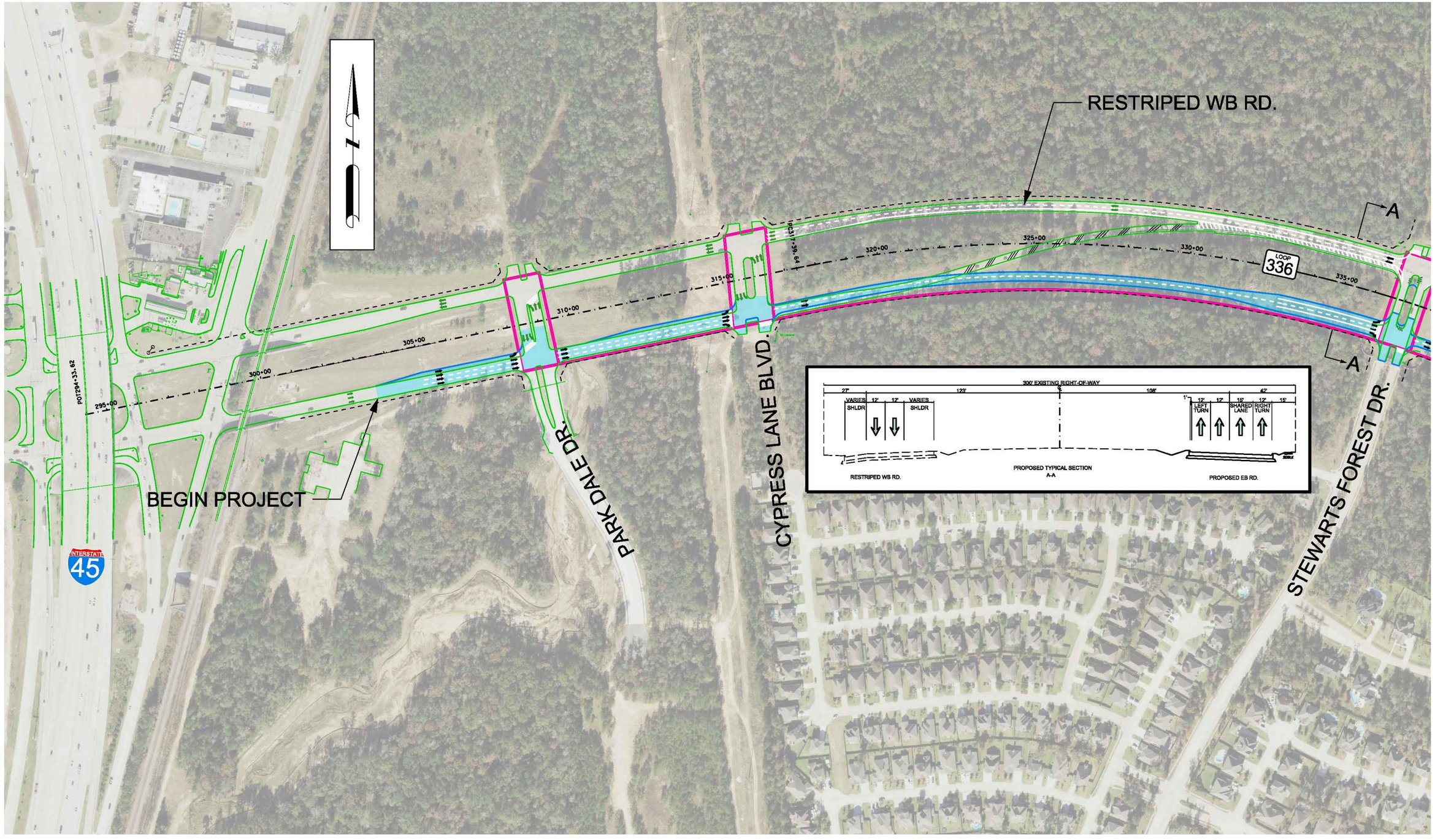

Figure 2a. Project Schematic

