Guidance

Indirect Impacts Analysis

This guidance describes the detailed steps for conducting an indirect impacts analysis for TxDOT projects.

TxDOT Environmental Affairs Division
Effective Date: January 2019
720.02.GUI
Version 3

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1.0 Introduction

The requirement to assess indirect impacts of a proposed project is established in the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) for federal actions and in the Texas Department of Transportation (TxDOT) environmental review rules (43 TAC Chapter 2).

This guidance document describes the detailed steps for conducting an indirect impacts analysis for TxDOT projects, relies heavily on recognized references on the subject, and provides a balance between a systematic methodology and scalable application. A consistent theme throughout this guidance is the importance of maintaining ***a connected sequence of defendable decisions*** in meeting the required consideration of the indirect impacts associated with a project.

1.1 TxDOT Policy

It is TxDOT policy to evaluate and document indirect impacts in compliance with state and federal requirements. An indirect impacts analysis generally includes several types of actions. However, it is TxDOT policy to analyze and document encroachment alteration impacts concurrently with the direct impacts analysis and to focus the indirect impacts analysis on induced growth. The induced growth impact analysis is conducted after the encroachment and direct impact analyses and uses information from both analyses. Refer to Section 10.0 for more information on encroachment effects.

1.2 Additional Resources

- AASHTO Practitioner's Handbook 12 – Assessing Indirect Effects and Cumulative Impacts Under NEPA (AASHTO Handbook 12): A primary source for this TxDOT guidance document, the American Association of State Highway and Transportation Officials (AASHTO) handbook provides a concise overview of legal requirements for both indirect and cumulative impacts evaluations.
- National Cooperative Highway Research Program (NCHRP) – Report 466: Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects (NCHRP Report 466): This report provides an eight-step framework for analyzing indirect impacts and an overview of methods for completing each step.
- Questions and Answers Regarding Indirect and Cumulative Impact Considerations in the NEPA Process (FHWA Q&A): In this guidance, the Federal Highway Administration (FHWA) answers some common questions about their regulations for considering indirect impacts.
- NCHRP Forecasting Indirect Land Use Effects of Transportation Projects (NCHRP Forecasting Report): This report – prepared as part of NCHRP Project 25-25, Task 22 – contains information about the practice of land use forecasting across the nation and highlights several methods and details that might be helpful for practitioners.

2.0 Impacts

The CEQ regulations for implementing the procedural provisions of NEPA require environmental effects to be evaluated for proposed transportation projects. The terms effect and impact are used synonymously in the CEQ regulations and in this guidance. Some resource agencies might define these terms differently. According to 40 CFR 1508.8:

> *Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions*

which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

The following three types of impacts must be considered when evaluating a project. Figure 1 graphically depicts the relationships among the types of impacts, and Figure 2 provides a tabular comparison between the types of impacts.

- **Direct Impacts** occur as a direct result of an action at the same time and location as the action.
- **Indirect Impacts** are reasonably foreseeable and occur as a result of an action, but occur later in time or are removed from the action location.
- **Cumulative Impacts** result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. For additional guidance on cumulative impacts, refer to the Indirect and Cumulative Impacts Toolkit.

