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7.0 POTENTIAL IMPACTS ANALYSIS

7.1 INTRODUCTION

Chapter 7 evaluates the impacts resulting from the construction and normal operation of the Longhorn Pipeline System (System) as proposed in early 1999 and potential impacts resulting from accidental releases. Many changes in System design and operation (as a result of mitigation measures) are described in Chapter 9. Construction impacts include ground-disturbing activities associated with the new lateral pipelines near El Paso and along the Odessa lateral, future work at pump stations, and upgrading of segments of the pipeline. Operational impacts are associated with the normal transport of gasoline and various other refined products through the pipeline and with planned maintenance. These products will be referred to generically as gasoline in this chapter, because gasoline is expected to be the primary product transported.

For the purpose of the Environmental Assessment (EA), adverse and beneficial impacts of the System are assessed. Environmental baseline data are derived from Chapter 4, along with identification of sensitive receptors. Information on risks of spills, including gasoline and crude oil specifications, is based on information in Chapter 5 and Chapter 6.

Chapter 9 addresses the mitigation of impacts identified in this chapter.

7.1.1 Impacts Classification

The impacts that could result from the operation of the pipeline were evaluated by category: human health and safety, ground water, aquatic biology, terrestrial biology, surface water, air quality, geology, soils, transportation, land use, and noise.

For the impact categories most critical to this EA, particularly those categories specified in the Settlement Agreement (Settlement), there are additional subcategories. For example, ground water impacts to agricultural and livestock use, drinking water supply, and recreational use were evaluated separately. Analyses of sensitive and hypersensitive areas along the pipeline were performed according to the criteria included in Appendix 7A.

7.1.2 Event Types

Five types of events were studied for each impact category and subcategory identified. Four of these are associated with pipeline operation; the fifth is related to construction. Event types are:

- Normal operation;
- Pipeline leak;
- Pipeline rupture;
- Pipeline rupture plus ignition; and
- Construction.

For the purposes of impacts analysis discussion there is no difference in whether a leak or rupture occurs along the pipeline or at a pump station. The impact from a continuous low-volume leak in the pipeline or drips or spills at the pump station would be similar. Likewise, the impact from a pipeline rupture or from a large release due to equipment failure at a pump station would be similar. In all instances, the impacts are dependent on environmental setting and the quantity and nature of the leaks.

7.1.3 Evaluating Impacts

It is not possible to absolutely predict or characterize all possible impacts, particularly those resulting from accidental releases. There are *potential* impacts, such as a possible release of product in certain areas. Final consideration of acceptable levels of risk requires understanding both of the probability and the impact associated with an incident.

Overall determination of whether an impact is significant depends on the probability of impact occurrence, as presented in Chapter 6, and the consequences of an impact occurrence.

Because the primary interest in this chapter is the *consequence* of an impact, it is separated from the *probability* function in the decision-making process. For example, a very major consequence (e.g., a large leak to an important aquifer) might have a low probability, while a minor impact (e.g., volatile emissions from pumping stations) might have a high probability.

7.1.3.1 Gasoline Versus Crude Oil

The potential impacts posed by transporting refined products and crude oil are similar in nature, but are not identical. This is due to the differences in the chemical composition and in the physical nature of refined products and crude oil. Also, refined products and crude oil move differently in ground water depending on the type of aquifer and differences in chemical and physical properties.

Because gasoline will be the primary refined product transported and is more toxic and flammable than the other products, it is used as a surrogate for refined products in this analysis. Gasoline has a higher benzene content than crude oil. For the modeling exercises associated with this EA, a concentration of 0.14 percent benzene was used for crude oil, while 4.9 percent benzene was modeled for gasoline. This difference is important because benzene is the primary toxic constituent in gasoline. Four aromatic hydrocarbons—benzene, toluene, ethylbenzene, and xylene (BTEX)—are found in gasoline at concentrations greater than 1.0 percent by weight. Of these constituents, benzene has the lowest maximum contaminant level (MCL) for public drinking supplies in Texas, at 5 parts per billion (ppb), two orders of magnitude lower than the next lowest constituent (ethylbenzene, at 700 ppb)[1].

The physical characteristics of gasoline versus crude oil and, in particular, the characteristics of benzene and methyl tertiary-butyl ether (MTBE) in gasoline, would greatly affect movement of gasoline relative to crude oil in some environmental media. Gasoline has a lower specific gravity and a lower viscosity than crude oil. The large percentage of heavier weight organic constituents and the high viscosity of crude oil would limit its spreading (PBS&J, 1998). Gasoline, which contains a high percentage of lighter or monoaromatic hydrocarbons, would tend to evaporate in the air and dissolve into water at a higher rate and concentration. A release of gasoline would rapidly spread out due to low viscosity and high solubility. During a release, lateral transport of gasoline components is more common than vertical transport (Davidson, 1998). In addition to contributing to gasoline's viscosity, specific gravity, and solubility, benzene, as well as xylene, can increase the permeability of clay over time. These chemicals can cause clay shrinkage and cracking, thereby increasing the chances of fracturing clay soils in the upper horizons and providing pathways for gasoline to move more rapidly to subsurface aquifers than might otherwise be indicated (Ross, 1998).

[1] The Texas Natural Resource Conservation Commission (TNRCC) has established Standards of Chemical Quality for drinking waters in the state, published in the 30 Texas Administrative Code (TAC) Part I, Chapter 290, Section 290.103.

This process of clay shrinkage and cracking may not be relevant in emergency response scenarios following a large pipeline rupture. Such permeability changes are likely to occur over a long time period (Kreitler, 2000). Thus, this mechanism would increase the risks posed by persistent contamination, such as from a slow leak or from unremediated soils left in place, but is not likely to increase the mass of gasoline from a single large accident which reaches the karst aquifer.

As initially proposed, the pipeline would occasionally be used to transport pure MTBE. This was modified before the draft EA was published to limit MTBE to a maximum of 15 percent. (Note: As part of the mitigation plan, Longhorn has committed not to transport MTBE.) MTBE is a known nuisance factor at very low concentrations in drinking water, giving an unpleasant odor and taste to the water. Taste and odor thresholds for MTBE range from 2.5 ppb to 680 ppb and 2 ppb to 190 ppb, respectively (State of California Health and Environmental Assessment of MTBE). In response to this threshold, the California Department of Health Services has proposed a MCL for MTBE of 5 ppb. The State of Texas has a proposed contamination limit of 15 ppb for MTBE in ground water, and the US Environmental Protection Agency (EPA) recommends "keeping levels of contamination in the range of 20 to 40 micrograms per liter (µg/L) (ppb) or below to protect consumer acceptance of the water resource" (EPA, 1997). Additional information on MTBE is provided in Appendix 7B.

Despite the nuisance threshold, MTBE is not likely to pose a health risk to the public. At 20 ppb in water, the EPA estimates that a safety factor of 40,000 exists for cancer effects and over 100,000 exists for some non-cancer effects. This means that the concentration at which MTBE yields an unpleasant odor or taste is 1/40,000 of the concentration at which health effects could occur. The implication is that people would stop drinking MTBE-contaminated water at concentrations before it reaches a level that would pose serious health effects. Texas Natural Resource Conservation Commission (TNRCC) experts state that drinking water containing 240 ppb of MTBE could be consumed over an individual's lifetime without adverse health effects (TNRCC, 2000). EPA's Blue Ribbon Advisory Panel (EPA, 1999) noted "There have been no human or animal health effect studies performed for MTBE in drinking water. Animal ingestion studies performed using 'bolus' dosing of MTBE in olive oil have shown carcinogenic effects at high levels of exposure (250,000 micrograms per kilogram of animal body weight and higher)." These dose levels are equivalent to the average human ingesting 17 grams of pure MTBE, or drinking 300,000 gallons of water contaminated at a level of 15 ppb.

The presence of MTBE in a contaminant plume can affect the transport characteristics of the plume. MTBE has a very high solubility in water, much higher than benzene, a low affinity for organic carbon, and a low volatilization when dissolved in water. MTBE is also relatively resistant to biodegradation. If a release occurs, MTBE may move quickly and flow more freely to reach ground water or surface water than organic constituents found in gasoline, whose transport may be retarded by preferential sorption onto organic matrices, volatilization, and/or biodegradation (Davidson, 1998; Lahvis, 2000).

In the unlikely event of a release to an aquifer, MTBE would move ahead of benzene and other contaminants in the ground water. It is possible over time that a plume of MTBE-contaminated ground water will even detach from a benzene-contaminated plume, particularly in porous media aquifers. Therefore, it would often be the most downgradient contaminant and the first to reach a drinking water well or a surface water intake (Davidson, 1998). Because of this characteristic, and because of MTBE's offensive taste and odor, it can often serve to warn a potable-well user about subsurface contamination before the arrival of more toxic aromatic hydrocarbons from a blended gasoline spill.

On July 27, 1999, based on the findings of an advisory panel that MTBE causes a foul smell and taste and can pose risks to water supplies, the EPA Administrator called for a significant reduction in the use of MTBE in gasoline as soon as possible (EPA, 1999).

Based on these factors, impacts from specific events were projected differently for gasoline and crude oil, as follows:

- Gasoline may have higher impacts to drinking water, for both ground water and surface water, because of the effects of benzene and MTBE, and because transport characteristics make it more likely to reach a drinking water source in the event of a release.
- Crude oil may have higher impacts to long-term water quality in ground water, because the higher viscosity, sorbability, and specific gravity make a crude oil release more likely than gasoline to sink deeper into the ground water column, to resist natural dilution and transport through flushing, and to be less likely to volatilize. This difference in impact varies by aquifer type.
- Except in those potential cases involving ignition, crude oil may have greater impacts to long-term land use than gasoline. In the absence of an ignition, a large crude oil release would result in more severe long-term impacts to land use because slower movement rates and absence of volume removal effects of volatilization.
- If ignition occurs, gasoline would impact a larger radius and potentially cause more risk of injuries and death and more damage to land use.
- Gasoline is more likely to ignite than crude oil, and because of the rapid heat release and the wider area of spread from a comparable volume released, a

gasoline fire would be expected to result in greater damage than a fire involving crude oil.

Chapter 9 discusses a commitment not to transport MTBE additive in the gasoline.

7.1.3.2 Ignition

Leaks involving an ignition and fires are evaluated separately from other leaks of comparable size. The primary differences in impacts between these two types of leaks are as follows:

- Fires create an immediate threat to human health and safety and to property.
- Fires reduce the volumes of released gasoline or crude oil, and therefore reduce contamination of water resources.
- Fires associated with spills over rivers or streams can cause fish mortality in the area of the fire and downstream, due to changes in water temperature and because surface water fires can consume dissolved oxygen in the water.
- Fires increase air quality impacts temporarily due to release of combustion byproducts.

7.1.3.3 Leaks Versus Ruptures

Intuitively, the impacts from large rapid leaks, such as that which would occur during a pipeline rupture, would be more severe than the impacts from a small, but persistent leak. However, small leaks can occur for a considerable amount of time without detection, possibly releasing contaminants as much as or more than a large leak. The primary difference would be the duration of the event. In the worst case, a small leak would remain below the sensitivity of the leak detection system and would remain undetected until an actual environmental impact was discovered along the pipeline.

Because of this phenomenon and because large instantaneous leaks and smaller persistent leaks have different probabilities associated with them, these types of events were evaluated differently for each sensitive receptor. It is difficult to determine whether a pipeline leak or rupture would result in greater impacts in every instance. A rupture may overwhelm an environmental system’s capacity to retard the progress of gasoline from a rupture; conversely, a rupture is more likely to be detected, responded to quickly, and therefore, the contaminant can be contained, removed, or remediated before reaching more sensitive receptors. Both of these possibilities, neither of which can completely be characterized or predicted ahead of time, could have a large impact on the long-term consequences of an event.

7.1.3.3.1 Pipeline Leaks

A pipeline leak most commonly results from corrosion, failure of equipment, or third-party damages. A pipeline leak has a lower spill rate than a pipeline rupture, but may still result in a large loss of gasoline, if the volume of the leak is below the detection thresholds of the leak detection systems.

The Longhorn pipeline would rely on a variety of leak detection systems (see Appendix 6D). Due to the limitations of these detection technologies, it is possible that a leak of 10 bph could go undetected. This could result in a loss of 2,000 barrels (bbl) (or 80,000 gallons) in a week. This type of leak in a populated area should be detected by other means such as patrols or by local residents, and in particular, the vapors, pooling, or stressed vegetation should be readily observable by patrols. However, because this size leak is considered to be possible based on the limits of the proposed leak detection system, it is used as an upper bound for a representative sub-detection threshold leak.

A leak of this volume could contaminate (1) surface water bodies through runoff or ground water movement, (2) ground water, and (3) a large area of soil.

7.1.3.3.2 Pipeline Ruptures

This hazard involves the unlikely event of a full rupture of the pipeline, resulting in a short-term, high-volume flow of gasoline or other refined products from the pipeline. The most likely cause of a pipeline rupture would be due to third-party damage (e.g., a backhoe or drill operator striking the pipeline), but operational transients or ground movement are also capable of causing pipeline rupture.

A large rupture of the pipeline could result in drainage of much of the contents between the two closest valves. Assuming that the leak detection system effectively shuts down the pumps and initiates valve closure immediately after detecting the rupture, the maximum volume that could spill would be product remaining between the two closed valves and any product flowing until the valves close. In fact, there are ways for pipeline operators to reduce draindown and therefore theoretical draindown volumes rarely occur. A methodology for calculating the maximum release volume during a rupture is provided in Chapter 6.