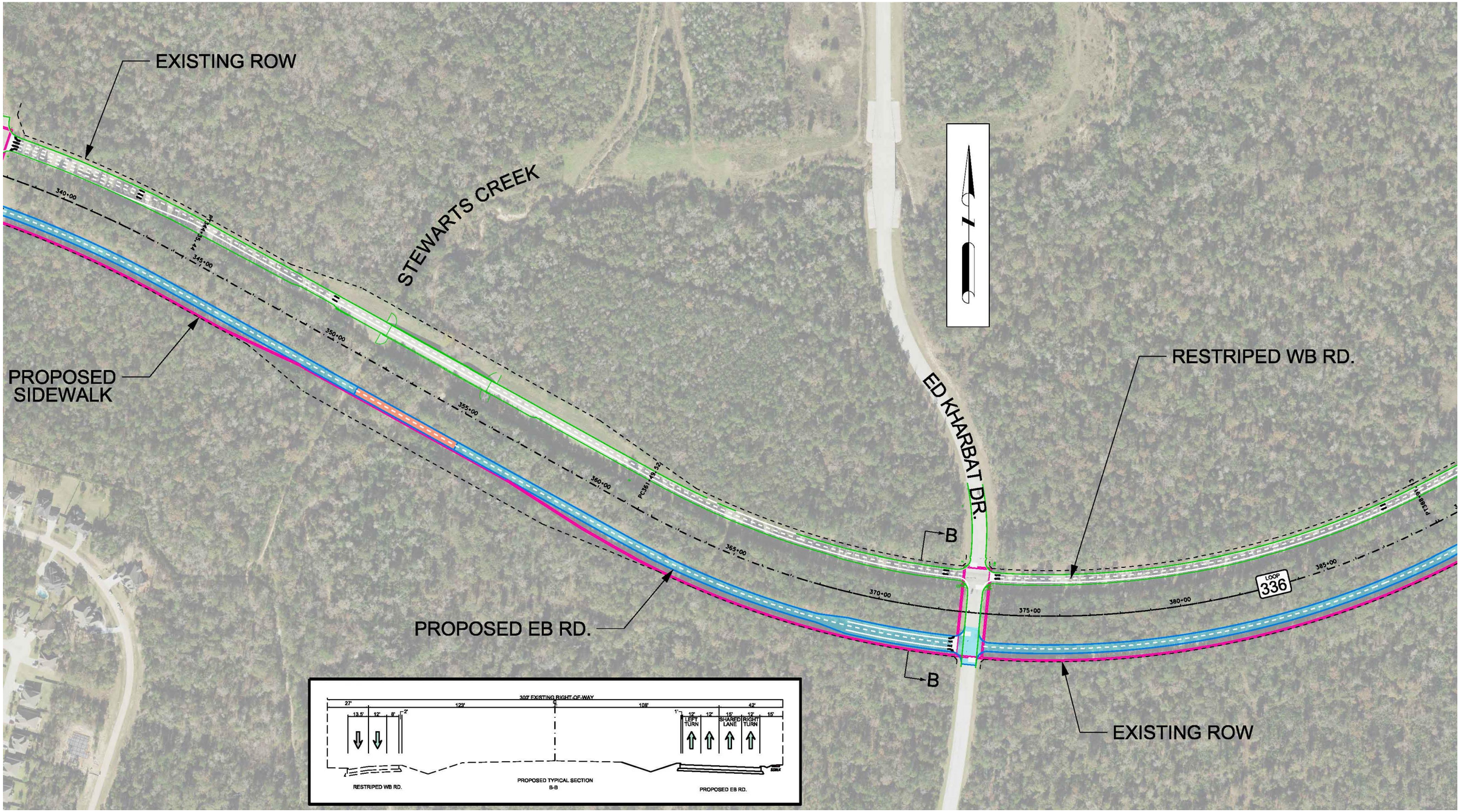

Figure 2b. Project Schematic

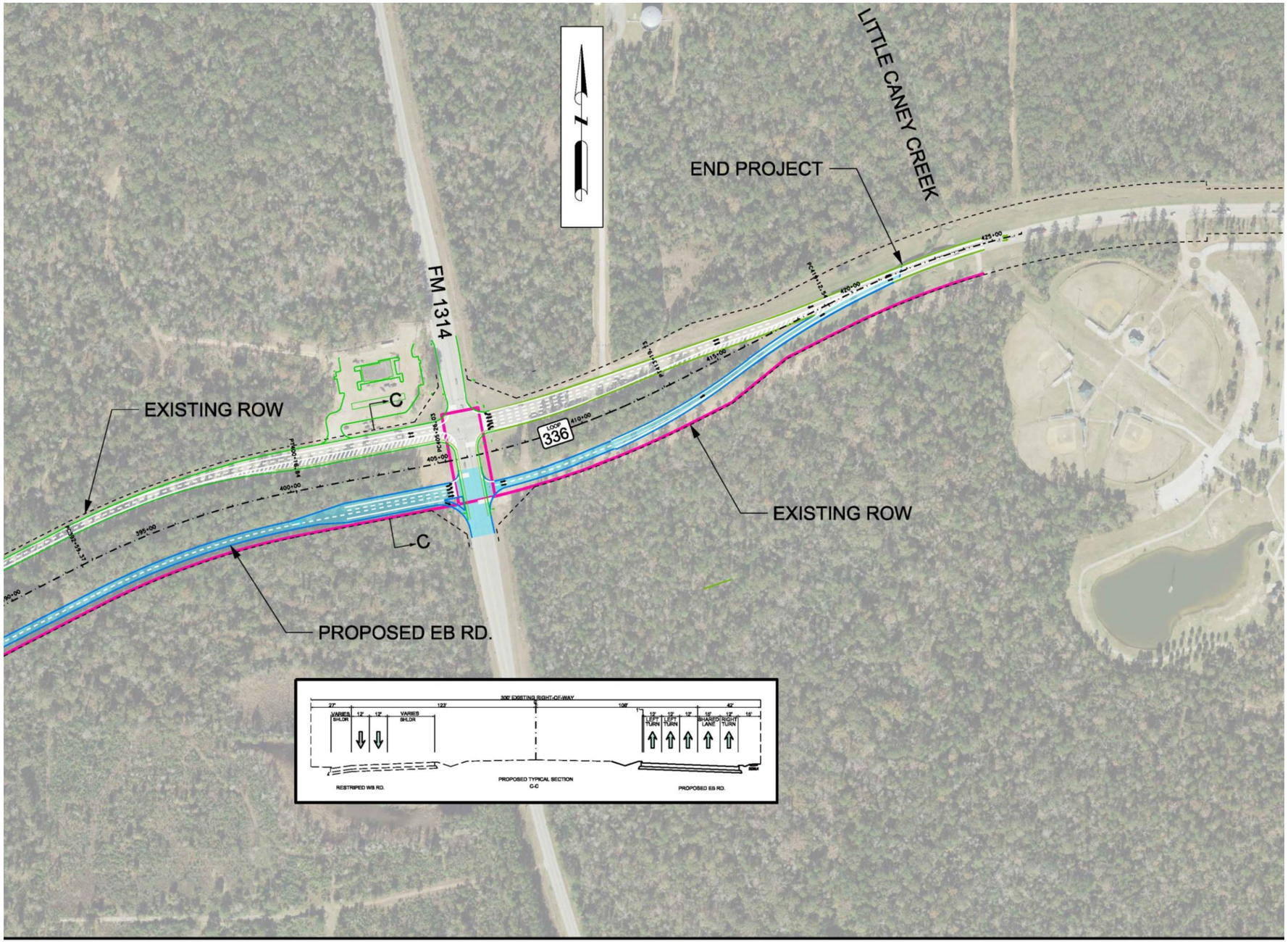