Figure 1
Relationship of Types of Impacts

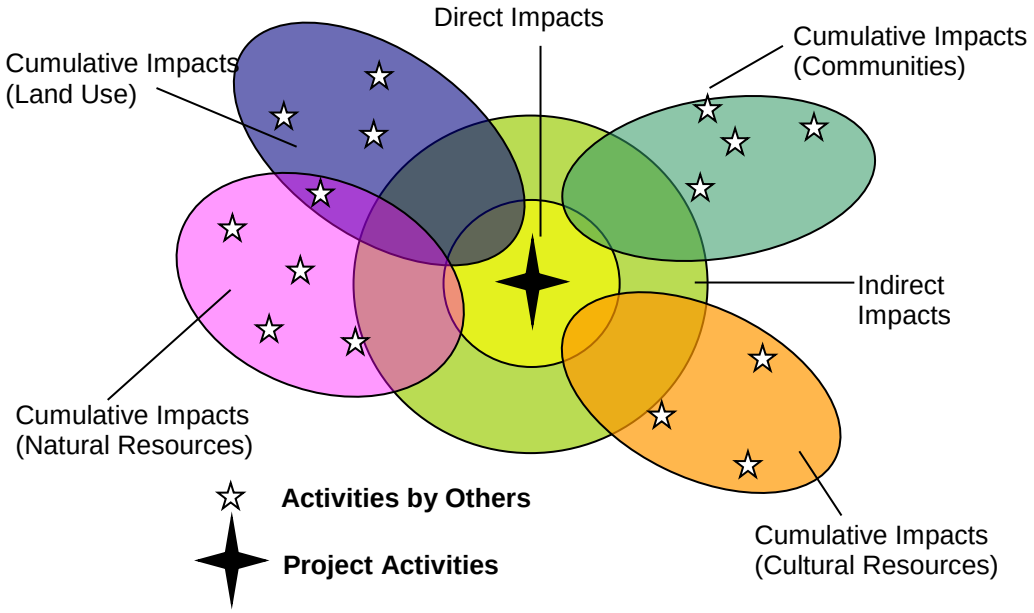

Figure 2
Impact Types

Impact Types			
	Direct Impacts	**Indirect Impacts**	**Cumulative Impacts**
Impact	Caused by the project activities	Caused by the project activities, but occurring later or farther away than direct impacts	Caused by the project activities, plus pre-existing conditions, plus the actions of others
Timeframe	Present	• Present • Reasonably foreseeable future	• Past • Present • Reasonably foreseeable future
Focus	Project activities	Project activities	Resource condition
Study Area	Within and closely adjacent to the project limits	• Within and near the project limits • Often a larger area than the study area for direct impacts • The geographic area that can be influenced by the project	• Multiple study areas • Each specific resource study area reflects the condition of that resource • Boundaries are not influenced by the project, but by existing boundaries like community boundaries, habitat type, watershed, etc.

In other words, an impact is the result or outcome from a change caused by an action. It is important to consider an impact as change in the trend of a resource as opposed to an impact in static terms.

In 40 CFR 1508.8, CEQ defines indirect impacts as those that:

> *… are caused by the action and are later in time and 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.*

Transportation projects have a wide range of impacts to the environments in which they are located. Some of these impacts are directly attributable to aspects of the project design or function. Other impacts are more indirectly attributable to a transportation project. These indirect impacts often are less obvious because they are more removed from the transportation improvement in time or space and, like direct impacts, can be adverse or beneficial.

Direct and indirect impacts are linked in a causal chain. By nature, indirect impacts are less certain than direct impacts, but are still reasonably foreseeable. Indirect impacts are probable rather than just possible consequences of an action. Determining probable consequences of an action involves reviewing numerous sources of information – such as development trends, land purchases, local plans, investment and/or marketing studies, etc. – and requires logical analysis of the likely effects of the proposed action. Then, the practitioner analyzes the possible consequences to determine the likelihood that they will occur.

2.1 Induced Growth Indirect Impacts

While many factors – such as real estate prices, local amenities, etc. – influence development, the link between transportation improvements and developments cannot be ignored. Transportation projects

often reduce travel time, enhancing the attractiveness of surrounding land for development through changes in accessibility. These changes in accessibility might influence development in a localized area adjacent to the transportation project (e.g. gas stations and motels near an interchange) and larger-scale effects on the location of future development within a region. An analysis of these induced growth impacts involves tracing the chain of causation connecting a transportation project to future land use changes and then to the impacts of those changes. The steps in this chain of causation can be expressed as three distinct sets of questions.

- Does the project have the potential to increase mobility and/or accessibility? If so, in what geographic area is increased accessibility likely to occur?
- Is the increased accessibility likely to cause changes in development patterns (timing, type, location, or amount)? If so, where are those changes in development likely to occur?
- Are impacts likely to result from project-related changes in development patterns? If so, what specific types of resources could be impacted?

2.2 Encroachment Alteration Indirect Impacts

Encroachment alteration impacts are more closely related to direct impacts than induced growth impacts. When looking at a direct impact, it may be most helpful to think about how that impact would look five, ten, or twenty years from construction. Additionally, how the direct impact would impact the resource outside of the project footprint should be considered. Although these impacts will be documented by resource, it is important to remember that resources, both biological and social, are interrelated. A single project action has the potential to impact a variety of resources. For example, the placement of fill into a waterbody could impact not only the waterbody itself but also water quality, vegetation, soils, and wildlife habitat.

3.0 Level of Analysis by Class of Action

CEQ regulations require all federal agencies to consider the indirect impacts of all proposed agency actions. The TxDOT environmental review rules require an environmental impact statement (EIS) or environmental assessment (EA) prepared for a project to include a description of indirect impacts associated with the proposed project. The consideration, documentation, and analysis have requirements that vary in degree by class of action and are commensurate with the potential for adverse and significant impacts, whether direct, indirect, or cumulative (FHWA Q&A). It is important to document the consideration of indirect impacts and the rationale for determining the level of analysis. The class of action helps determine the level of consideration and documentation.

3.1 Categorical Exclusions (CE)

Categorical Exclusions (CEs) are types of actions that, based on prior experience with similar projects, do not individually or cumulatively have significant environmental impacts (40 CFR 1508.4 and 23 CFR 771.117(a)). They are excluded from the requirement to prepare an environmental impact statement. They are also excluded from the requirement to prepare an environmental assessment to determine if an environmental impact statement is required. TxDOT's process for making CE determinations requires staff to certify, among other statements, that the project does not induce significant impacts to planned growth or land use for the area, does not have significant impacts on travel patterns, and does not involve unusual circumstances. A written indirect impacts analysis should not be prepared for a CE project.