7.1.4 Alternative Pipeline Routes

7.1.4.1 Austin Re-route

The Austin Re-route Alternative would replace a 12-mile segment in south Austin with a 21-mile segment that loops further to the south through eastern and southern portions of Travis County and northern Hays County. The route departs from the existing Longhorn pipeline southwest of the Austin-Bergstrom International Airport and rejoins the existing pipeline west of Austin. The Austin Re-route Alternative was designed to minimize the population density proximal the pipeline. The Austin Re-route is shown in Figure 3-1.

7.1.4.2 Aquifer Avoidance/Minimization Route

The Aquifer Avoidance/Minimization (AA/M) Route Alternative is shown in Figure 3-1. This route was developed in order to avoid sensitive aquifers identified in the Settlement, including the Edwards, Edwards-Trinity, Carrizo-Wilcox, Gulf Coast, and Colorado River Alluvium. The discussion of aquifers crossed by the Longhorn pipeline in Chapter 4 explains that it is not possible to completely avoid several of these aquifers because they cross the state in wide, sweeping bands that parallel the Gulf of Mexico from northeast to southwest.

The AA/M Route chosen was based on the "Northern Alternative" routing proposed for the All American Pipeline Supplemental Environmental Impact Statement (SEIS) about 14 years ago. This route largely circumvents the Edwards and Edwards-Trinity aquifers in the central portion of Texas. The route would intersect and tie-in to the former Exxon Pipeline Company (EPC) segment of Longhorn pipeline approximately 12 miles southwest of Brenham, Texas. This tie-in would be at Milepost (MP) 93 on the existing Longhorn pipeline. The route then goes northwest for approximately 114 miles to a point approximately 15 miles southwest of Waco, Texas. The route then turns west for approximately 125 miles, then generally west-southwest for 130 miles to the tie-in point near Big Lake. The total route mileage is 370 and ties in to the Galena Park Station-to-Crane, or former EPC Pipeline at MP 406.

This pipeline route would pass through hilly and uneven terrain from MP 0 to the Colorado River at MP 250, which is about 50 miles east of San Angelo, Texas. The construction cost estimates prepared by Longhorn include trenching through rock from approximately MP 115 to MP 300, which is 185 miles, or approximately one-half that of the cost for the entire pipeline. The estimate is based on normal trenching operations for the remaining one-half of the pipeline.

The AA/M Route would replace 313 miles of the existing Longhorn pipeline with 370 miles of new pipeline.

7.1.4.3 El Paso Montana Avenue Alternative

Longhorn's proposed route for the three yet-to-be constructed 8.3-mile-long laterals connecting the El Paso Terminal to the Kinder Morgan and Chevron pipelines and a fourth return line would pass through Fort Bliss. Longhorn has developed an alternative route that would be used if Fort Bliss authorities were not to approve the use of Fort Bliss property for a right-of-way (ROW). This route alternative, the Montana Avenue Alternative, runs west from the El Paso Terminal to the Kinder Morgan and Chevron pipelines along Montana Avenue. Both the Fort Bliss and the Montana Avenue Routes are described in Chapter 3 of this EA and depicted in Figure 3-1.

7.2 HUMAN HEALTH AND SAFETY

7.2.1 Introduction

The "Pipeline Integrity Analysis and Risk Assessment," as stipulated in the Settlement, refers specifically to a methodology common in the pipeline industry for assessing pipeline integrity and for assessing the potential for various accidents to occur.

The following documents were reviewed in developing a methodology to assess the human health risks. The "Guidelines for Ecological Risk Assessment," discusses the appropriate level of scope and complexity of a risk assessment, stating that "Risk managers and risk assessors ... must often be flexible in determining what level of effort is warranted for a risk assessment. The most detailed assessment process is neither applicable nor necessary in every instance. Screening assessments may be the appropriate level of effort."

The DOT's draft "Risk Management Program Standard," states that consequence analysis should consider the amount of hazardous substance that could be released; physical pathways and dispersal mechanisms; the amount of substance that could reach employees, the public, or the environment; and the expected effect of the released substance. It continues, "Consequences of events can be estimated in either qualitative or quantitative terms, or both." This methodology has been followed in this impacts assessment.

Impacts to human health and safety were evaluated. No significant operational impacts will result from the normal operation of this pipeline. Potential human health and safety impacts which may result from a release of gasoline include:

- Fire or explosion;
- Short-term exposure to hazardous vapors resulting from a gasoline spill;
- Long-term exposure to hazardous vapors resulting from contaminated soils, ground water, or surface water; and
- Exposure to toxic constituents of gasoline from ingestion.

If a major release in a populated area occurs, potential impacts include property damage, reduced property values, injuries, or death. Previous use of the pipeline from J1 (Houston) to Crane had a risk of fire during crude oil transportation. Releases from gasoline pipelines are twice as likely to ignite as crude oil pipeline releases, primarily because of the higher vapor pressure of gasoline.

The focus of this section is to identify potential impacts on populated areas and other sensitive receptors along the pipeline that are within a specific distance of the pipeline. Population density is used to define sensitive and hypersensitive areas for potential impacts to human health and safety. Density measurements are not intended to measure the number of people who could be injured in a gasoline or crude oil fire. Rather, where the residential density is currently lower, a fire along the pipeline is less likely to impact an existing residence.

Table 7-1 includes a listing of areas along the pipeline that are sensitive for potential impacts to population, and Table 7-2 includes a sub-listing of areas that are hypersensitive for population.

7.2.2 Impacts

7.2.2.1 Construction

Pipeline construction would result in minimal health and safety impacts to local populations. Impacts due to construction-related air emissions are discussed in Section 7.7.2.1.

7.2.2.2 Normal Operations

Normal pipeline operation would result in minimal impacts to local populations. Impacts due to routine air emissions are discussed in Section 7.7.2.1.

7.2.2.3 Accidental Releases

There exists a potential for impacts to human health and safety in the event of an accidental release of pipeline products. There are two primary hazard scenarios associated with the operation of petroleum products pipelines. These are (1) pipeline leak and (2) pipeline rupture (or large spill). Both scenarios could conceivably result in fire or explosion. Pipeline leaks and ruptures are analyzed separately because they present different hazards.

7.2.2.3.1 Pipeline Leaks

Pipeline leaks are discussed in Section 7.1.3.3. As release of gasoline from the pipeline proceeds, there would be an immediate threat to health and safety once a certain threshold volume of release has occurred. This threshold is the point at which gasoline vapors create hazardous conditions in the area of the pipeline, due to the danger of ignition. It is less likely that these conditions would occur due to a low volume leak going undetected for an extended period of time, than were a major pipeline rupture to occur.

A release could result in danger of ignition near the pipeline, or elsewhere within an urban setting where engineered features such as storm drains could collect and transport the gasoline some distance away from the pipeline. It is unlikely that runoff down a naturally occurring stream bed or stream would cause a gasoline fire distant from a small leak. At lower leak rates, it is probable that a combination of natural processes would limit the distance from the pipeline that a pool of gasoline of sufficient size to present a hazard could occur. These natural processes include dilution into the water column, volatilization of gasoline constituents, and adsorption of gasoline into stream bed soils.

Barring a substantial pooling of gasoline at the surface, a condition readily detected by patrols or local residents, the gasoline vapors resulting from a leak confined below ground should not present acute hazardous conditions. Soil contamination could result in chronic or nuisance conditions due to gasoline vapors if a leak continued undetected for a long period of time, or if the soil was not adequately remediated following a leak. Due to the highly volatile nature of gasoline, any conditions that pose risk to human health would become a nuisance, requiring response, before significant health effects were reached. The Austin Fire Department notes that the odor threshold of gasoline is about 10 percent of the level which poses hazards. The extent of this problem would vary along the pipeline, depending on soil conditions.

For example, most of the populated portions of the pipeline cross areas of clays and silts having low permeability. These soils would first capture gasoline spilled from the pipeline within fractures in the soil. Over time, soils would trap light petroleum fractions within the soil matrix with more soluble components diffusing into the matrix first. Capture of contaminants in the soil matrix would make them generally unavailable for human exposure because as they diffuse into the interior pores of the soil (or into the humic fraction) they would not rapidly reappear at the soil surface. This limits (1) the risks due to direct soil contact, either by ingestion or dermal contact, and (2) the rate of volatilization of contaminants from the soil, and therefore, air emissions. One reference notes that "Air emissions from low permeability soils are generally unlikely to pose an inhalation exposure threat from outdoor or indoor vapors. This is true even when the hydrocarbon source is directly adjacent to a basement, an excavated trench, or the soil surface" (Walden, 1996).

However, in areas of high soil permeability (greater than 10^{-5} cm/sec hydraulic conductivity), such as the sandy loams found over western portions of the pipeline route, soil composition would not pose as high a barrier to human exposure to toxics in gasoline. It is important in areas where people are residing next to contamination resulting from a leak that thorough remediation of soils take place to limit potential health effects.

In general, immediately following an accidental release, gasoline vapors would rapidly dissipate out of high permeability soils and from the fractures in low permeability soils. These vapors are easily identifiable, and contaminant levels that could cause potential chronic conditions should be detected before they occur. See Appendix 7B for health effects related to MTBE and Appendix 7C for health effects of gasoline spills in general. The risk to human health and safety through the contamination of drinking water supplies, either through contamination of ground water or surface water, are discussed in future sections (see EA Sections 7.3.1 and 7.6.3).

The potential for pooling of gasoline, which would lead to greater ambient air concentrations of toxic or hazardous vapors, is highly location-specific. Factors that influence this potential include depth of cover of the pipeline, soil types, vadose zone saturation, presence of localized conduits such as storm drains that could channel gasoline away from the leak, depth to ground water, nature of underlying aquifer, and topography.

In general, the risk to human health and safety from smaller undetected leaks is lower than the risk due to a pipeline rupture. This is because a smaller volume of gasoline would reach the surface before the leak was detected, and natural processes (volatilization, dilution, adsorption) would limit the amount of exposure and hazard.

7.2.2.3.2 Pipeline Ruptures

Pipeline ruptures are discussed in Section 7.1.3.3. The maximum theoretical volume of release from a rupture varies by location along the pipeline. Within the population sensitive areas in and around Houston, this maximum volume is 17,700 bbl to the east of the Satsuma Station, and 28,400 bbl to the west of the terminal. The average Houston area potential spill size is 12,500 bbl, and the median is 12,400 bbl.

In population sensitive portions of Travis and Hays counties, this maximum volume is 6,170 bbl; the average possible spill size is 2,930 bbl, and the median possible spill size is 2,613 bbl.

For the most part, the residential areas along the pipeline occur in areas of relatively flat terrain. Once the pipeline is shut down, gasoline would continue to spill at a gradually decreasing flow rate until it was drained from the ruptured pipeline segment between the valves. Where the pipeline has adequate depth of cover, the release rate would be slower than where the pipeline is exposed.

A pipeline rupture in the Houston or Austin metropolitan areas could result in gasoline flowing into city streets and storm drains and into a number of surface water bodies, including numerous bayous and channels in the Houston area and into tributaries of Onion and Barton creeks in the Austin area.

Because a rupture could result in a large pool of product in the urban environment, fire, or to a lesser extent explosion, is possible. The likelihood of these events is discussed in Chapter 6. The worst-case rupture scenario would include the potential for impacts in densely populated areas of Houston or Austin, with fire occurring either in a pool proximal to the pipeline at the location of the rupture or downstream from the pipeline along a surface water body or in a storm sewer system. While natural processes are expected to limit the potential for fire due to a small leak, the large volumes rapidly exiting the pipeline during a rupture could overwhelm the potential for these processes to limit the transport or hazards of gasoline.

The risk of a gasoline fire results from the volatility of components forming flammable vapor clouds. Once a high concentration of flammable hydrocarbons is achieved, a source of ignition (such as a spark from a vehicle or construction machinery or from an open flame from grills or use of matches or lighters) could cause a fire.

It is difficult to estimate the potential extent of human injury because there are so many factors affecting the size of a fire or explosion, including rate of evaporation, size of the pool of products, and concentrations of vapors. These are influenced by temperature, wind, and topographic conditions. However, it is evident that in an urban area, a gasoline fire could cause property damage, injury, and death.

In the absence of a fire, a large rupture is not likely to cause major long-term direct impacts to human health and safety (indirect impacts, such as health impacts to drinking contaminated water, are discussed in later sections). There may be some short-term impacts due to inhalation of gasoline fumes, but exposure should be limited because during a rupture event the population would evacuate the area. However, a potential for mortality related to inhalation of gasoline fumes still exists, due to the: acute toxicity of benzene vapors; dangers posed by temporary disorientation; or loss of consciousness due to inhalation of high concentrations of vapors.

Long-term exposure to gasoline fumes, post-remediation, would be less than ordinary exposure of gasoline fumes from vehicle fueling.

The volatility of gasoline can also cause the rapid accumulation of acutely toxic constituents, particularly benzene, in the immediate vicinity of a gasoline pool caused by a pipeline rupture. Inhalation of gasoline vapor can cause dizziness and loss of coordination. In the 1999 Olympic Pipeline accident in Bellingham, Washington, one fatality occurred because an individual lost consciousness due to gasoline fumes and drowned. The Austin Fire Department estimates that an area of approximately 1,000 ft by 1,800 ft (41 acres) downwind of a large spill might need to be evacuated. For additional discussion of health effects immediately following a pipeline accident, see Appendix 7C.