Figure 2c. Project Schematic

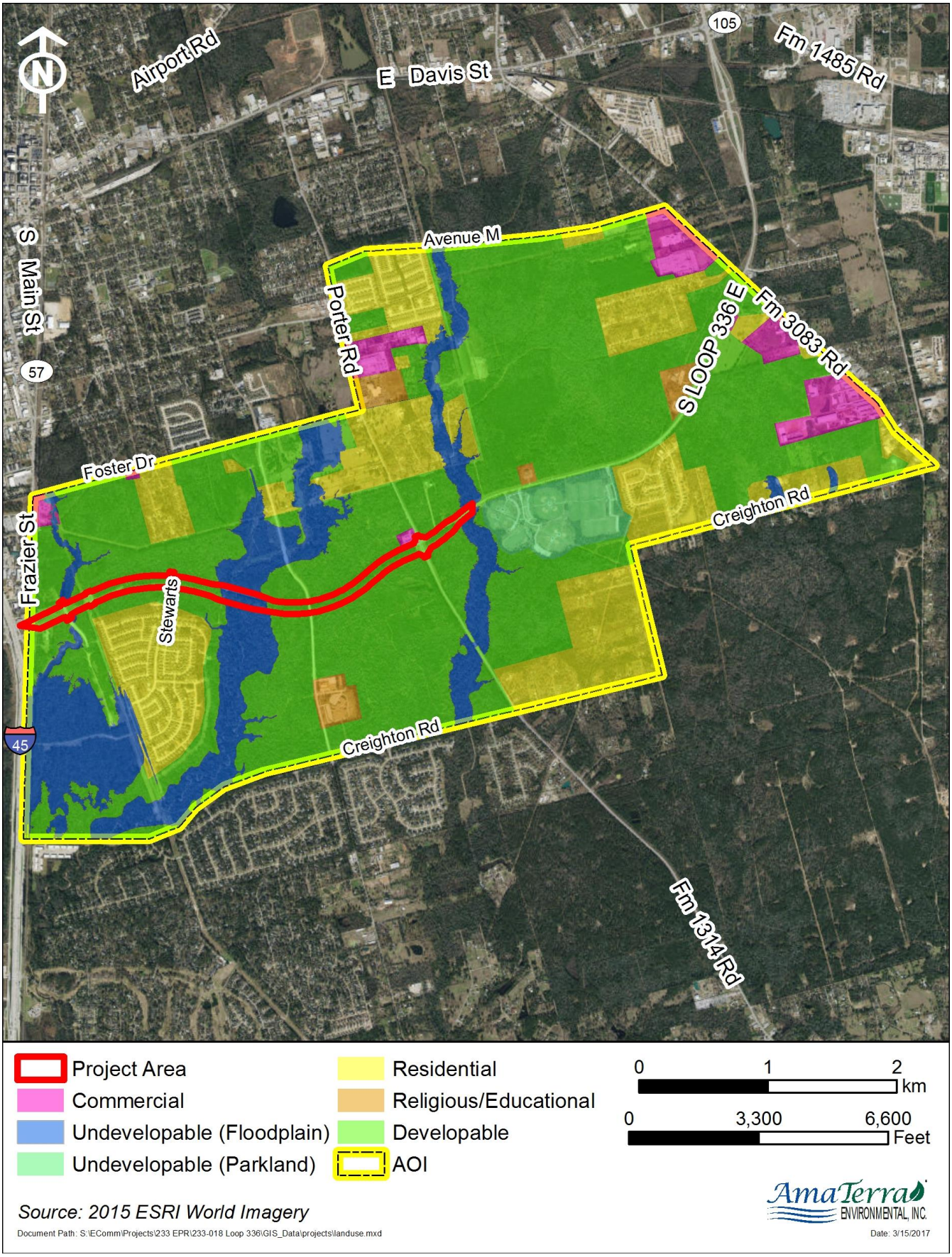