3.2 Environmental Assessment (EA)

Projects classified as EAs have environmental impacts, but the significance of the environmental impacts is not clearly established prior to the analysis. An EA should be a concise document that briefly provides the public and decision-makers sufficient evidence and analysis for determining whether an environmental impact statement or a finding of no significant impact is appropriate. It should not contain long descriptions, detailed information, or analyses (40 CFR 1508.9 and FHWA Guidance for Preparing and Processing Environmental and Section 4(f) Documents Technical Advisory 6640.8A). The degree to which indirect impacts need to be addressed in an EA depends on the potential for the impacts to be significant and varies by resource, project type, and geographic location (FHWA Q&A).

3.3 Environmental Impact Statement (EIS)

Because actions requiring an EIS have significant environmental impacts, the consideration, analysis, and documentation of the appropriate issues must be reasonably detailed and disclosed as required by the CEQ regulations and Texas Administrative Code (TAC). Actions processed with an EIS need to be carefully evaluated during the scoping process to determine the environmental resources, geographic boundaries, time periods, and methodologies to be used in analyzing indirect impacts (FHWA Q&A).

4.0 Scoping

Scoping is the early and open process for determining the scope of issues, actions, alternatives, and potential impacts to be addressed in the NEPA study (40 CFR 1501.7). Environmental studies are intended to be meaningful and focused on decision-making, which means the project scope must not be defined too broadly or narrowly. The scoping process, as required by 43 TAC 2.44, is intended to focus on the real issues and de-emphasize consideration of minor issues. This appropriately narrows the scope of the environmental analysis to only the issues that will influence the decision or deserve attention from an environmental stewardship perspective. If a topic does not add value to the project decision, the related decisions of other agencies, or promote full disclosure, it may only be necessary to briefly explain it or, in some cases, not include it at all (FHWA Q&A).

4.1 Induced Growth Impacts

TxDOT developed a Scope Development Tool to aid in the scoping process and help determine if an induced growth effects analysis is necessary. The scope development tool does not require any detailed project information and can be completed during the scoping process. During the scoping process, the practitioner uses basic project information to determine if the project has potential to induce growth and warrants an analysis. The scope development tool was designed using circumstances and situations leading to induced growth, but the tool does not cover all possible situations. If there is information about the project or project area that is pertinent to the potential for induced growth, use professional judgment, consult the subject matter expert, and/or collaborate with the core team to determine if an analysis is warranted. Use the Induced Growth Impacts Analysis Decision Tree, depicting the related questions and logic, to determine if an analysis is warranted.

4.2 Encroachment Alteration Impacts

Encroachment alteration impacts should be analyzed for all resources which will be evaluated for direct impacts.

5.0 Indirect Impacts Analyses Methodology

No single formula is applicable for determining the appropriate scope and extent of an indirect impacts analysis. The practitioner must determine the methods and extent of the analysis based on the proposed project's size, type, location, potential to affect environmental resources, and potential to affect the health of any resource.

5.1 External Influences

Two methodologies inform the current TxDOT indirect impacts analysis process.

First, the following, detailed, eight-step process provided by NCHRP Report 466 influenced the TxDOT process and is a widely accepted methodology.

1. Conduct scoping.
2. Identify the study area's direction and goals.
3. Inventory the study area's notable features.
4. Identify impact-causing activities of the proposed action and alternatives.
5. Identify potentially significant indirect effects for analysis.
6. Analyze indirect effects.
7. Evaluate analysis results.
8. Assess the consequences and develop appropriate mitigation.

Second, AASHTO Handbook 12 provides a high-level explanation of indirect impacts analysis which focuses primarily on induced growth impacts. As part of the scoping process and prior to the full analysis, AASHTO suggests that the practitioner define the study area, determine the time horizon, select the methodology, consider requirements of other laws, and consult with resource agencies. After this initial work is complete, an analysis can be conducted. AASHTO suggests the indirect impacts analysis include the following four basic steps.

1. Assess the potential for increased accessibility.
2. Assess the potential for induced growth.
3. Assess the potential for impacts on sensitive resources.
4. Assess potential minimization and mitigation measures.

5.2 TxDOT Processes

Previously, the TxDOT indirect impact analysis process was based on the NCHRP Report 466, which suggests examining both the biological and socioeconomic encroachment alteration impacts and the induced growth impacts as indirect impacts. TxDOT revised its process after practicing it for several years. The TxDOT indirect impacts analysis process now focuses on the project's likelihood to induce growth and the effects of that growth.

As described in Section 1.1 of this guidance, encroachment alteration and induced growth impacts are analyzed separately. Refer to Sections 8.0 and 9.0 for more information about an induced growth impacts analysis and to Section 10.0 for more information about an encroachment impacts analysis.

5.3 Other Federal Environmental Requirements and Indirect Impacts Analyses

In addition to NEPA, several environmental regulations, legislations, and authorities include indirect impact requirements or general policies applicable to specific resource considerations. These requirements are addressed and satisfied by other TxDOT processes and are not addressed in this process. These regulations do not necessarily define indirect and cumulative impacts in the same way they are defined by NEPA. Therefore, the resources covered by the regulations listed below will still be evaluated for indirect and cumulative impacts under NEPA. The following list from the FHWA Q&A is for illustration purposes and is not intended to be all-inclusive.