The consequences of a fire were modeled at a number of release locations along the pipeline by varying: the type of fire (flash fire versus pool fire); the volume of the release (50 bbl, 500 bbl, 1,500 bbl, and site-specific maximum release volume); the fuel (crude oil or gasoline); and, for pool fires, the heat generation rate (See EA Chapter 6). If a flash fire were to occur in a heavily populated area, the predicted impact distance is 921 ft from the pipeline for a gasoline leak and 407 ft from the pipeline for a crude oil fire. A slower-burning pool fire could impact a larger distance from the pipeline, but would have a reduced chance of resulting in death or injury because of the greater time available to evacuate the zone of impact. Such a pool fire could still cause major property damage in some areas.

Explosions that could cause pressure waves and endanger humans or damage property not immediately adjacent to or in the path of the spill were not evaluated for zone of impact because of the lack of confined spaces that could result in explosion along most of the pipeline. As noted in Chapter 6, no explosions were listed in the DOT database of all hazardous liquid pipeline spills.

7.2.2.4 Gasoline Versus Crude Oil

As described in Section 7.1.3.1, transport of gasoline is expected to increase the health impacts resulting from a pipeline release. Gasoline is more volatile than crude oil. This volatility increases the risks of a spill igniting. In addition, the combination of greater volatility and greater toxics concentration in gasoline makes the hazards posed by inhalation of gasoline vapors higher than the corresponding risk from crude oil.

7.2.3 Zone of Impact

The risks posed from a large rupture, either due to inhalation, fire, or explosion, are proportional to the population density along the pipeline. A higher population density around the pipeline, such as urban residential areas, increases the likelihood of any accident resulting in an injury or fatality. Places with high levels of human activity at certain times of the day, such as day care centers, schools, hospitals, and parks, also increase the likelihood of an accident having human health and safety impacts. These areas along the Longhorn pipeline route are rated as sensitive for potential impacts due to pipeline ruptures.

7.2.3.1 Urban Areas

These risks are greater in those places where multi-family or very high density housing is adjacent to the pipeline. This is because of the higher population density, the difficulty introduced in emergency response and evacuation of these areas, where residents cannot readily escape gasoline vapors or a fire, or where response crews cannot readily move in equipment.

7.2.3.2 Rural Areas

The hazards posed by gasoline releases in rural areas are largely similar to the urban hazards. Some factors, such as evacuation, may pose less risk. The major difference is that in general, rural releases are less likely to result in any fatalities due to the effects of population density.

7.2.4 Sensitive Areas

The following areas were identified as being at risk of major health and safety or public property-related impacts if a spill with an ignition were to occur at that point in the pipeline:

- Areas with 20 or more residences per linear mile within 1,250 ft of the pipeline, including urban and suburban areas in the Houston Metropolitan Area, Aberdeen Trails Subdivision in Bastrop County, and urban and suburban areas in the Austin Metropolitan Area;
- Areas with schools and day care facilities within 1,250 ft of the pipeline, including 22 schools and day care facilities in the Houston Metropolitan Area, and 5 schools and day care facilities in the Austin Metropolitan Area; and
- Areas with health care facilities within 1,250 ft of the pipeline, including Greenway Manor Personal Care, Gulf Bank Medical Center, and Medical Center of East Houston in the Houston Metropolitan Area, and the Brown Schools Rehabilitation Center in south Austin.

Table 7-3 lists and describes these population sensitive areas along the pipeline route.

7.2.5 Alternative Routings

7.2.5.1 Austin Re-route

The Austin Re-route Alternative would replace a 12-mile segment in south Austin with a 21-mile segment that loops further south, through eastern and southern portions of Travis County and northern Hays County as described in Section 7.1.4.1. The primary purpose of this route is to avoid populated areas. However, much of the areas of south Travis County and northern Hays County near and west of the I-35 corridor are currently subject to heavy development pressures.

Approximately 70 dwelling units were identified in early 1999 within 1,250 ft of the Austin Re-route compared to 2,893 on the portion of the existing route that would be bypassed. Despite the additional pipeline length, potential impacts to human health and safety residing near the Austin Re-route are much lower than for the proposed pipeline, based on this difference in population density. Local officials have indicated that no new schools, parks, or other public facilities are planned along the Austin Re-route at this time. Therefore, none of the Re-route would be expected to be population sensitive for the near term.

7.2.5.2 Aquifer Avoidance/Minimization Route

Since a formal alignment for the AA/M Route has not been platted or surveyed, it is presumed that a route minimizing impacts to population would be selected. Some unavoidable population density may be encountered when crossing the I-35 corridor between the cities of Temple and Waco. Overall, the AA/M Route is likely to have less affected population residing adjacent to the pipeline than does the current pipeline alignment. Both routes have the densely populated Houston area in common, but the AA/M Route would avoid the populated areas of south Austin and Travis County.

7.2.5.3 El Paso Montana Avenue Alternative

Because the Montana Avenue Route Alternative lies along an area that is partially developed and is likely to develop more as El Paso expands to the east, it is subject to greater potential for third-party damage to the pipelines. Moreover, the City of El Paso water and wastewater pipelines lie along Montana Avenue. Work on these pipelines in the future pose the risk of third-party damage to the pipeline laterals. The proposed Fort Bliss Route would be on undeveloped federal property that is inaccessible to development and therefore poses minimal third-party risks.

Furthermore, should an accident occur on the three laterals and the return line, there would be more persons at risk along the Montana Avenue Alternative. An estimated 3,755 persons live within 1,250 ft of the Montana Avenue Alternative as compared to 232 persons within 1,250 ft of the Fort Bliss Route. The residents within 1,250 ft of the Montana Avenue Route Alternative are in 12 subdivisions, apartment complexes, and mobile home parks. The residents within 1,250 ft of the Fort Bliss Route are in the Butterfield Square Colonia.

In addition to the residences, the Montana Avenue Alternative would pass within 1,250 ft of other sensitive receptors including two churches, a new Ysleta Independent School District elementary school, and several businesses. No such vulnerable receptors were identified along the Fort Bliss Route.

7.2.6 Mitigation Measures

In order to reduce the potential for impacts to human populations, mitigation measures that address pipeline safety are necessary. Such measures could include:

- Mitigation measures designed to reduce the overall risk of pipeline failure through testing and, if necessary, repair or replacement of pipe and components in specific areas;
- Mitigation measures designed to locate potential problems during the service life of the pipeline, such as ongoing testing programs and enhanced leak detection capabilities;
- Mitigation measures directed towards prevention of third-party damages in highly populated areas; and
- Mitigation measures aimed at reducing the impacts to health and safety such as improved emergency response procedures if an accident does occur.

7.3 IMPACTS TO GROUND WATER

7.3.1 Introduction

Ground water is an important water supply resource for several municipal areas near the Longhorn pipeline route as well as for many landowners who rely on private drinking water wells. Ground water is also valued as a source of irrigation water, and for watering livestock on many farms and ranches traversed by the pipeline.

Ground water also serves important environmental purposes. Ground water wells and alluvial aquifers replenish and maintain flow levels in many of Texas' rivers and streams. Karst formations in much of the central Texas hill country have numerous caves and fissures that readily conduct ground water. The ability of these formations to harbor vulnerable biological species is tied to the quality of the ground water they transport. Some of these caves and springs are also considered recreational resources.

Table 4-10 provides a list of aquifers crossed by the Longhorn pipeline, identifying segments of the pipeline where aquifer characteristics or proximity to drinking water supplies are of greater concern. Tables 7-1 and 7-2 list aquifer features classified as sensitive and hypersensitive for drinking water quality based on the identifications made in Table 4-12, as well as areas where ground water quality can impact vulnerable species populations. These areas are described in more detail in Sections 7.4 and 7.5. Also listed are areas where ground water can affect surface water quality and areas where ground water can impact recreational facilities. These areas are described in more detail in Section 7.6.4 and elsewhere in this section.

7.3.2 Potential Impacts

7.3.2.1 Construction

Construction of future pump stations, or excavation associated with pipeline repair or replacement activities, could result in runoff containing silt or debris entering or plugging recharge features in karst areas. Future work along the pipeline must follow a stormwater pollution prevention plan to avoid these impacts.

7.3.2.2 Normal Operations

During normal operations of the pipeline, no impacts to ground water are anticipated.

7.3.2.3 Accidental Releases

During operation of the pipeline, the possibility exists that the pipeline could rupture or be damaged by third-party activities, or a pipeline component could leak and release gasoline into the environment. Chapter 6 discusses the probabilities of accidents occurring along the Longhorn pipeline before mitigation, and Chapter 9 presents the probability of accidents after mitigation.

7.3.2.3.1 Pipeline Leaks

As discussed in Section 7.1.3.3, leaks below a certain threshold rate could occur and fail to activate leak detection systems. Undetected for a long period of time, such leaks could cause substantial damages to ground water quality in an aquifer. Frequent patrolling of the pipeline is intended to prevent these leaks by identifying vapors, pools, distressed vegetation, or other signs of gasoline contamination.

There are two scenarios where patrols may fail to identify the presence of a leak that is undetectable by monitoring systems. The first is a leak that occurs immediately beneath a river or stream crossing, whereby gasoline could leak into an alluvial aquifer and continuously seep into the surface water. This would result in a low volume of gasoline continuously mixing into the surface water, potentially at a concentration that would prevent easy detection. The second is a leak that occurs immediately next to or above a karst feature, whereby the gasoline could proceed directly downward into a karst aquifer with minimal contamination of surface soils above the pipeline. This latter condition could result in a continuous increase in the level of gasoline contamination within the aquifer. These consequences are discussed with respect to environmental conditions in Section 7.3.3.

7.3.2.3.2 Pipeline Ruptures

Pipeline ruptures can rapidly release a large volume of gasoline over an aquifer, and therefore pose a different type of risk. The larger volumes can spread over a wider area or travel farther down streambeds or creeks. Depending on local and environmental conditions, this could either increase or decrease the possibility of gasoline from a specific spill size reaching an aquifer. For example, if the gasoline spill cannot easily move upward (e.g., due to a pipe rupture from overpressurization or some other pipeline failure), the rapid release of gasoline may saturate the soil in excess of the soil residual concentration and penetrate downward into the ground water before remediation excavates and removes contaminated soils. If the gasoline from a rupture flows to the surface, as occurs from most third-party damage scenarios, the gasoline may flow overland towards a depression or recharge feature where reduced soil thickness leaves the aquifer more vulnerable.

Conversely, in the case of rupture where gasoline flows to the surface, the overland flow of gasoline may instead reduce the potential for gasoline contamination of an aquifer by increasing the surface area of the gasoline, and therefore the rate of volatilization. Overland flow could also reduce the potential for aquifer contamination by increasing the amount of soil available to absorb the gasoline, by causing the gasoline to flow towards a surface water body where it will dissolve into the water column; or by creating a potential for a pool fire that reduces the amount of gasoline that could permeate downward into the aquifer. These consequences are discussed with respect to environmental conditions in Section 7.3.3.

7.3.2.4 Gasoline Versus Crude Oil

With respect to contamination of ground water resources, gasoline is considered to have higher impacts to drinking water supply than crude oil for the following reasons:

- Gasoline has a higher BTEX content than crude oil.
- Very low concentrations of MTBE can render a drinking water supply nonpotable.
- The low viscosity of gasoline allows it to travel faster and farther in most aquifers.
- The lighter hydrocarbon fractions in gasoline tend to spread more readily at the water surface.

Gasoline was studied as the product of concern with respect to ground water contamination over diesel or jet fuel for the following reasons:

- Gasoline would be the primary product shipped in the Longhorn pipeline.
- Gasoline grades may contain between 11 and 15 percent MTBE in order to satisfy reformulated gasoline requirements. MTBE is not added to other petroleum products; as discussed in Appendix 7B. MTBE is a leading constituent of concern with regards to ground water contamination.
- Some gasoline grades transported in the Longhorn pipeline may contain up to 4.9 percent benzene according to Longhorn's product specifications; other products generally contain far less benzene (less than 0.1 percent in diesel, 0.02 percent in jet fuel, according to Heath et al., 1993).
- Gasoline is the lightest, most mobile, and most flammable compound to be carried by the pipeline, and it contains the highest fraction of water-soluble compounds.
- Diesel and jet fuel hydrocarbons are heavier (higher molecular weight) hydrocarbons; most are almost insoluble in water, which minimizes the concentrations that can leach into the water.

The toxicity and possible exposure routes for the different constituents of interest are discussed briefly in Appendix 7C. The rationale for their prioritization is also discussed in this appendix.

Because of their lower mobility, volatility, and solubility, diesel or jet fuel would take longer to dilute and flush from the subsurface. This lengthens the time for natural attenuation of these products compared to gasoline. While they attenuate, they serve as a source of contaminant for a longer time than gasoline. However, these properties also make it more likely that an identified and accessible spill can be recovered. Diesel and jet fuel would release contaminants to ground water at a lower rate and lower concentration than gasoline. A diesel or jet fuel spill would tend to contaminate a smaller area than a gasoline spill of the same size. The soil contamination with free-phase product would be less extensive, as would the plume of dissolved organics, especially if one takes into account the dissolved MTBE plume potentially associated with gasoline.

The long-term impacts of crude oil would likely be higher than for gasoline, because of its high viscosity and surface tension when compared to gasoline, and because of crude oil's lower solubility combined with higher density and lower volatility. This is particularly evident in non-karst formations because gasoline will move rapidly through the aquifer and dissolve more readily from an alluvial aquifer into the associated river or stream.

Within a karst aquifer, crude oil would move at a slower rate through the formation, and the surface tension of crude oil would cause it to adhere to conduit walls during low flow conditions, rather than spreading across and dissolving into the water column. Turbulence in the water passing through conduits would also have an impact on entrainment of gasoline or crude oil into the water phase.