Figure 3. Indirect Impacts Area of Influence

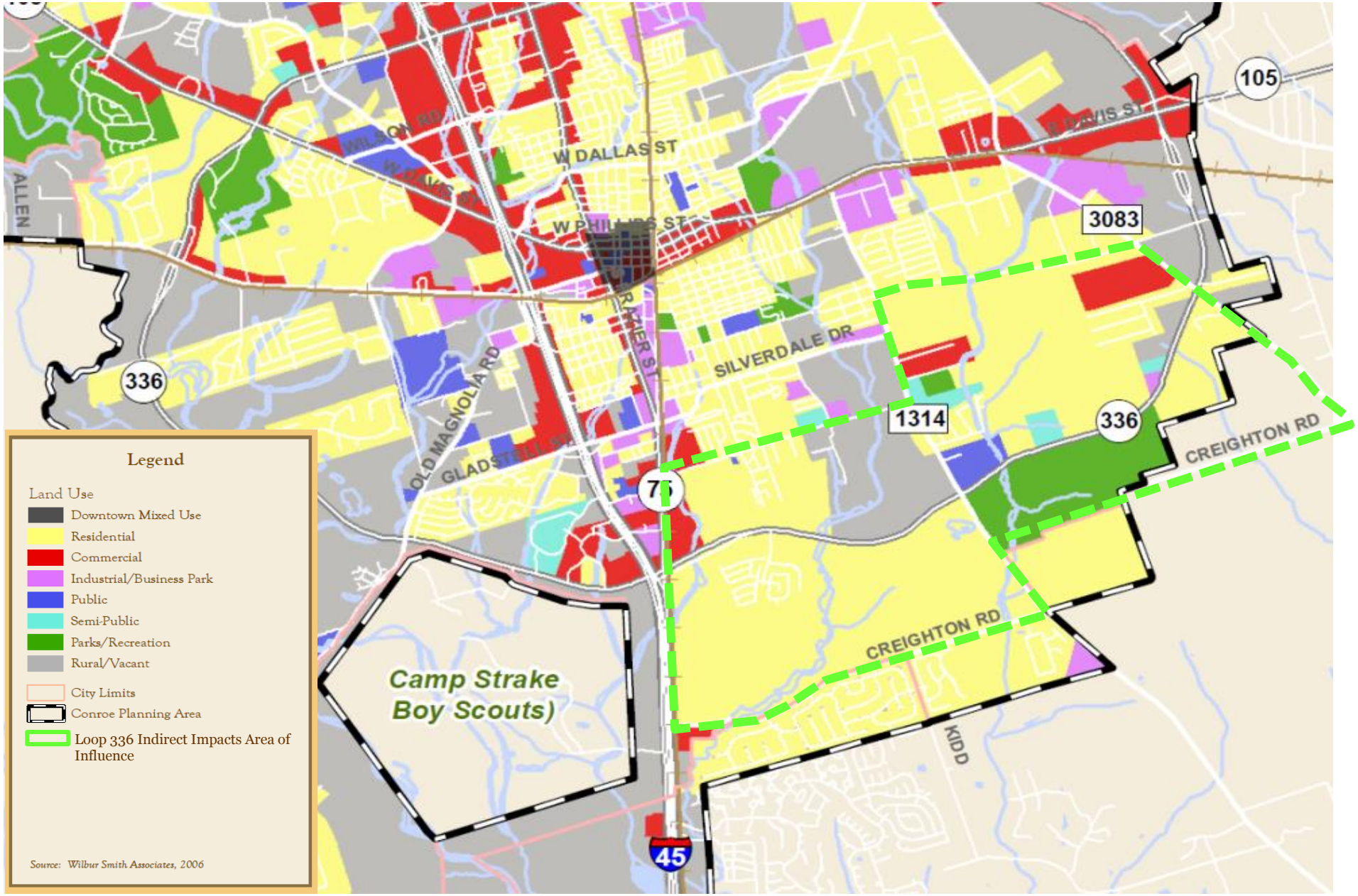

Figure 4. City of Conroe Growth Scenario Map
(from City's Comprehensive Plan)