The regulations implementing **Section 106 of the National Historic Preservation Act (NHPA)** require the consideration of indirect and cumulative impacts, when applying the criteria for determining adverse effects on historic properties (36 CFR 800.5(a)(1)) and delineating the area of potential effects (APE) (36 CFR 800.16(d)).

Section 404 of the Clean Water Act (CWA) establishes a permitting program to regulate the discharge of dredged and filled material into waters of the United States, including wetlands. The Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230, Subpart B) requires the CWA Section 404 permitting authority to determine the potential short- or long-term effects by determining the nature and degree of effect the proposed discharge will have, individually and cumulatively. Cumulative and indirect effects on the aquatic ecosystem must be considered as part of the Section 404(b)(1) analysis.

The Endangered Species Act (ESA) of 1973, as amended, requires the evaluation of direct, indirect, and cumulative effects on listed species and designated critical habitat of proposed federal actions (50 CFR 402.12 and 402.14). In 50 CFR 402.02, indirect effects are defined under “Effects of the action” as effects “caused by the proposed action and later in time, but still are reasonably certain to occur.”

6.0 Induced Growth Impacts Analysis Process

Combining the logic from the NCHRP and AASHTO methodologies, TxDOT established a process for determining the potential for induced growth and the potential impacts of that growth. Completed during the scoping process, the Scope Development Tool helps determine if a full analysis is warranted. If an analysis is not warranted, file the completed tool in the project file, and include a short narrative in the environmental review document explaining the outcome and referencing the location of the tool. If an analysis is warranted, use the following six-step methodology.

1. Define the methodology.
2. Define the area of influence (AOI) and 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.

As previously stated, the consideration, documentation, and analysis requirements vary in degree by class of action and are commensurate with the potential for adverse and significant impacts.

Step 1 – Define the Methodology.

Numerous methods of analysis are available for the study of induced growth impacts effects. The required environmental review document content is as much about which method is selected as explaining how that

method was implemented. The document needs to identify very clearly the method of analysis used; the assumptions and limitations involved in that method; and the underlying data and to explain how that analysis was applied to produce the documented results.

This guidance provides a specific framework for conducting an analysis. However, there are different methods a practitioner can use to gather and analyze the data. Different methods are appropriate for different situations. The selection of a particular method depends on numerous factors, including best available data, project context, and controversy. Plus, more than one method can be used in combination. Figure 1 provides detailed information about the most commonly used methods. For detailed information on this and other complex methods, refer to the NCHRP Report 466 located in the Indirect and Cumulative Toolkit.

Figure 1 Induced Growth Impacts Analysis Methodologies

Method	Description	Advantage	Disadvantage
Planning Judgment	It uses experience, professional literature, data collected from knowledgeable persons, and assessment of local conditions – trends and forecasts – to make judgments about impacts. Computations are generally done in simple tables and spreadsheets. Line of logic and data upon which the logic is based must be explained.	• Inexpensive • Quick • Logical • Scalable	• Pure judgment must be avoided; use of planning judgment often and easily lapses into pure judgment. • Quality is highly variable. • It is generally qualitative, not quantitative.
Collaborative Judgment	It emphasizes group process, diverse inputs, and outreach and is useful for gathering a wide range of information on multiple actions and resources using questionnaires, interviews, panels, etc. It can be expanded to include public involvement.	• Flexible • Useful for subjective information • Transparent • More credible than an individual planner's judgment	• Quantification can be difficult or impossible. • Results can appear more subjective than other methods.
Cartographic Techniques	It includes a wide range of techniques based on various types of maps. Overlay techniques are commonly used. Resource Capability Analysis is a cartographic technique that overlays specific types of maps – opportunity and constraint maps for development – to identify areas likely to undergo land use change. All cartographic techniques can be performed using a geographic information system (GIS) platform.	• Addresses spatial pattern and proximity of effects • Can be adapted to account for temporal effects • Useful for compiling many different types of data • Tools and data often readily available • Effective visual presentation • Can allow for optimization of development or mitigation options	• It can be time consuming. • Important data might not be available. • It is limited to effects based on location. • It is difficult to address the magnitude of effects.

Method	Description	Advantage	Disadvantage
Elasticities	It measures the effect a change in one variable has on the amount of change in another variable. It can be used to account for induced travel effects and for post-processing adjustment of travel demand model results.	• It can capture induced travel. Forecasts often account for route redistributions, but not new latent trips.	• It relies on estimates; if local data are unavailable, estimates need to reflect the specific condition of an improved corridor. • It is not recommended as a stand-alone method.
Four-Step Model	Almost universally used for travel-demand modeling by MPOs and other planning organizations, the four steps are trip generation, trip distribution, mode-choice, and travel assignment.	• Readily available • Widespread support and institutional legitimacy • Quantified results	• While it can provide information about traffic, it does not, in most cases, account for land use impacts, and such analysis results require supplementation from other methods. • It has difficulty accounting for induced travel. • Primary units of analysis are too large to account for neighborhood-scale, making it only applicable for corridors, regions, metropolitan areas, etc. • Utility and accuracy of results depend on data quality and assumptions. • It can be difficult to explain to the public
Comparative Case Analysis	It uses case studies of similar past projects to forecast likely outcomes.	• Relatively simple and inexpensive • Might allow for identification of indirect impacts that are otherwise difficult to identify	• The major limitation of this method is finding completely comparable situations on which to base forecasts. Therefore, this method is not recommended as a stand-alone analysis, but can be used to supplement other methods of analysis. • It is only effective for truly comparable cases similar in size,