7.3.3 Zone of Impact

The aquifers along the pipeline are described in detail in Chapter 4, with respect to characteristics that determine susceptibility to contamination from a release of gasoline or crude oil from the pipeline. These hydrogeological characteristics include: (1) depth to water; (2) aquifer media; (3) soil development; (4) transmissivity; (5) whether confined or unconfined; and (6) net recharge.

These characteristics are summarized for specific pipeline segments of the pipeline with respect to drinking water supply in Chapter 4. Pipeline segments are defined as places where aquifer changes occur. For example, a change in hydrogeological sensitivity occurs near MP 60, where the pipeline passes from the Gulf Coast Aquifer System to the Brazos River Alluvium.

The distance from the pipeline to a public water supply (PWS) well is a critical parameter in the determination of the potential for impacts. In addition, the potential for a release to reach a specific well in any individual aquifer is related to the rate of ground water transport that can be realized within the aquifer.

The nature and rate of transport can also influence the ability to control the spread of gasoline once it has reached the aquifer and the rate at which the gasoline contaminants may be expelled from the aquifer through seepage or springflow.

The level of available data and of understanding regarding contaminant transport velocity, and therefore a "zone of potential impact," varies. There are areas where the fate of contaminants reaching the ground water is either:

- Well-defined through study (the Edwards Aquifer-Balcones Fault Zone [BFZ]);
- Difficult or impossible to exactly predict in the absence of specific dye tracer studies (Edwards-Trinity and other karst aquifers);
- Predictable based on gradients within the aquifer and associated surface waters (alluvial aquifers); or

- Reasonably characterized using traditional ground water transport models (other porous media).

7.3.3.1 Karst Aquifers (including Edwards, and Edwards-Trinity)

Two major karst aquifers are crossed by Longhorn pipeline – the Edwards Aquifer (MP 164.9 to MP 173.5), and the Edwards-Trinity Aquifer (intermittent, from MP 206.0 to MP 446.8). In addition, minor aquifers with karst features include the Ellenburger-San Saba Aquifer.

7.3.3.1.1 Edwards Aquifer – Balcones Fault Zone

More is known about the movement of ground water in the karst of the Balcones Fault Zone (BFZ) of the Edwards Aquifer than in the Edwards-Trinity Aquifers, because of substantial dye testing conducted by the City of Austin and the Barton Springs/Edwards Aquifer Conservation District (BS/EACD). The Edwards Aquifer in the area of the Balcones Fault Zone is known to have large gradients, causing high transport velocities. The Balcones Fault Zone also has large flow systems.

Longhorn conducted an intensive geotechnical investigation of the pipeline crossing of the Edwards Aquifer-BFZ (LBG-Guyton, 1998). The data generated by this investigation do not provide a useful tool for a more refined delineation of sensitivity across the zone, particularly with respect to the bands of hypersensitive Leached and Collapsed Member and Kirshberg Evaporate Member units of the zone. First, the investigative technique's ability to locate fractures or voids may be limited, leaving open the possibility of existing narrow, barely detectable fractures that still provide ample conduit for contaminants to travel rapidly to the ground water table in the event of a release. Second, even in the absence of a localized recharge feature, the pooling or overland flow from a major release along this segment, could, nonetheless, reach a recharge feature and result in contaminant entering the aquifer.

In a karst environment, aquifer flowpaths may be identified on a regional scale as in any aquifer utilizing potentiometric surface mapping. On smaller scales, the task of determining flowpaths becomes increasingly difficult. Tracer flowpath studies are the best tool for identifying specific ground water flowpaths in a karst aquifer. The data supplied by BS/EACD developed a generalized picture of the flowpaths that are present in the Barton Springs segment of the Edwards Aquifer. These studies attest to the extreme sensitivity of the ground water system to contamination.

The most recent results of the test may be summarized as follows:

1. Recent Studies

Dye testing has been performed at locations along Bear and Little Bear creeks in the westernmost portions of the recharge zone. Testing was performed more recently, when semi-drought conditions prevailed. As would be expected under these conditions, lower conductivities were measured. Dye injected at some locations proceeded to Barton Springs in time frames of seven to 21 days; while other locations were found where no discharges of dye to springs were noted within a three-month time period under semi-drought conditions. More water was added at specific locations to enhance flushing of the dye. Dye was detected in some water wells as a result of this testing.

2. September 28, 1999 Press Release Data

This report included data from dye tracing at two locations in the Slaughter Creek watershed. Both of these sites are relatively close to the current Longhorn pipeline, compared to previous study sites further north in the Williamson and Barton Creek watersheds. Tracer that was poured into Whirlpool Cave in the Slaughter Creek Metro Park on the western side of the recharge zone required 7 to 8 days to arrive at the springs over eight miles away on Barton Creek. Tracer injected into the Brodie Sink, a sinkhole near Slaughter and Brodie lanes, required 1 to 2 days to flow 7.4 miles to the springs.

3. Oak Hill Water Supply Wells

No tracer was detected in Oak Hill drinking water wells as a result of either Slaughter Creek Watershed injection point over a three-month period. This contrasts with the results of past dye tracer studies further north in the BFZ, suggesting that ground water from the area near the pipeline moves in different pathways than ground water which recharges farther to the south.

Based on the results of dye testing within the BFZ, or recharge zone, the entire length of the pipeline across the zone is considered to have the potential to impact wells between the pipeline and the Colorado River as well as Barton Springs and Cold Springs. The flow direction in this area is well mapped out, and it is unlikely that gasoline from a Longhorn pipeline gasoline release would impact ground water or wells south of the pipeline, except for small localized variations. However, the zone of impact for this segment of pipeline is considered to extend to one-half mile south of the pipeline to account for these potential localized flows.

Data from these studies demonstrated not only the travel time, but also helped to establish the distribution of flow from these recharge features to the different springs in Barton Creek. Preliminary results indicate that Upper Barton Springs and Barton Springs are not impacted by dye traces injected into the Brodie Sink, while Eliza Springs and Old Mill Springs, which are downstream of the dam at Barton Springs Pool, are impacted. Tracer dye from Whirlpool Cave appeared in each of the springs.

Another area of concern for the Edwards Aquifer (BFZ) is the contributing zone upstream of the recharge zone. It is possible for contaminants from a pipeline release entering Slaughter Creek, Barton Creek, or their tributaries to be transported to karst recharge features within the creek streambeds. These features provide an additional pathway for contaminants to enter the aquifer. Because of the natural attenuation of gasoline through adsorption into the streambed and by volatilization of contaminants while traveling downstream in surface waters, a release in the eastern portion of the contributing zone poses a higher risk than a release into the western reaches of the zone.

Since releases at points in the contributing zone can have impacts to the Edwards Aquifer, and thus to drinking water wells and to recreational springs in the aquifer, overland flow pathways were modeled to determine which points along the pipeline have the highest potential for contamination to Barton Creek and associated tributaries in the event of a spill at a location other than the crossing. These points, which reach the crossing via overland flow, are also used to identify pipeline sensitivity.

7.3.3.1.2 Edwards-Trinity and Other Karst Aquifers

In the absence of delineated wellhead protection areas, a band 25 miles to either side of the pipeline (50-miles wide) is selected as a potential zone of impact over karst aquifers. There are no data available to suggest that in the Edwards-Trinity Aquifer, fracture or conduit flow of contaminants would occur over distances greater than 25 miles. Modeling of the Edwards-Trinity was not attempted because "ground water models to delineate the likely flowpaths, time of travel, dilution, and dispersion of contaminants are typically of little value in assessing karst aquifers except for gross, regional generalizations" (Veni, 1999).

In general, the Edwards-Trinity Aquifer is characterized by smaller, localized flow systems. The rocks dip very gently to the south and southeast; fractures appear to be related to regional uplift rather than to local faulting and folding. Many of the caves, though extensive, are confined to small vertical intervals, either by lithology of the confining beds or by still-standing nearby rivers. About 200 miles of the pipeline route, between Gillespie and Upton counties cross the subregion of the Edwards Plateau called the Central Edwards Plateau. Veni also notes that for the Central Edwards Plateau "North of the Devils River Trend, cavernous rocks become progressively thinner to the north…in the northern part the total soluble limestone is thin and limits vertical development. Stream incision into the soluble carbonates is much younger in most of this area, and fewer well-integrated caves have formed" (Veni, 1994).

Longer cave formations and correspondingly longer conduits for ground water flow are more likely to be found in the Llano Region of the Edwards Plateau. The southern end of the Llano Region is skirted by the pipeline in Blanco, Gillespie, and Mason counties. This region has abundant normal faulting, and jointing is pervasive.

7.3.3.1.3 Contaminants in Karst Aquifers

Upon reaching the ground water table in an unconfined aquifer, petroleum hydrocarbons would spread out on top of the water surface, travel in the direction of water flow, eventually emerging at springs, and causing particular concern for those wells which withdraw from the top of the water column (Rose, 1986). Gasoline, including toxic constituents such as benzene, would also dissolve into the water column.

In the absence of site-specific testing, it is impossible to rule out the possibility of a concentrated plume of contaminants entering a karst aquifer traveling distances up to or farther than five miles in a time that would preclude remediation. Mace (1997) states that based on limited data, there are estimates that benzene plume lengths could exceed 7,600 ft (1.5 miles) in the Edwards Aquifer. To be conservative regarding this uncertainty, a distance of 25 miles was used as a criterion for determining sensitive areas where PWS may be contaminated by spill from the pipeline over karst aquifers.

The prediction of long-term impacts in karst aquifers is a complicated phenomenon. Because of the existence of localized recharge features, there is the potential for rapid movement of contaminants from a release close to the surface of the ground water table. However, since only a portion of a large leak or spill may find this recharge feature, some volume of a large release may simply leach into the topsoil and percolate into the aquifer at a slower velocity, dependent on rainfall events. Contaminants may still enter the ground water table long after the original introduction of contaminants and result in long-term water quality problems due to the nature of the input to the hydrologic system. Thus, rapid response to a release over a karst aquifer is very important in order to limit the amount of gasoline that may reach a recharge feature, while thorough follow-up to remove or treat contaminated soils is critical to prevent recurring damage.

Another phenomenon that could cause long-term water problems due to contamination of karst formations is the "bathtub ring" effect (Veni, 1998), whereby contaminants in ground water may attach to the walls of caves or be trapped in pores or on ledges during high flow conditions and remain when the water level decreases. When another high flow condition raises the water level, contaminants from the earlier release of crude oil or gasoline can re-enter the ground water and cause a degradation in water quality. Because of this effect, it is possible for a well or spring to no longer appear contaminated, then begin discharging contaminated water following a major rainfall event.

Thus, karst terrain is very sensitive to long-term impacts to ground water quality from any hydrocarbon contamination from pipeline leaks and ruptures. As noted earlier, a leak over a karst aquifer may complicate detection because gasoline passing from the pipeline through the thin soil layer to the aquifer, then reaching the karst, may rapidly transport downward through karst pathways. Once it reaches the aquifer the gasoline may rapidly transport away from the spill location, spreading via ground water flow. This could reduce the ability of a leak to be detected at the surface by limiting the normal observable signs of a leak. Nevertheless, the thin soil layers covering most of the Edwards and Edwards-Trinity aquifers should, in most cases, readily expose any leaks.

If a low volume of contamination in a karst aquifer proceeds through this mechanism, gasoline will travel along the surface of the water table, particularly if ground water velocities in the region are high enough to prevent high concentrations from building up at the water surface. In this case, contaminants would discharge through seeps and springs, as would be expected under normal conditions in BFZ. Lower ground water velocities, including those caused by temporary low flow conditions due to drought, would increase the concentrations of contaminants at the surface of the water table where the gasoline enters the aquifer and would provide a greater gradient for dissolving contaminants into the ground water.

With respect to long-term consequences to a karst aquifer, a rupture at or near a recharge feature probably poses the worst-case scenario. A larger volume of gasoline entering the aquifer in a short period of time is more likely to result in a concentration gradient that could cause deeper penetration of benzene, toluene, ethyl benzene, and xylene (BTEX) and MTBE into the aquifer, slowing the rate of eventual flushing from the aquifer through seeps and springs. Under this scenario, contamination is likely to remain in the aquifer for a considerable period of time and be resistant to treatment or removal by mechanical means.

Various authors have estimated the volume of release from a pipeline, or other hydrocarbon spill that would likely result in contamination of the Edwards or Edwards-Trinity aquifers. Rose (1986) estimated that "any oil spill of 1,000 bbl or larger probably has a reasonable possibility of reaching the water table in either unconfined Edwards Aquifer. Spills of 5,000 bbl or more can probably be expected to contaminate Edwards ground water to some degree." Ross (2000), focusing on the Edwards Aquifer-BFZ, estimated that "potential petroleum product soil retention capacity indicates that from 350 to 1,600 bbl could be retained within the soil over the Edwards recharge zone."

It is difficult to estimate the probability of a leak or rupture located close enough to a recharge feature where contamination of the karst aquifer would result before remediation and volatilization could contain and remove most of the gasoline constituents. For the Balcones Fault Zone, this probability has been estimated at 75 percent; this is conservative, given the ground penetrating radar surveys conducted by LBG-Guyton, and follow-up drilling work indicated that none of the anomalies identified by the radar have apparent large caves or interconnected karst features (Kreitler, 1999). This 75 percent estimate is intended to reflect the potential for surface migration to features such as the Pipeline Sink on the Blowing Hole Sink tract, which is located 800 ft from the Longhorn pipeline (Ross, 2000). This probability may be reduced by mitigation measures to contain spills.