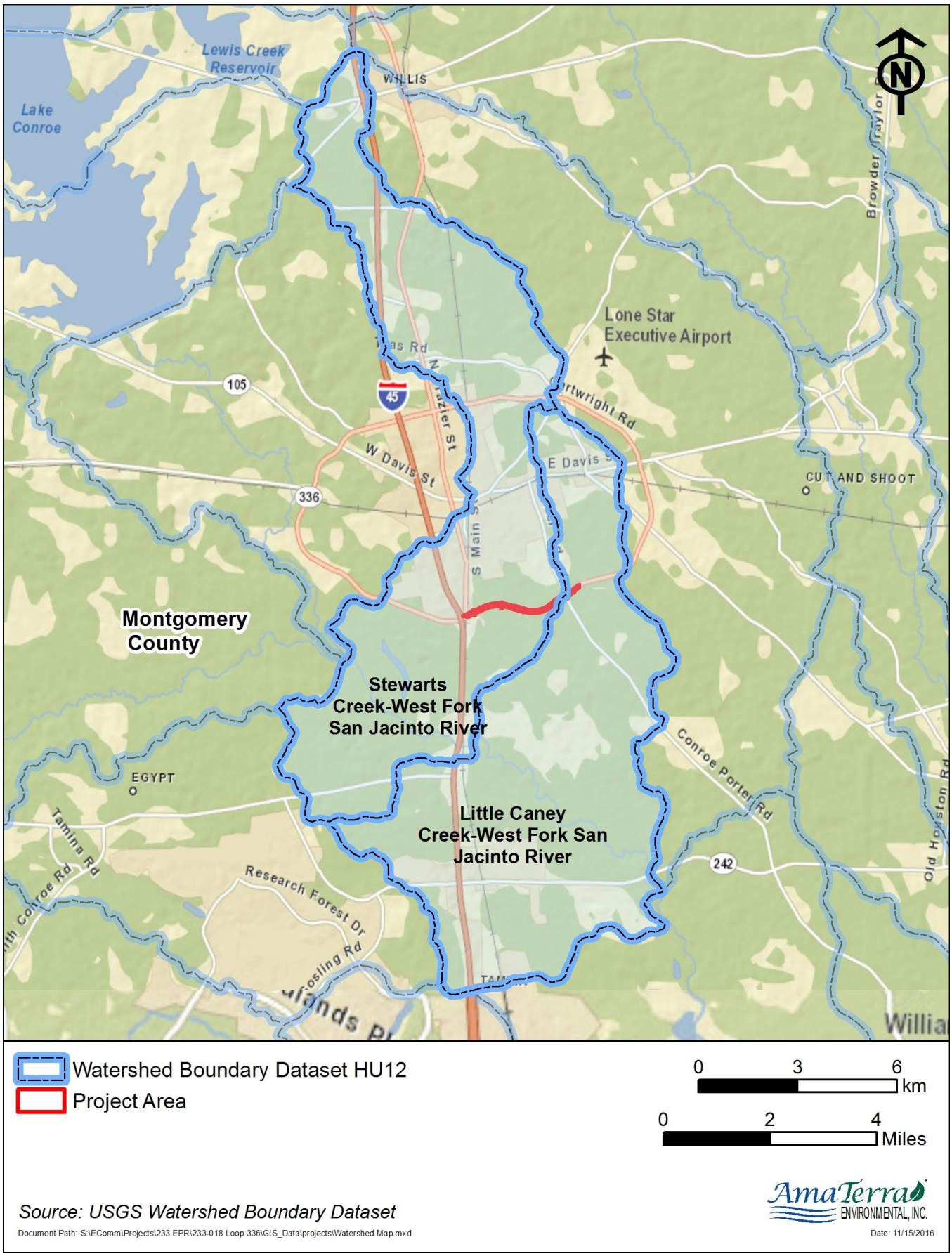

Figure 5. Watersheds Defining Vegetation, Wildlife, and Surface Water RSAs.