Method	Description	Advantage	Disadvantage
			project type, location, design, demographic conditions, growth rates, etc. • Data sources must be similar for both cases. • It requires data collection for all cases to be compared. • Retrospective analysis requires separating project-related impacts from those caused by other factors. • It is not recommended as a stand-alone method.
Scenario Writing	In narrative form, it outlines one or more logical sequences of events to describe the conceivable future environment and can be used to establish the upper and lower bounds of potential outcomes.	• Relatively simple and inexpensive • Useful for outlining a range of possible effects	• It requires assumptions and consideration of numerous uncertainties. • Reliability of the results depends on the plausibility and credibility of the argument and the qualifications and/or competence of the writer. • It might be difficult to identify all appropriate variables. • Completeness, validity, accuracy, and reliability are questionable.
Trend Extrapolation	It allows for projections based on analysis of time series data and involves linear (simple) extrapolation, curve fitting, or upper limit curves.	• Simple and requires readily available software • Useful for establishing baseline projections	• Utility is limited to baseline or no-build forecasts. • It might be too simplistic. • Projections taken too far into the future or based on too few historic data points might be flawed. • It assumes no change to the conditions supporting past trends and might be

Method	Description	Advantage	Disadvantage
			unrealistic even as a baseline.

Traditionally, TxDOT relied on planning judgment, but this requires some caution and involves some risk. Although there is a tendency to rely heavily on the experience of the analyst, this is rarely a self-sufficient method, as it provides no citation to authority. This method also can lapse into the use of pure judgment, which must be avoided. The analysis must include written findings, incorporating supporting logic and facts. Interviewing local land use experts is a good way to gather facts to support the findings. The causal chain of events must be documented and supported by facts or accepted theory. While planning judgment is often the most expedient method for analysis of induced growth, other options might be preferable. For complex projects, planning judgment is generally not sufficient.

Collaborative judgment expands planning judgment into a group effort, which helps to provide transparency and impartiality. Collaborative judgment can be used for any type of impact (direct, indirect, and cumulative) and might include public involvement and panels of experts. Collaborative judgment is likely to be viewed as more legitimate than a single planner's judgment. In the absence of other resources, collaborative judgment might be the only sufficient method. Numerous techniques might be employed for collaborative judgment, ranging from informal to highly structured, such as Delphi panels. The key feature of the collaborative method is interaction among all members of the group.

Whatever method is selected, it is important to consider any assumptions throughout the analysis. It is also necessary to evaluate and disclose the level of uncertainty involved in the analysis and to communicate it to the decision-maker and the public. The method used affects both the level of uncertainty and the way it is documented. If expert panels or stakeholder involvement are used in forecasting induced growth impacts effects, it is very important to document any differing opinions. **When analyzing results, it is always preferable to quantify impacts when practicable. However, in some situations, qualitative methods can be sufficient for analysis of indirect impacts. For complex or controversial projects, more sophisticated methods might be necessary.**

Step 2 – Define the area of influence (AOI) and study timeframe.

Several techniques are available to determine the appropriate study area for induced growth impacts, or the AOI. These techniques include adopting political and/or geographic boundaries, using the project commute shed, using the location of next major parallel roadway, and incorporating input gathered from stakeholder interviews or public involvement. Also, consider travel-time savings and travel volume while determining the AOI. Combined, these techniques can define the appropriate AOI for the full ranges of potential induced growth effects impacts.

Generally, larger project improvements with greater savings in travel time – such as improved mobility and access – have a larger AOI. Large-scale projects of regional importance might have much larger study areas. Produced as part of Task 22 of NCHRP Project 25-25, the NCHRP Forecasting Report provides specific guidance on the magnitude of time savings and its relevance to induced growth impacts, as well as an explanation on elasticities, which can be used to define the appropriate AOI more accurately. If a project is short in length but opens previously inaccessible parcels, a smaller AOI might be appropriate. A good example is connecting a discontinuous frontage road.

If indirect impacts are considered early in the scoping process, it is possible to develop the overall study area for the project with consideration of the potential induced growth impacts. If this is the case, the AOI might be the same as the project study area. If induced growth impacts were not considered when establishing the study area boundaries, it might be necessary to select an expanded AOI. There is no

concrete formula for establishing a study area appropriate in every instance. The Environmental Affairs Division (ENV) is available to assist in determining an appropriate AOI. Although doing so requires additional data collection, it is preferable to have an oversized rather than undersized AOI. **Whatever the size and shape of the AOI selected, the environmental review document must clearly explain the logic behind that selection.**

Selection of an appropriate AOI also requires consideration of the timeframe. Most analyses use the transportation plan horizon year as the appropriate timeframe for an induced growth impacts analysis. **Timeframe considerations for an induced growth impact analysis only have a future component, unlike cumulative impacts analyses.** While an induced growth impacts analysis does not require a past temporal boundary, the analyst should consider past trends when determining if growth might occur.