For the Edwards-Trinity Aquifer, which is generally less sensitive than the BFZ (although some segments of the Edwards-Trinity will be as sensitive as the BFZ), it is estimated that any spill of 500 bbl or greater has a 50 percent probability of occurring at a place where it is more likely to impact ground water supplies. It has been estimated that approximately 5 percent of the mean annual rainfall on the Edwards-Trinity Aquifer serves to recharge the aquifer, while "the remaining rainfall runs off, evaporates, or transpires" (Allen, 1997). Allen also indicates that focused recharge of rainwater is more likely to infiltrate the surface and reach the aquifer recharge at the topographic divides between subwatersheds. Since much of the pipeline does run along these topographic divides, a 5 percent probability may be low. To be conservative, a probability of 50 percent was selected.

7.3.3.2 Porous Media Aquifers

7.3.3.2.1 Alluvial Aquifers

Alluvial aquifers crossed by the Longhorn pipeline include the Brazos River Alluvium, the Colorado River Alluvium, and the Cenezoic Pecos Alluvium as well as some smaller systems such as alluvium along Sandy Creek within the Edwards-Trinity aquifer region. These aquifers consist of a fine-grained topstratum and coarse-grained substratum; the substratum may contain discontinuous silt and clay beds. The thickness of the topstratum and substratum varies. Rivers vary between partially and fully penetrating the thickness of the alluvium. Ground water in alluvial aquifers is unconfined.

Because of the proximity of public water supply wells that may be impacted by a spill that contaminates the alluvium, the Colorado River Alluvium was evaluated in the area of Bastrop (see Appendix 7D). Wells in the alluvium are typically 30 to 60 ft in total depth and can produce large quantities of good quality ground water.

Ground water flow in the alluvium is generally toward the river, except when underflow conditions prevail, then ground water flows in a direction parallel to the flow of the river. Near Bastrop, ground water and spring flow generally contribute to the flow of the river, which is greatest during the winter and least during the summer.

An average hydraulic conductivity for the Colorado River near Austin was calculated at 202 ft per day, while near the Bastrop well field, hydraulic conductivities ranged from 105 to 174 ft per day. From pumping tests and modeling (Hibbs, 1991), the average ground water velocity in the Colorado River Alluvial Aquifer was estimated at 1,588 to 3,033 ft per year. Given the average ground water velocity, a band up to 2.5 miles to either side of the Longhorn pipeline is selected as a potential zone of impact. In addition, since contamination of surface waters provides a seasonal pathway for contaminants to enter an alluvial aquifer, alluvium within 40 miles downstream of a pipeline crossing is also considered to have the potential for contamination from a release.

This latter assumption is very conservative. For example, modeling conducted by Hibbs and Sharp (Hibbs, 1993) determined that for a pumping well 620 ft from the center of the river, with a constant contaminant level in the Colorado River, the contaminant would be first detected in the well after 98 days. After 192 days, 40 percent of the well water would have originated from the river. Impacts to a well 620 ft from the river (as measured by exceedance of the 5 ppb benzene standard) would require continuous benzene concentrations of about 12 ppb in the

Colorado River, which would be significant for water quality impacts over that long period of time. Because of operational and design standards, this continuous a level of contamination is not expected.

7.3.3.2.2 Other Porous Media Aquifers

For non-karst, non-alluvial aquifers along the pipeline route, a distance of 2.5 miles is considered a conservative (i.e., tends to overstate effects) zone of impact. Flow of ground water in these aquifers is generally slow. For example, modeling studies performed for the Carrizo-Wilcox Aquifer estimated velocities of 37 to 2,190 ft per year for ground water flow (see Appendix 7D).

Additional factors such as depth of the soil layer above the ground water table, presence of confining strata, and local evapo-transpiration rates must also be considered. For example, approximately 30 ft of soil overlay the water table in the Carrizo-Wilcox Aquifer, limiting the transport of gasoline contaminants through the soil. The recharge for the Hueco Bolson occurs to the west of the pipeline terminus in El Paso. The portion of this aquifer underlying the pipeline is protected by a thick layer of soil, the localized environmental conditions make it unlikely that volatile gasoline constituents would transport downward, or that rain would increase mobility of the gasoline to an extent that there would be an impact on the aquifer. The confining layers of artesian porous media aquifers makes it more difficult for hydrocarbons to enter the aquifer because these aquifers are often under pressure due to the confining layer. However, this does not absolutely preclude soluble constituents from being introduced to confined aquifers (Rose, 1986).

7.3.3.2.3 Contaminants in Porous Media Aquifers

In segments of the pipeline overlying porous media aquifers, rapid detection and response to a leak or rupture would allow the long-term impacts to the aquifer water quality to be minimized. Surface observation should reveal any leaks continuing for days, as gasoline contamination would rapidly distress vegetation and give off volatile odors, and proper pipeline corrective action can be taken to prevent any additional volume from being leaked. If a rupture occurs at a point where overland spread occurs, much of the gasoline would be captured by retention capacity of the soil. For example, a 5,000-bbl spill spreading over 40,000 square feet, where the soil cover over the aquifer is 15 feet thick, may contaminate approximately 20 million kilograms of soil.

An American Petroleum Institute (API) bulletin (Brost, 2000) reports a range of 3,400 to 80,000 mg/kg for the residual concentration of gasoline in soil. Using this range, between 68,000 kg (600 bbls) and 1.6 million kg (14,000 bbls) of gasoline could be retained in this volume of soil. Remediation of these soils, particularly prior to rainfall or flooding, which could dissolve soil contaminants, is an important first step towards limiting the amount of gasoline that reaches the aquifer.

Once contaminants reach the aquifer, rapid initiation of ground water pumping can reverse gradients in localized portions of a porous media aquifer and draw contaminated ground water to the wellhead where the water can be withdrawn and treated to remove contaminants. Mace has completed studies of benzene (1997) and MTBE (1998) plume lengths resulting from leaking underground storage tanks in various aquifers in Texas. In non-karst aquifers, Mace concludes that most benzene plumes will be less than 250-ft long and impact an area of less that 100,000 square ft. Plume length is limited by natural attenuation processes including volatilization, sorption, and biodegradation as well as by remedial activities. He also concludes that there is no statistical difference in benzene plume length between plumes in different hydrogeologic settings throughout Texas, with the exception of karst aquifers. MTBE plumes are defined by a concentration of at least 10 ppb, have a median length of 174 ft, with the 90 percent having a length of 386 ft, and the 99 percent having a length of 750 ft (Mace, 1998). MTBE plumes are, on average, longer than benzene plumes because of the ineffectiveness of biological processes for limiting MTBE spread, although data suggests that some biodegradation of MTBE may take place.

7.3.4 Sensitive Areas

7.3.4.1 Drinking Water

The pipeline crosses at least 12 aquifers between Houston and El Paso, representing a distance of about 540 miles of pipeline. At least eight of those aquifers have at least moderately high hydrogeologic vulnerabilities (representing a distance of about 365 miles of pipeline).

Hydrogeologic vulnerability of the individual aquifers and proximity of public water supply receptors in the vicinity of the System are evaluated separately in Chapter 4 and then combined to form a single vulnerability score. The vulnerability score was then used for identifying points along the pipeline that may be considered sensitive or hypersensitive for potential impacts to ground water drinking water quality. The Chapter 4 evaluation focuses on PWS wells—including municipally-owned systems, municipal utility districts, and water supply companies. Numerous domestic, irrigation, and stock wells are adjacent to the pipeline throughout the length of the pipeline. Only a fraction of these wells are identifiable through Texas Natural Resource Information System databases. These data were reviewed in preparing the EA and support the conclusion that along much of the pipeline, the potential exists for a release to result in gasoline contamination of one or more private wells. The presence of these private use water wells was not applied as a criterion for determining areas of higher sensitivity, which would require location-specific mitigation measures. Rather, the potential impact to private wells is a criterion for requiring additional mitigation measures for the entire pipeline, and for requiring mitigation directed at addressing the needs of well owners if contamination occurs. These mitigation measures are discussed further in Section 7.3.5 and in Chapter 9.

Maximum impacts to drinking water quality might occur where the (1) geological sensitivity of the aquifer, (2) aquifer transport characteristics, and (3) proximity of PWS wells indicate it is possible for contaminants from a leak to travel the distance from the leak to the wellfield and cause drinking water MCLs to be exceeded.

The Edwards Aquifer-BFZ, from MP 170.5 to MP 173.5, is considered hypersensitive for potential drinking water contamination because of the high potential for impacts to drinking water wells in Sunset Valley and surrounding areas that are not currently served by either the city of Austin or Lower Colorado River Authority (LCRA) drinking water systems. The contributing zone for the Edwards recharge zone is considered to be sensitive for potential ground water potability impacts, because of the potential for runoff to draindown Barton Creek or Long Branch to the Edwards recharge zone.

Between MP 341 and MP 346, the pipeline is potentially upgradient from public drinking water wells that supply the city of Eldorado, less than 2.5 miles north of the pipeline. Karst features identified in the vicinity of the pipeline could provide a conduit to contamination of this portion of the Edwards-Trinity Aquifer that supplies the city. Releases from the pipeline are unlikely to contaminate the Eldorado PWS wells because of the regional potentiometric contours and the location of the pipeline with respect to the wells. These factors suggest that in a macroscopic sense, ground water in the region flows away from Eldorado wells. However, in a microscopic sense, there is still the potential for localized conduit flow or aboveground transport to recharge features that could impact the Eldorado wells; therefore, the area is rated hypersensitive.

One alluvial band along the pipeline, a large portion of the pipeline crossing the Carrizo-Wilcox Aquifer in Bastrop County, and two additional locations over the Edwards-Trinity

Aquifer are rated as sensitive for drinking water. In the draft EA, not all of these areas were listed as sensitive.

- The segment of the pipeline (MP 163.48 to MP 164.91) that crosses the Onion Creek watershed in eastern Travis County, because public water supply wells for the city of Bastrop may draw from the Colorado River Alluvium downstream of Onion Creek's confluence with the Colorado; and
- Portions of the Carrizo-Wilcox and Colorado Alluvial aquifers in a band extending between MP 125.6 to MP 150.7 and from MP 157.4 to MP 157.7, due to the presence of public water supply wells including Aqua Water Corporation and the city of Bastrop.

Two additional stretches rated as sensitive for contamination of public water supplies are:

- The segment of the pipeline (MP 356 to MP 361) that crosses the Edwards-Trinity Aquifer within 2.5 miles of an identified PWS, but not in the area of identified karst formations; and
- A stretch (MP 423 to MP 428) proximal to Upton County Water District wells within 2.5 miles of the pipeline.

7.3.4.2 Agricultural Uses

Evaluation of impacts to agricultural uses of ground water focused on potential impacts to irrigation wells. Irrigation wells and stock tanks were identified along the pipeline using the same distance criteria described above for domestic drinking water wells.

MTBE should not impact to a great extent the use of ground water for irrigation purposes. However, it is not known whether the higher BTEX concentration of gasoline, or the viscosity and additional contaminants (e.g., metals) in crude oil, would cause gasoline or crude oil to have relatively greater impacts to agricultural uses.

Depending on the local hydrogeological situation, pumping for irrigation or stock watering may have to be reduced or discontinued to prevent migration of the dissolved hydrocarbon plume or of the pure phase hydrocarbon source.

If MTBE does not exceed 20 µg/L, the water meets the EPA's drinking water advisory (20 to 40 µg/L) concentration and therefore, would be appropriate for irrigation or stock watering. For benzene, the drinking water MCL is 5 µg/L; benzene has the strictest MCL of all BTEX constituents. Water with benzene concentrations below this level is appropriate for irrigation, provided no other MCL is reached.

If an affected well water exceeds these levels, and it is unclear to what extent, the well use would be limited. BTEX constituents readily biodegrade in the surface soils and in the root zone of plants. BTEX can also be removed fairly easily by filtration through activated carbon or by air stripping. Some air stripping occurs during spray irrigation. As far as MTBE is concerned, it is readily excreted by mammals (Appendix 7B of the final EA), so it should not bioaccumulate. These and other facts suggest that some use of water for irrigation and stock watering is possible when its contaminant content exceeds the MCL or drinking water advisories.

7.3.4.3 Recreational Uses

Recreational uses of ground water resources were evaluated based on the potential for and impacts to caverns, or to springs having public recreational value.

Seven aquifers along the pipeline were identified as containing caves that would make them susceptible to contamination—the Edwards Aquifer (BFZ), the Trinity Aquifer, the Ellenburger-San Saba Aquifer, the Marble Falls Aquifer, the Edwards-Trinity Aquifer, the Cap Mountain Limestone, the Capitan Reef Complex Aquifer, and the Rustler Aquifer.

Along much of the Edwards Plateau, there exists a potential for caves to have been formed in the karst areas. These caves provide a valuable recreational resource for cavers who have access to private lands containing these caves. A gasoline release that contaminates the ground water entering a cave could pose a threat to individuals, as hazardous vapors could collect in portions of a cave with poor air circulation. The actual threat to the cave is low, although biological populations relying on the cave as ecosystem could be impacted. This is addressed in the Phase II Biological Assessment (BA) (see Appendix 4E).

Due to these factors, the recreational use of a given cave by individuals could conceivably be curtailed following a release from the pipeline. Therefore, those places along the pipeline where a release could limit use or cause permanent damage to a publicly-owned cave, or a commercial cave with public accommodations, would be defined as sensitive for recreational impacts to caves. There are no places along the pipeline that fit this description.