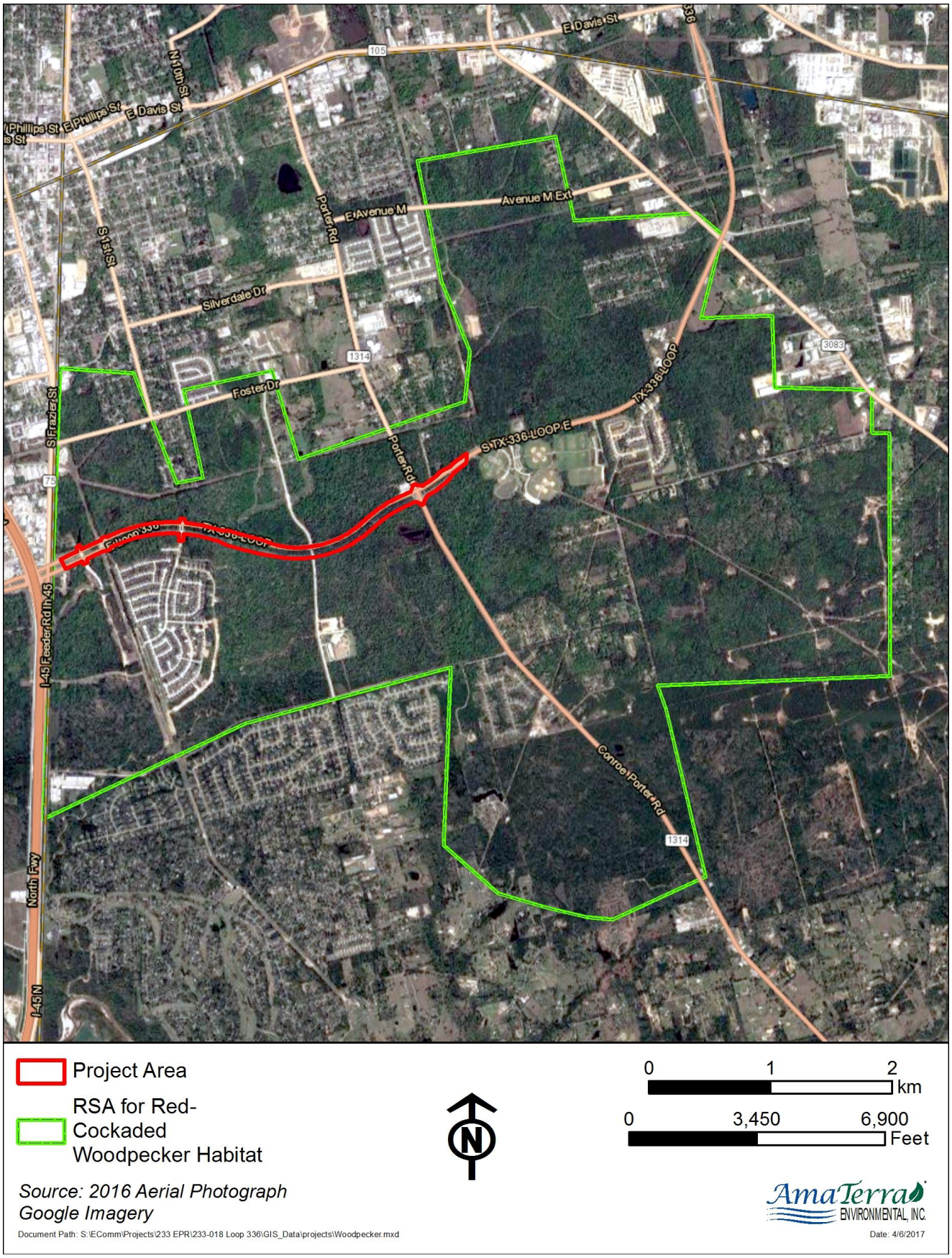

Figure 6. RSA for Red-Cockaded Woodpecker Habitat.

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