Step 3 – Identify areas subject to induced growth in the AOI.

Once the AOI is determined, the practitioner uses information gathered from aerial photography, available GIS data layers, information from local officials or planners, or information from other sources to determine which areas within the AOI would be most likely to experience induced growth. This cartographic technique can be achieved most effectively using GIS. However, it is possible to complete this exercise with other computer applications or on paper. Include a map depicting the AOI in the environmental review document.

When looking at the AOI, the practitioner first identifies undevelopable parcels, areas they are confident will not experience development and/or redevelopment as a result of the project. This could include areas such as parks, wildlife refuges, floodplains, or areas that are currently developed.

When eliminating currently developed parcels, the practitioner considers the age of the development and the potential of that parcel to be redeveloped. Redevelopment is likely to be most important in developed areas that are currently undergoing change, are designated by the local government as areas where redevelopment is desirable (i.e. Tax Increment Financing (TIF) districts), or have high vacancy rates and/or properties for sale. Transportation projects can also affect the rate at which planned development is implemented.

After the undevelopable parcels have been eliminated, the practitioner can examine the remaining areas to determine which parcels will be subject to induced growth. This step incorporates several factors including information from planning documents and information from the local agency on availability of utilities, accessibility to the parcel, etc.

For example, a parcel is not likely to experience induced growth if all of the following are true:

- The project proposes to build a new roadway making several undeveloped parcels newly accessible;
- The area does not currently have water or sewer lines running near the newly accessible parcels; and
- The planning document and/or official have no plans to construct utilities to that area.

However, a parcel would be subject to induced growth if all of the following are true:

- It is adjacent to the limited access highway;
- The parcel currently has utility lines available to it; and
- The project proposes to construct an access road that would allow traffic to reach the parcel.

Step 4 – Determine if growth is likely to occur in the induced growth areas.

After identifying the parcels that would be subject to induced growth, the practitioner analyzes how likely it is that growth will occur. Factors that determine the likelihood of induced growth include information

gathered using the collaborative judgement method, from planning documents; from zoning, population, and employment trend data; and from local planners or other knowledgeable officials. It is critical to document very clearly the sources of data, their use in the analysis, and the certainties and uncertainties of the information used and to draw a clear line of logic in the analysis to the conclusion.

In the environmental review document, the practitioner first indicates if any of the available parcels are currently slated for development. This can be determined using the local agency's current planning document, information from planner interviews or questionnaires, or by searching the local agency's website for filed plans and/or building permits. When explaining about these developments, state if they are dependent on the proposed project.

Next, the practitioner analyzes any available data to determine if induced growth will occur on the remaining parcels by using the trend extrapolation method to examine trend data. If the trend in population for a city or town shows that population has been steadily increasing over the past 20 years and is projected to continue to do so, then induced growth may be more likely to occur. If the employment trend for a town shows employment opportunities have been steady but are beginning and are projected to continue declining because of the loss of a major industrial facility, induced growth is not likely. In general, the most clear and concise method of conveying trend data is using charts or graphs. If possible, the practitioner should use charts or graphs to illustrate employment and population trends in the AOI.

In addition to trend extrapolation, comparative case analysis and scenario writing can also be useful methods for examining potential outcomes in this this step. A detailed list of various methodologies is shown in Figure 1.

Unlike most other indirect impacts, land use impacts are described in value-neutral terms. Changes in land use are not described as positive or negative, as they might be either, depending upon the context, area goals, and perceptions. The same land-use change is likely to be viewed differently by different groups.

Step 5 – Identify resources subject to induced growth impacts.

If it is determined that induced growth might occur, the practitioner identifies the resources that could be impacted by the possible growth. If there is no detailed information on the development that may occur, the practitioner uses the details of a worst-case scenario. The analysis must include an inventory of all the resources present on the areas identified as likely to experience induced growth. However, substantial impacts require a more detailed analysis. Whether an impact is substantial is a function of the context, the likelihood of the impact, and the reversibility of the impact.

Using GIS or other available resources, the practitioner determines what is present on the induced growth parcels. As discussed previously, quantitative analysis is always preferable, so the practitioner provides the acreage of impacts categorized by vegetation class, habitat type, or current land use. After taking inventory of the resources present, the practitioner examines which resources might be substantially impacted.

An impact can be substantial due to its context. As with direct impacts, a potential induced growth impact can be considered small in and of itself, but also substantial due to the setting or condition of the resource. Consider the following example of a potentially substantial impact to vegetation. If there was a parcel with creek adjacent to a 2.3 acres stand of woody vegetation completely surrounded by retail and residential development and the proposed project would likely induce growth on that parcel, the impact could be substantial as the stand is likely the only refuge for wildlife traveling along or living in the adjacent creek. However, if the same size stand was surrounded by rangeland and other stands of the same vegetation, the potential induced growth impact would not be substantial.