While it is possible that damage could occur from the weight of liquid passing through the pipeline over a collapsible formation, this was not a problem during the several decades the EPC pipeline operated. Therefore, no impacts were found for normal operation. While pipeline construction activities can damage caves, current plans do not call for any activities that could cause cave damage.

A major spill from the pipeline in the Edwards Aquifer-BFZ, or in the contributing zone, has the potential to impact recreational uses of Barton Springs for a considerable period of time. First, Barton Springs Pool would close down while cleaning and containment of the spill took place, as water quality within the pool would potentially be unhealthy. Second, following a spill, emergency procedures would be necessary in order to restore populations and habitat of the Barton Springs Salamander. Barton Springs would be closed for an additional period of time while restoration activities took place. Finally, there could be an unquantifiable damage to the civic reputation of Austin from such a shutdown. The large amount of public concern regarding this pipeline has illustrated the intrinsic value of Barton Springs as a treasured resource within the city.

7.3.5 Impacts to Alternative Routings

7.3.5.1 Austin Re-route

Ground water sensitivity in the area potentially impacted by the Austin Re-route is summarized in Table 4-15. Much of this route would pass over sensitive and highly sensitive aquifers. The length of hypersensitive aquifer covered by the Austin Re-route is 8.2 miles, compared to the 3.0 miles covered by the existing pipeline ROW. Therefore, the risks to sensitive karst features during construction and the potential for serious impacts to the Edwards Aquifer caused by a release of product from the pipeline would both be increased by the utilization of the Austin Re-route. It is difficult to develop an Austin Re-route that would minimize crossing of the Edwards Aquifer because this band is continuous expanding southward from Austin. In addition, relocation of the pipeline further south would have potential for impacts to the drinking water quality of San Marcos. Relocation further north directly affects the Colorado River and the Highland Lakes.

7.3.5.2 Aquifer Avoidance/Minimization Route

The AA/M Route Alternative would largely avoid the sensitive and hypersensitive portions of the Edwards Aquifer, Colorado River Alluvium, Edwards-Trinity Aquifer, Ellenburger-San Saba Aquifer, Marble Falls Aquifer, and Hickory Aquifer. It is estimated that 175 miles of the existing pipeline passes over karst aquifers, and that these are mostly high-yield aquifer areas. By contrast, only 80 miles of the AA/M Route would pass over karst aquifers, and these are mainly low-yield aquifer areas (Veni, 1999b).

Although much of the proposed route that would be bypassed by the AA/M Route Alternative is not rated as sensitive or hypersensitive because of the lack of proximal drinking water supplies, there is still a risk of irremediable impacts to the karst aquifers crossed by the proposed route and to private water wells used for domestic, livestock, and irrigation purposes. Overall, the AA/M Route Alternative would largely reduce the threat from a potential major release to karst aquifers.

The AA/M Route Alternative does pose some ground water resource risks. Some of the aquifers crossed – particularly the Sparta, Carrizo-Wilcox, and Queen City aquifers – are hydrogeologically sensitive. The city of Rockdale PWS wells are located within 2 miles of the AA/M Route Alternative, and it would be impossible to construct an AA/M routing that would not be upgradient of the wellfields in the Simsboro portion of the Carrizo-Wilcox Aquifer purchased by the city of San Antonio for water supply system purposes. Avoidance of this portion of the aquifer would require two additional crossings of the Brazos River.

Only one additional aquifer would be crossed by the AA/M Route Alternative–the Lipan Aquifer in Concho and Tom Green counties. The Lipan Aquifer is not generally suitable for public or drinking water supply and is not considered sensitive.

7.3.5.3 El Paso Montana Avenue Alternative

The Hueco Bolson is not considered to be sensitive to contamination from pipeline releases in the portion of El Paso County that would be crossed either by the Montana Avenue or the Fort Bliss pipeline routes. Therefore, there is no impact on route selection due to potential ground water concerns.

7.3.6 Summary

Normal pipeline operations and construction activities present little or no impacts to ground water resources. There may be some impacts due to silting from construction or maintenance activities, but these are considered minor.

There is a potential for damage to ground water from a large release of crude oil or gasoline along much of the pipeline. A limited portion of the pipeline is considered sensitive for impacts to drinking water resources. Impacts from a release of gasoline to agricultural or stock use of ground water, or to recreational caves, are expected to be minor. In the event of a spill, there could be greater recreational impacts from a spill that would require a prolonged closing of the Barton Springs Pool in Austin.

There are a number of aquifer features where an event involving a large release of crude oil or gasoline could potentially cause major negative impacts to drinking water supplies. Impacts could include human health risks posed by benzene, toluene, and other organic compounds present in gasoline and, to a lesser extent, crude oil. Additionally, exceedance of the Texas MCLs for any of these constituents would cause problems for communities relying on the contaminated portion of an aquifer for drinking water supply. The presence of MTBE in a release of gasoline could also cause nuisance problems which render ground water unpotable.

Areas along the pipeline deemed sensitive for ground water contamination are included in Table 7-1. Table 7-2 provides a sub-listing, including areas judged to be hypersensitive.

7.3.7 Mitigation Measures

Any measures that reduce the probability or potential volume of a gasoline release to sensitive aquifers, or reduce the hazard of the product transported would reduce risk to these resources posed by the pipeline. In particular, capabilities for enhanced leak detection to locate smaller leaks is more critical in protecting ground water supplies because a small leak can release a considerable volume of product over time if undetected. In addition, enhanced emergency response could provide additional safety in the event of a release to reduce the amount of gasoline from a release that may reach a downstream or underlying sensitive aquifer. For completeness, emergency response procedures may need to include contingency planning for provision of drinking waters to public water supplies whose drinking water wells could be rendered non-potable from a leak.

Extra preventative mitigation measures analogous to those prescribed for public water supplies would not be required for portions of the pipeline where a leak would only impact private water wells. Mitigation measures should provide a plan for rapidly identifying wells that may be impacted by a release of gasoline from the pipeline. Mitigation measures should also provide an alternate water supply or water treatment methodology while the wells are not usable due to ground water contamination from a pipeline spill. Finally, reducing risk to drinking water supplies by removing MTBE from the pipeline would eliminate many of the potential impacts.

7.4 AQUATIC BIOLOGY

7.4.1 Introduction

An accidental release of product that would enter a water body is likely to affect aquatic organisms at the release site (point of entry) and downstream. The extent of such impacts would be contingent upon the amount of product and temporal and spatial factors. These factors could range from short-term and confined to a limited reach of the river or stream, to long-term and extensive that could reach several miles downstream. Common fish species that could be affected are listed for major rivers and streams in Chapter 4.

7.4.2 Impacts

7.4.2.1 Construction

Ten pump stations are planned for construction, and three existing stations would be modified to increase pipeline throughput from 72,000 bbl per day (bpd) to an ultimate capacity of 225,000 bpd. All new stations would be constructed within a fenced area, and gravel or caliche would be used to surface the work area. As much as five acres could be disturbed during site construction, and under some conditions, additional areas could be disturbed for site access. Sediment and soil transport from areas under construction at pump stations may degrade riverine habitat.

Specific locations of new pump stations are not known at the present time; however, their relationship to natural regions within the state, as discussed in Chapter 4, were identified for analysis purposes. Planned new stations, milepost locations, county locations, and natural regions are as follows:

Planned New Station Locations

Station	Milepost	County	Natural Region
Buckhorn*	67.5 - 77.5	Austin	Gulf Coast Prairies and Marshes
Orotaga*	203.8 - 213.8	Blanco	Llano Uplift
Llano*	265.0 - 275.0	Mason	Llano Uplift
Cartman*	334.0 - 344.0	Schleicher	Edwards Plateau
Olson*	410.0 - 420.0	Reagan	Edwards Plateau
Big Lake	373.5	Crockett	Edwards Plateau
Pecos*	516.2 - 526.2	Ward	Trans-Pecos
Utica*	543.6 - 553.6	Reeves	Trans-Pecos
Cottonwood	576.3	Culberson	Trans-Pecos
Harris*	642.6 - 652.6	Hudspeth	Trans-Pecos

*Specific location undetermined

A review of river and stream crossings indicates that the Buckhorn Station would be no closer than 3.5 miles to the Brazos River, the Llano Station would be no closer than 1.5 miles to the Llano River, and the Pecos Station would be no closer than 0.6 miles to the Pecos River, all of which are classified as major rivers. Based on minimum distances from major rivers, it is unlikely that fishery resources would be impacted from station construction activities. All other station locations are near small creeks and drainages that are unlikely to have fish populations that could be impacted from construction activities.

No species of concern were identified within the waterways crossed by the proposed Odessa lateral.

7.4.2.2 Normal Operations

Normal operations along the pipeline such as maintenance and cleaning performed under the Phase I BA and Biological Opinion (BO) (see Appendix 4E) will have no net negative impact on threatened and endangered species.

7.4.2.3 Accidental Releases

7.4.2.3.1 Small Leaks

Small persistent leaks could be assimilated by the species of interest on a short-term basis, but may damage reproductive organs and affect species growth in long-term scenarios. In addition, small persistent leaks may alter habitat long-term by increasing toxicity and changing vegetation in the area of interest.

7.4.2.3.2 Ruptures

Impacts associated with a large instantaneous release of product include losses due to fire, toxicity (contamination), and effects of contaminant cleanup and remediation. Impacts due to product release may include immediate toxic situations, which could cause mortality to the species of interest or long-term hazards from contamination of ground water or sediment. In addition, hazards arise due to fires from spills that may destroy federally listed threatened or endangered aquatic species.

7.4.2.4 Gasoline Versus Crude Oil

Gasoline and crude oil can cause similar impacts to aquatic species, but with some notable differences.

First, the higher concentration of toxic BTEX compounds in gasoline could result in greater immediate and long-term toxics effects, depending on the nature of the spill and the receiving media. However, the environmental persistence of crude oil may cause greater damages to some ecosystems than lighter weight and less viscous refined products including gasoline, as it is less volatile and would absorb more into soils and sediments.

The low volatility of crude oil can cause greater impacts particularly in non-turbulent waters which are dependent on oxygen transfer across a relatively placid air-water boundary. A gasoline sheen will volatilize more rapidly than an oil sheen, which could persist and severely lower dissolved oxygen content of a water body.

7.4.4 Zone of Impact

There are potential impacts to aquatic populations in the event of a release at any point where the pipeline crosses a stream or river, or where a release from the pipeline could drain toward a surface water body. Other impacts may result from contamination of aquifers.

7.4.4.1 Rivers and Streams

A large release of gasoline to Hunting Bayou, Greens Bayou, White Oak Bayou, Halls Bayou, Cypress Creek, Brazos River, Colorado River, Pedernales River, Llano River, Pecos River, or their tributaries would likely result in a loss of fish and aquatic invertebrates at the release site and immediately downstream. Aquatic species that could be affected by a large release include: Largemouth Bass, Guadalupe Bass, Channel Catfish, Green Sunfish, and Longear Sunfish; however other species that could be affected include those which are part of the overall food web associated with the river.

Loss of fish within affected river reaches could result from toxicity as well as other causes. For example, if the product were ignited, heat and oxygen depletion within the water column also could contribute to mortality rates. Although the extent of such impacts would be highly variable and dependent upon flow conditions at the time, quantity of product lost, and other factors, it is possible that toxicity levels would be sufficiently high to affect population numbers a significant distance from the point of the discharge.

A release to a major river would not directly affect federally listed threatened or endangered fish species. Potential effects to such species are addressed in the Phase II BA (Appendix 4E).

7.4.4.2 Aquifer-Dependent Species

Releases to karst areas that are crossed by the existing pipeline system could impact cave-dwelling and aquifer-dependent species. Potential impacts associated with the planned new pump stations also are addressed. Analyses of karst invertebrates focused on federally listed species in Travis County. None are within proximity to Longhorn pipeline, and none would be directly affected by a release of product. Determination of sensitivity is based on potential for known or suspected habitat loss from a release and potential takings of individual species members.

The US Fish and Wildlife Service (FWS) (1995a) and Texas Parks and Wildlife Department (TPWD) currently list the Bee Creek Cave Harvestman, Bone Cave Harvestman, Kretschmarr Cave Mold Beetle, Tooth Cave Ground Beetle, Tooth Cave Pseudoscorpion, and Tooth Cave Spider as endangered species within Travis County. Although the distribution of these species is generally limited to the Jollyville Plateau and other northern Travis County areas, they are indicative of species that are unique to karst habitat. All known populations of federally listed karst formation invertebrates in Travis County are located north of the System and would not be affected by an accidental release to the Edwards Aquifer (BFZ). Additionally, the FWS (1995b) indicates an additional 38 rare endemic arthropods to be present in karst formations that were evaluated as part of the Balcones Canyonlands Conservation Plan.

7.4.4.3 Barton Springs Recharge and Contributing Zone

It is assumed that a major release of product to the hypersensitive karst aquifers crossed by the existing pipeline would impact karst invertebrates. Areas most susceptible to adverse impacts of an instantaneous release are downgradient from MP 170.5 through MP 173.5. The pipeline also crosses 14.5 miles of less sensitive karst formation west of MP 173.5 that contributes to the Edwards Aquifer (BFZ) and Barton Springs. There are additional known karst areas scattered throughout much of the Edwards Plateau west of Austin.

The Barton Springs Salamander is particularly susceptible to acute and/or chronic ground water contamination. Since the species is fully aquatic, there is no possibility for escape from contamination or other threats to its habitat. Crustaceans, particularly amphipods, on which the salamander feeds, are especially sensitive to water pollution. The species also is particularly susceptible to contaminants due to their semipermeable skin, the development of their eggs and larvae in water, and their position on the food web (*Federal Register*, 1997).

The City of Austin and the FWS drafted a Habitat Conservation Plan to protect the Barton Springs Salamander. The plan was drafted to allow incidental takings of the species that would likely occur as a result of maintenance, cleaning, and recreational use of the springs (Eliza, Old Mill, Upper Barton Springs, and Barton Springs Pool), and it includes requirements to protect the species in the event of an instantaneous spill of toxic substances. Specifically, Austin is required to "…develop a instantaneous spill response plan…" to address spill prevention, containment, remediation, and salamander rescue. The Habitat Conservation Plan also requires Austin to maintain a viable captive breeding population to ensure survival of the species in the event of an instantaneous spill. Such precautions would be in place during the operation of the pipeline; they would not reduce the severity of impacts to the habitat or the species should a large release of product enter the springs.

If a release were to occur, which led to contamination of the Edwards Aquifer BFZ, there is the possibility for adverse impact to the Barton Springs Salamander. A slightly higher potential may exist for gasoline than for crude oil to reach the aquifer and be transported to Barton Springs, where impacts to the salamander populations would occur. However, potential impacts from a release of crude oil to Barton Springs may be higher than potential impacts from a release of gasoline product. The uncertainty is due to a combination of factors discussed in Section 7.3, including the potential for the contents of a gasoline or crude oil release to pool on the surface versus transport directly into the aquifer. There is currently no way to precisely and quantitatively differentiate between the impacts to the Barton Springs Salamander from a release of gasoline at worst-case locations within the Edwards Aquifer (BFZ) recharge zone or contributing zone compared to a release of crude oil at the same locations.

Additional information regarding measures to protect the species is provided in the Phase II (and Phase I) BA (see Appendix 4E).

7.4.5 Alternative Routings

7.4.5.1 Austin Re-route

Ecological resources along the Austin Re-route are identified in Chapter 4. The primary potential impact that could result from a release along the Austin Re-route would be damage to the Barton Springs Salamander, because of the mechanisms for contamination of the Edwards Aquifer (BFZ) noted in Section 7.4.4.3. Any releases along the Austin Re-route that conducted contaminants to Barton Springs could threaten salamander populations and habitat.

7.4.5.2 Aquifer Avoidance/Minimization Route

Of the water bodies that would be crossed, only seven support important freshwater fisheries, according to stream classifications prepared by FWS. These include Yegua Creek, Little River, Leon River, Colorado River, Lampasas River, South Concho River, and Dove Creek.

A total of 96 fish species occurs in the seven streams potentially affected by the AA/M Route Alternative (ERT, 1987). Of these, 36 are considered important in terms of recreational or commercial value. The most important recreational fish species in most of these streams are members of the catfish, sunfish and temperate bass families. Other members of the sunfish family represent some recreational value. The channel, blue, and flathead catfishes are the principal species sold commercially and are important sport fish.

No federally listed endangered or threatened species are known to occur in streams that would be crossed by the AA/M Route Alternative. Two federal candidate fish species are known to occur in the study area: Guadalupe bass and the sharpnose shiner. The Guadalupe bass is known to inhabit Dove Creek, South Concho River, and the Colorado River. The sharpnose shiner inhabits the Colorado River.

The Concho water snake is restricted to a few reaches of the Concho River below Veribest and in the Colorado River, upstream and downstream of the Concho River confluence. Extensive field searches have failed to locate this species in other regional streams or other sections of the Colorado River. The pipeline route crosses the Colorado River in a reach just upstream of where Concho water snakes are known to occur. It is unclear if surveys have been conducted at the exact pipeline crossings; therefore, it is possible that Concho water snakes also occur there. Exact alignment at the Colorado River could reduce impacts to this species (impacts would be greatest in shallow riffles and least in deep water). It is possible that construction in a riffle area would reduce numbers of this species, but should not threaten the viability of the population.

The effects of construction on aquatic communities could include reductions in plant and benthic macro-invertebrate abundance and displacement or possible reduction in resident fish populations. Significant reductions to fish populations would occur if important spawning or juvenile rearing areas were covered by increased sediment or removed from the stream. Sediment-related impacts would be considered short term in duration, generally less than one year or one life cycle for fish and several months for other aquatic communities. In summary, no significant impacts would be expected in streams or downstream reservoirs as a result of increased sediment and minor temporary habitat alteration.

7.4.5.3 El Paso Montana Avenue Alternative

Fort Bliss officials are unaware of any federally protected biological resources which may be impacted by the proposed Fort Bliss Route.

No biological surveys have been conducted along the Montana Avenue Route Alternative. However, because much of the area along the route has been previously disturbed for development, any biological resources that would have been impacted would have already been affected by road and infrastructure construction.

7.4.6 Mitigation Measures

The one identified major impact to threatened and endangered species lies in the potential for a release of gasoline or crude oil to the Barton Springs Pool where it could damage Barton Springs Salamander populations. Therefore, measures should be implemented to mitigate, in part, the risk to the salamander population by reducing the chance and potential volume of a release over the Edwards Aquifer and places in the contributing zone. Leak detection enhancement measures could also prevent possible damages to the salamander population as well as incorporation of any other means of reducing emergency response times.

At a minimum, Longhorn mitigation measures should ensure that emergency response plans are consistent with the City of Austin's Barton Springs Oil Spill Contingency Plan and the FWS Barton Springs Salamander Recovery Plan.

See Chapter 9 for a discussion of those mitigation measures that have been adopted.

7.5 TERRESTRIAL BIOLOGY

7.5.1 Introduction

The focus of this section is on non-aquatic federally listed threatened or endangered species and species that are candidates for listing as either threatened or endangered that could be affected by the project. Analyses also addressed potential impacts to dominant species, other species of concern, and important habitat along the existing pipeline corridor, along the additional pipeline to be constructed in El Paso, along the Crane lateral, and at future pump station locations.

7.5.2 Impacts

7.5.2.1 Construction

The pipeline west of Crane and Crane to Odessa has been recently constructed; consequently, habitat that once was present along the ROW has been disturbed. Construction activities associated with pump stations and storage facilities may impact the species of interest, causing displacement to other, less-suitable habitat. Construction activities would minimize impacts to threatened and endangered species through the techniques described in the Phase I BA (see Appendix 4E).

Ten new pump stations are planned for construction to increase pipeline throughput from 72,000 bpd to 225,000 bpd. Potential impacts associated with new station construction would include disturbance to approximately five acres at the station location as well as along new roads, should construction be required to provide vehicular access. Two station locations have been identified; specific locations of eight of the ten stations are unknown, but would be located within specified 10-mile-long segments along the existing pipeline. Local wildlife in the area would be impacted as a result of facilities development and increased human activity and noise. The extent of the impacts would cause the permanent loss of at least one acre at each pump station location as well as long-term changes in habitat within adjacent areas that would be disturbed during construction. Short-term impacts to local wildlife would result from increased human activity and noise during construction. This could cause the temporary displacement of some species.

7.5.2.2 Normal Operations

During normal pipeline ROW maintenance done in accordance with the Phase I BO, no impacts would occur to endangered and threatened terrestrial species. Minor and infrequent impacts to other species might include temporary seasonal disturbance of habitat and prevention of species from maturing within the ROW itself. These impacts would be equivalent whether gasoline or crude oil is transported in the pipeline.

Periodic brush removal would require the use of heavy machinery that would cause disruption to and displacement of local wildlife. The extent of such impacts would include minor displacement of mammals, birds, and reptiles within and adjacent to the ROW as a result of human activity and noise. Actual loss of habitat that would be attributed to ROW maintenance is not expected because the ROW from Houston to Crane has been maintained and is relatively clear of trees and brush as part of previous pipeline operations.

7.5.2.3 Accidental Releases

Impacts associated with such a spill release of product include losses due to fire, toxicity (contamination), and effects of contaminant cleanup and remediation. These impacts would be equivalent whether crude oil or gasoline is lost.

7.5.2.3.1 Small Leaks

Small persistent leaks could be assimilated by the species of interest on a short-term basis, but may damage reproductive organs and affect species growth in long-term scenarios.

7.5.2.3.2 Ruptures

Large instantaneous spills could immediately create toxic situations resulting in adverse impacts on species of interest. In addition, fires from spills may destroy federally listed threatened or endangered terrestrial and vegetation species and habitat. Bioaccumulation of spill constituents in species lower on the food chain may affect predator populations (such as the Bald Eagle).

7.5.2.4 Gasoline Versus Crude Oil

As discussed for aquatic toxicity (Section 7.4.2.4), gasoline and crude oil spill impacts would have some similarities, but some notable differences. Gasoline toxicity and flammability would cause a greater immediate threat to ecosystems in most scenarios. However, over time, crude oil could have greater impacts due to persistence and long-term damages to ecosystems.

7.5.3 Zone of Impact

7.5.3.1 Future Pump Stations

Impact analyses associated with proposed station locations were conducted based on available literature. Field investigations would be required to acquire site-specific information. Only one station, Orotaga (which would be located between MP 203 - MP 213) has a location range which includes existing habitat. The Phase I BA notes some parcels of Golden-cheeked Warbler habitat around MP 208.

The Buckhorn Station would be located in Austin County, which is in the Gulf Coast Prairies and Marshes Natural Region. Federally listed threatened and endangered species within the county are limited to the Bald Eagle. However, it is unlikely that the species would be affected by the project because habitat supporting the species is not within the area crossed by the pipeline.

The Orotaga and Llano stations would be constructed in the Llano Uplift Natural Region. It is possible that potential Golden-cheeked Warbler and/or Black-capped Vireo habitat could be affected by site development. The area is in an upland setting and devoid of large trees that are required for Bald Eagle nesting. Therefore, potential impacts to the species are unlikely.

The Cartman, Olson, and Big Lake stations would be located on the Edwards Plateau Natural Region in Schleicher, Reagan, and Crockett counties, respectively. The Black-capped Vireo is the only federally listed species known to occur in the counties, and potentially the only federally listed species that could be affected by site development.

7.5.3.2 Houston Toad Habitat

Results of field investigations conducted by Horizon Environmental (1999) indicate that the 0.8 pipeline miles cross potential Houston Toad habitat. Subsequent follow-up added 2.3 miles of potential habitat (Sherrod, 2000). Potential impacts to the species and measures to reduce the likelihood of impacts are addressed in the Phase I and II Bas, Phase I BO, and Phase II Concurrence Letter (Appendix 4E). The pipeline crosses Buescher State Park and is part of the federally designated critical habitat for the species.

Suitable habitat and known occurrence of the species are predominantly in unaffected Bastrop State Park and lands to the north. Secondary effects of a major release could occur in association with cleanup activities as a result of soil compaction, removal of trees and brush, and loss of habitat. Potential impacts to the species from a release are addressed in the Phase I and II Bas, Phase I BO, and Phase II Concurrence Letter (see Appendix 4E).

7.5.3.3 Avian Species Habitat

The Black-capped Vireo and the Golden-cheeked Warbler are known to breed and nest in Travis County and in several counties west of Austin. Habitat requirements for the Vireo include dense shrubs that provide suitable nesting sites relatively close to the ground. The Golden-cheeked Warbler requires mature ashe juniper and hardwoods for nesting and foraging. Although land management practices, including brush clearing, have reduced the availability of habitat for both species throughout their ranges, it is likely that they are present to some portions of the pipeline corridor. Field investigations conducted by Horizon Environmental (1999) indicate that Black-capped Vireos and Golden-cheeked Warblers were present along 7.4 and 16.6

miles of the pipeline, respectively, during the spring to early summer of 1999. Potential impacts to both species are addressed in the Phase I and II BAs (see Appendix 4E).

The range and distribution of the Southwestern Willow Flycatcher include Hudspeth, Culberson, and El Paso counties, which are west of the Pecos River. Habitat requirements include dense riparian willow, cottonwood, tamarisk, baccharis, and other woody species that are relatively common along stream banks and arroyos of the region. Although populations may be present at scattered locations near the existing pipeline ROW, none would be within the corridor due to routine brush removal.

Adverse impacts to the Black-capped Vireo, Golden-cheeked Warbler, and Southwestern Willow Flycatcher population are not expected during normal pipeline operations; however, corridor maintenance, including routine brush removal, could temporarily disturb some nesting birds adjacent to the pipeline corridor. Such impacts are eliminated through measures detailed by the Phase I BO and Phase I BA (see Appendix 4E).

The Bald Eagle is most often found in mature bottomland forests where suitable nesting sites are available in tall loblolly pine, bald cypress, oaks, cottonwood, and sycamores. An instantaneous release of product to streams and rivers that flow to area impoundments could have an adverse effect on Bald Eagles that use such areas for feeding. Ingestion of contaminated fish, or the loss of fisheries resources could result in the loss of some birds or changes in hunting (fishing) locations. Other adverse impacts to the species (and potentially other species) include bioaccumulation of hydrocarbons within the food chain. Toxicological analyses would be required to determine sub-lethal effects on the Bald Eagle. The Interior Least Tern is a migratory species with a current summer distribution along the Red River from Louisiana to the Texas panhandle, along the Canadian River (in the panhandle), the upper Trinity River, and several waterways within central Texas. Winter distribution is limited to the Texas coast. Habitat requirements for the species are primarily based on the presence of bare or nearly bare ground and alluvial islands for nesting, availability of food (primarily small fish), and favorable water levels during the nesting season. Preferred nesting sites are salt flats along lake shorelines, broad sandbars, and barren shores within wide, unobstructed river channels. In the unlikely event of a large spill to the mainstream or major tributaries of the Brazos, Colorado, Llano, or James rivers, nesting Interior Least Terns might be adversely affected.