An impact can be substantial due to its likelihood of occurring. As an example, consider a sensitive resource on a parcel identified as an induced growth area. If the parcel were in a rapidly developing

suburban area experiencing a sharp upward population growth trend, the impact would be substantial. However, if the parcel were in an area experiencing a steady population trend and no new building permits or development plats have been recently filed for any adjacent areas, the impact might not be substantial.

An impact can be substantial due to the resource's ability to recover from the impact. For example, impacts to wetland might be less likely to be substantial, as impacts to wetlands require mitigation by replacement. Whereas, impacts to environmental justice populations might be more likely to be substantial, since there are no specific mitigation requirements for such impacts. Therefore, the community might be less able to recover.

If an impact is found to be substantial, the practitioner does additional analysis to determine the magnitude of the potential impact. Then, the practitioner considers whether this substantial impact might assist the decision maker in determining which project alternative would be preferred.

Step 6 – Identify Mitigation

In general, mitigation is considered for indirect impacts that:

- Conflict with study area goals;
- Could worsen the condition of a sensitive or vulnerable resource;
- Could delay or interfere with planned improvement of a resource; and/or
- Are inconsistent with an applicable law.

The practitioner develops mitigation options similarly to the method used for direct impacts and evaluates those options for practicality the same way. Potential mitigation options for induced growth impacts can fall outside the jurisdiction or control of the sponsoring agency. Courts have determined that environmental review documents need to identify potential mitigation strategies, even if they are not under the control of the sponsoring agency. Additionally, the document must identify who might adopt those mitigation strategies and advise those entities with mitigation authority on what was considered appropriate mitigation.

Robertson v. Methow Valley Citizens Council, 490 U.S. 332 (1989) states: "where the adverse effects … are primarily attributable to predicted off-site development that will be subject to regulation by other governmental bodies, the EIS serves the function of offering those bodies adequate notice of the expected consequences and the opportunity to plan and implement corrective measures in a timely manner." The document must include a statement explaining the effectiveness of possible mitigation measures, but does not need to include a fully developed mitigation plan.

In most cases, TxDOT does not mitigate for impacts caused by others. There are occasional exceptions, when endangered species are impacted. An induced growth impact to listed species can lead to consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act (ESA). For some induced growth impacts to endangered species, USFWS requests conservation measures. Although this situation is rare, there are cases where TxDOT must implement conservation measures to mitigate induced growth impacts.

Some induced impacts are considered within the control of the sponsoring agency. These impacts include those related to, but not limited to:

- How the project is located and its access provisions;
- How the project is constructed;
- How the project is operated; and
- How the project right-of-way will be used and maintained.

For these impacts, the document must explain avoidance measures, minimization measures, and appropriate compensatory mitigation.

7.0 Induced Growth Impacts Analysis Summary

The following questions are listed for each step of the TxDOT induced growth impacts analysis process and are used by practitioners to analyze and document induced growth impacts comprehensively. Thoroughly answering these questions ensures a sufficiently reasoned and documented analysis.

Step 1 Define the methodology.

Was the methodology chosen based on the best available data, project complexity, and/or controversy?

Was the reasoning for choosing the methodology explained?

Is the methodology explained? If collaborative judgment was used, are all the consulted parties listed?

Step 2 Define the AOI and study timeframe.

Does the scale of the AOI reflect the scale of the proposed project?

Is the rationale for choosing the AOI explained?

Is the rationale for the AOI logical?

Has a study timeframe been established?

Is the rationale for choosing the study timeframe explained?

Is the rationale for choosing the study timeframe logical?

Step 3 Identify areas subject to induced growth in the AOI.

Were undevelopable parcels eliminated from calculation and analysis?

Does the document explain why those parcels were considered undevelopable?

Is the rationale for identifying induced growth areas explained?

Is the rationale for identifying induced growth areas logical?

Step 4 Determine if growth is likely to occur in the induced growth areas.

Were planned developments identified?

Does the document identify trends that would influence growth?

Does the analysis draw a conclusion as to whether induced growth might occur?

Are the conclusions supported by logical analysis and plausible reasoning?

Step 5 Identify resources subject to induced growth impacts.

Does the analysis quantify the acreage subject to induced growth?

Does the analysis state what is currently present on the induced growth areas?

Does the analysis differentiate between substantial and unsubstantial impacts?

Are the conclusions on substantial and unsubstantial impacts logical and plausible?

Step 6 Identify Mitigation.

Does the document identify induced growth impacts that would require mitigation?

Does the document identify mitigation measures that would protect resources from induced growth impacts caused by others?

8.0 Encroachment Alteration Impacts Analysis Process

For TxDOT projects with encroachment alteration impacts, which are caused by the project but separated from it by time and/or space, the practitioner analyzes each resource analyzed in the direct impact analysis. In the environmental review document, after the explanation of the direct impacts, the practitioner explains the continued effect the project's actions will have on the resource later in time. If no encroachment impacts are anticipated for any resource area, the practitioner includes a statement to that effect and briefly explains why no impacts are anticipated. For more detailed information on encroachment impacts, refer to NCHRP Report 466.

Examples of potential encroachment alteration impacts to biological resources could include, but are not limited to, habitat fragmentation, degradation of habitat, disruption of natural processes (i.e. hydrology, species competition, etc.), pollution affects on species, and disruption of ecosystem functioning related to direct mortality. Although any encroachment alteration impacts are documented separately for each resource, the practitioner should remember that ecosystem impacts are interrelated and must be considered in terms of interconnections within the ecological organization. Ecosystems are hierarchically arranged; reduction of diversity at one level causes impacts at other levels. The practitioner must understand the interconnections in the ecological system to analyze the chain of events originating with the transportation project. Over time, direct impacts caused at a particular time, within a particular level of ecological organization will have broader effects. For example, the direct impact of a project may be the addition of fill into a creek. Over time, this may lead to the degradation of fish and plant habitat. Or the direct impact is removing a cross street and adding a raised median therefore impeding access to a community pool which over time leads to disuse and closure of the facility.

The analysis of indirect ecosystem impacts also must include the ability of that ecosystem to respond to change. This involves two elements: the ecosystem's resistance and its resilience. Resistance refers to the ability of the ecosystem to resist variation imposed by disturbance. Resilience refers to the ability of the ecosystem to respond after being changed. These two factors determine the carrying capacity of the ecosystem, or the maximum number of individuals of a specific species that can be supported sustainably. It is important to consider the affect of project impacts on the carrying capacity of an ecosystem. The point at which the carrying capacity of the ecosystem and the population are in equilibrium is referred to as the tipping point. Nothing beyond this point, such as larger population or reduced capacity, can be sustained. For example, if the impacts reduced the carrying capacity, it is possible the current population levels could not be sustained.

Potential encroachment on the human environment generally can be attributed to changes in travel patterns and access or direct relocation or alteration of homes, businesses, or public facilities and/or community centers. These direct impacts might lead to indirect impacts on neighborhood cohesion, neighborhood stability, travel patterns, the local economy, access to specific services or products, recreation patterns at public facilities, pedestrian dependency and mobility, perceived quality of the natural environment, personal safety and privacy, and aesthetic and cultural values. Changes in access might include driveway changes, relocation of ramps, introduction of raised medians or alterations of intersections that restrict access to local streets, or addition of a toll. These changes might result in changes in travel patterns throughout an area. For example, introducing a toll or restricting left turn access at certain streets might redistribute traffic onto other streets with easier access.

Potential encroachment impacts can be identified through public involvement. Using public involvement to identify and assess impacts might require early and continuous public and stakeholder involvement. Public involvement that goes beyond the minimum requirement can benefit the overall project by helping the project team identify and resolve issues.

It is also important to consider impacts that occur once a project is planned, but prior to construction. For example, if the knowledge of a proposed project affects real estate investment, property values, or the maintenance of property, these impacts might be a good indicator of the long-term effects of the project. This can occur several different ways. Consider a new location roadway that is proposed in a relatively rural area characterized by large parcels of land, mostly used for ranching activities. After a public meeting with an announcement that the corridor is being considered for the new facility, numerous subdivision plats are filed in the area, and several of the large parcels are bought by developers from the individual land owners. This would indicate that the new access provided by the proposed road has encouraged land use patterns to change. As another example, consider situations in which maintenance has ceased on historic buildings after the owners learned that the property potentially would be purchased for a highway project. This situation can make it difficult to coordinate and resolve historic structures issues.

9.0 Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AOI	Area of Influence
APE	Area of Potential Effects
CE	Categorical Exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulation
CWA	Clean Water Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
ENV	Environmental Affairs Division
ESA	Endangered Species Act
FHWA	Federal Highway Administration
GIS	Geographic Information System
ICI	Indirect and Cumulative Impacts
MPO	Metropolitan Planning Organization
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
TAC	Texas Administrative Code
TIF	Tax Increment Financing
TxDOT	Texas Department of Transportation
USFWS	U.S. Fish and Wildlife Service

Appendix A: Revision History

The following table shows the revision history for this guidance document.

Revision History	
Effective Date Month, Year	**Reason for and Description of Change**
January 2019	Version 3 was released. Revised to indicate that a written indirect impacts analysis should not be prepared for a project that is cleared with a categorical exclusion, and to make the guidance consistent with the Handbook on Preparing an Environmental Assessment in not requiring separate labels for discussions of encroachment-alteration effects within each resource area.
July 2016	Version 2 was released. Added additional general information about various impact types (direct, indirect, and cumulative). References to the Indirect and Cumulative Impacts Handbook have been deleted.
September 2015	Version 1 was released. Replaced Preparing Indirect and Cumulative Impact Analyses (720.04.GUI, effective September 2010). The content was updated to reflect a policy changes. Encroachment alteration impacts are now analyzed and documented concurrently with the direct impact analysis, and the indirect impact analysis is now focused on induced growth impacts.