An accidental product release within the Golden-cheeked Warbler and Black-capped Vireo habitat could have an adverse impact on nesting birds if the event were to occur during the spring or early-summer should a leak have sufficient volume to reach downgradient-occupied habitat. The event and related cleanup activities also would result in the loss of potential habitat and loss of individual birds. A release of product in the Trans-Pecos natural area could similarly affect the Southwestern Willow Flycatcher, particularly if such an event were to result in flow to arroyos or similar drainages.

7.5.3.4 Plant Species Habitat

The Phase I and II BAs and Phase I BO indicate that three federally listed threatened or endangered plant species and two plant species that are candidates for listing are known to occur within counties crossed by the existing pipeline. Texas prairie dawn is known to occur in Harris and Waller counties and may be present along segments of the pipeline corridor where there is undeveloped land. Habitat requirements for the species include sparsely vegetated areas with fine sandy soils, poorly drained soils, and around the base of mima mounds and similar features. Field investigations conducted by Horizon Environmental during 1999 indicate that potential habitat is present along approximately 9.6 miles of the pipeline. Areas most likely to support the species are in western Harris County and eastern Waller County.

Navasota ladies'-tresses is endemic to moist sandy soils of southeastern Texas. The species is most often found within small openings in post oak savannah. The species typically is associated with erosional remnants between rills in slightly to moderately eroded areas along minor intermittent tributaries of the Navasota, Trinity, and Brazos rivers (Horizon, 1999). Associated species include post oak, blackjack oak, yaupon, slender bigelowia (*Bigelowia nuttallii*) and *Spiranthes cernua* (Horizon, 1999). According to Horizon Environmental in the Phase I BA (Appendix 4E), a small population is known to be within 6 miles of the pipeline and 2 miles north of the city of Fayette.

Tobusch fishhook cactus is known to occur on limestone gravels of stream terraces, limestone ledges and ridges, and within oak juniper woodlands in Kimble County. A preliminary field investigation found a tobusch fishhook cactus 50 ft off the ROW. A subsequent survey of the ROW within Kimble County found no additional plants in the ROW. However, as a result of the Phase I BA and BO, the ROW in the entire county was considered potentially suitable habitat and fully compensated. Texas snowbells are a rare endemic shrub that also is found on limestone bluffs and cliff faces along rivers, streams, and dry creek beds in Kimble County

Potential impacts to listed plant species range from temporary loss of some populations to the permanent or long-term (i.e., several decades) loss of habitat. The effects of spill cleanup would include soil removal, compaction, and other disturbances.

Regardless of potential impacts to threatened or endangered species, a large release of product could result in the loss of localized habitat that is common within ephemeral drainages and arroyos. Loss of such habitat would have secondary impacts to a wide variety of avian and mammalian species.

7.5.4 Sensitive Areas

No areas along the pipeline are classified as sensitive or hypersensitive for impacts to terrestrial species. Adherence to the Phase I BO and Phase II Concurrence Letter and avoidance measures described in the Phase I and Phase II BAs would protect any threatened and endangered species along the pipeline.

7.5.5 Alternative Routings

7.5.5.1 Austin Re-route

Ecological resources along the Austin Re-route are identified in Chapter 4. Protected terrestrial species that could be affected by a release, particularly if a large amount of cleanup was involved, include Golden-cheeked Warbler and Black-capped Vireo populations that inhabit the flora along the Austin Re-route Alternative.

In addition to potential impacts from accidents, the Austin Re-route would require establishing 21 new miles of pipeline ROW. Construction of the Austin Re-route could therefore potentially require clearing a 50-ft wide strip through portions of existing habitat. Additional ground level surveys would be required to establish this impact.

7.5.5.2 Aquifer Avoidance/Minimization Route

The AA/M Route Alternative would potentially affect 5 of the 11 major ecological areas of Texas described by Gould (1962) and modified by TPWD (1978). These are the Oak Woods and Prairies, Blackland Prairies, Edwards Plateau, Llano Uplift, and the Rolling Plains. These vegetation regions are shown in Figure 7-1.

The four major plant types of cover that would be crossed by AA/M Route include mesquite-juniper, mesquite, oak-mesquite, juniper (parks and woods), and post oak (parks and woods). Agricultural (ranching and farming) lands account for the largest land use area crossed by this route.

The 364 miles of the AA/M Route Alternative would traverse a variety of wildlife habitats and pass through the distribution ranges of many species. The white-tailed deer is the dominant big game along the AA/M Route and throughout the state. White-tailed deer population levels are currently high on the Edwards Plateau, with herd size often exceeding the estimated carrying capacity and resulting in damage to deer range. Other dominant mammals are the armadillo, coyote, fox, and striped skunk. The rangelands of the Edwards Plateau, Rolling Plains, and Blackland Prairies support the Rio Grande wild turkey along the AA/M Route from Reagan to Milam counties. Bobwhite, scaled quail, and mourning dove also occupy several habitats along the route. The bobwhite and mourning dove are common game birds along the route.

A variety of non-game mammals, birds, reptiles, and amphibians are supported by habitats along the AA/M Route Alternative. There is a much greater occurrence of agriculture along the AA/M Route, and wildlife habitat and representative species would reflect that land use.

Six federally classified threatened or endangered wildlife species occur in the geographic region crossed or potentially affected by the AA/M Route. The table below lists the protected species and their status.

AA/M Route Alternative Protected Species

Common Name	Federal Status	Common Name	Federal Status
Bald Eagle	LT/PDL	Navasota ladies'-tresses	LE
Black-capped Vireo	LE	Concho Water Snake	LT
Golden-cheeked Warbler	LE	Houston Toad	LE

LT: Federally listed as threatened

LE: Federally listed as endangered

PDL: Proposed for delisting

Certain species of ground-nesting birds would be precluded from nesting in the ROW. Areas that had supported woodland habitats would be changed to grasslands or shrublands.

The Bald Eagle nests along river systems or within one to two miles of other large bodies of water such as lakes and reservoirs. Nests are often located in areas where forests, marsh, and water meet. Nests are most often in tall trees that are generally above the surrounding forest canopy, which provides an unobstructed flight path to nest. Tree species most often used include loblolly pine, bald cypress, oak, cottonwood, and sycamore. Construction of a new pipeline through Bald Eagle habitat could adversely affect nesting birds, if such activities were undertaken during nesting season.

The Interior Least Tern is known to occur along major rivers and tributaries in central Texas. If pipeline construction were to cross such features during the summer, impacts from noise and activity could disrupt nesting birds. Although nesting success could be affected if construction were to coincide with nesting, most (if not all) river and major stream crossings would be reached by directional drilling, and loss of habitat is not anticipated.

Navasota ladies'-tresses are endemic to southeast Texas and occurs primarily in moist sandy soils in small openings among post oak savanna. Construction through the Navasota and Brazos watersheds could result in some loss of individual plants and short-term loss of habitat. Long-term impacts to the species could occur if herbicides are used for ROW maintenance and brush control.

The Black-capped Vireo is known to breed and nest in portions of the Edwards Plateau that would be crossed by the pipeline. Preferred habitat consists of scattered trees and dense clumps of shrubs growing to ground level, interspersed with open areas of barren ground, rock, grasses or forbs. The species is migratory and winters in Mexico. Pipeline construction could result in some loss of habitat. If construction coincided with the nesting season, it could affect nesting success.

The Golden-cheeked Warbler is known to breed and nest in portions of the Edwards Plateau that would be crossed by the pipeline. Habitat requirements are characterized as oak-juniper woodlands, including mature ashe junipers that provide nesting substrate. The species is migratory, wintering in central Texas. Construction of a new pipeline could result in some loss of habitat. If construction were to take place during the spring and summer nesting season, noise and activity could result in reduced nesting success along the pipeline corridor.

7.5.5.3 El Paso Montana Avenue Alternative

See Section 7.4.5.3 for overview of terrestrial and aquatic El Paso biological assessments.

7.5.6 Mitigation Measures

To eliminate or reduce the potential for adverse impacts due to construction of planned pumping stations, consultation with FWS and coordination with TPWD should take place prior to siting and construction of stations. The implementation by Longhorn of risk reduction, enhanced leak detection, and emergency response measures undertaken for prevention of large releases along the pipeline will reduce the risk of potential impacts to terrestrial species. Measures developed through consultation with the FWS are included in the Phase I and II BAs, Phase I BO, and Phase II Concurrence Letter in Appendix 4E.

7.6 IMPACTS TO SURFACE WATER

7.6.1 Introduction

The Longhorn pipeline crosses three major river basins in Texas—Brazos, Colorado, and Rio Grande, as well as the drainage to the West Texas Salt Basin. In addition, the pipeline crosses 12 separate tributary watersheds of the Colorado River and three tributaries of the Rio Grande. Of the 288 streamlines (any creek, stream, or identifiable channel) crossed by the pipeline, five rivers are crossed (Brazos, Colorado, Pedernales, Llano, and Pecos), along with four tributaries having basins exceeding 200 square miles upstream of the pipeline crossing (James River [Llano], Onion Creek [Colorado], Cottonwood Creek [Upper Pecos], and Antelope Gulch [drains to West Texas Salt Basin]). A description of the major river and stream crossings, including description of streamflow regime, downstream water quality, and downstream water rights for the crossings, is provided in Chapter 4.

7.6.2 Impacts

7.6.2.1 Construction

Crossing of major rivers has been completed. Any additional crossings performed using boring or directional drilling would not affect the crossed water body. The majority of stream crossings, however, are to be constructed using trenching technologies. Depending on the level of water flow in the stream, temporary retention and redirection may be required during construction of the crossing. To eliminate water quality impacts from construction in the streambed, crossing and sedimentation controls will be implemented under Longhorn stormwater pollution prevention plan. Construction along other portions of the line, including at future pump stations, could cause runoff that could impact surface waters. This could include siltation, and contamination from oil and gas leakage from construction equipment. These impacts should be mitigated by adherence to a stormwater protection plan.

Construction activities associated with the Longhorn Partners Pipeline project may result in impacts to navigable waters of the United States and/or waters of the United States, including wetlands. A permit would be required from the US Army Corps of Engineers (COE) under Section 404 of the Clean Water Act for any discharge of dredged or fill material into waters of the United States, including wetlands. A permit would be required from the COE under Section 10 of the Rivers and Harbors Act of 1899 for activity in, or affecting, a navigable water of the United States. Such activities may be authorized by general permit, such as nationwide permit 12 for Utility Line Activities, Regional General Permit CESWF-99-RGP-2 for Utility Lines and Outfall and Intake Structures in the Fort Worth and Albuquerque districts, and any applicable general permits for the Galveston District provided the permittee meets all the terms and conditions, including any special conditions, of the appropriate permit.

7.6.2.2 Normal Operations

Ongoing, routine operation of the pipeline is not expected to result in any surface water impacts.

7.6.2.3 Accidental Releases

A leak or rupture of the pipeline resulting in a release of gasoline to the environment could contaminate surface waters. This could result from:

- A leak directly at a point where the pipeline crosses over or under a river or stream;
- Contamination of ground water resulting in gasoline constituents entering a surface water body from seeps, springs, or alluvial baseflow;
- Overland flow of gasoline from a rupture to a surface water body, particularly through a normally dry gully, streambed, or arroyo; or
- In urban areas, runoff to streets or paved areas, and then to storm drain sewers which transport the spill directly to a stream or river.

The most immediate result of a release to surface waters would be the formation of a sheen of gasoline on the water surface.

At some distance downstream, the hazardous conditions posed by the gasoline sheen would subside due to the competing mechanisms of volatilization and dissolution which remove volatile gasoline constituents from the water and capture soluble gasoline constituents in the water column. At first, as the constituents remain in the gasoline phase, the volatility and solubility of gasoline would drive partitioning between air and water. As more of the gasoline becomes dissolved into the water, the chemical properties of the individual gasoline constituents such as benzene (soluble in water, but highly volatile) and MTBE (volatile, but highly soluble in water) will drive partitioning.

In the water column, gasoline constituents can render drinking water supplies non-potable, either due to the concentration of toxic constituents, such as benzene, or due to the very low nuisance threshold of constituents, primarily MTBE.

Finally, releases can cause contamination of aquifers, either through interface with associated alluvium or in karst areas by flowing with the surface water into a sinkhole or in a stream recharge feature.

7.6.2.3.1 Small Leaks

Any impacts to water quality from small leaks should be incurred at or near the point of the leak. Because of the volatility of gasoline constituents, impacts should not occur for downstream from a small continuous leak.

At or near the point of release, concentrations of toxic constituents or MTBE may build up to a varying steady state were a small leak to continue for extended periods. Steady-state concentration would vary based on meteorological and stream flow conditions. While this will not affect downstream water users, it could affect water users and ecosystems in the vicinity of the release.

7.6.2.3.2 Ruptures

A large pipeline rupture poses more severe consequences to surface waters, because the potentially large release volumes can cause concentrations of toxics and MTBE to be high far downstream of the release. This could potentially result in a large mass of these constituents entering a reservoir.

For some downstream distance, a gasoline sheen may be flammable, and, as occurred in the Bellingham pipeline accident in 1999, a fire may extend for miles down a river. This distance would depend on the amount of gasoline released, the flow rate in the river, and the volume of water in the river.

At the high initial concentrations in the water body immediately following the release, damages to aquatic biology can occur, either due to toxic effects or due to temporary anoxia which could result from a gasoline sheen, from chemical oxygen demands of the gasoline in water, or due to the effects of a fire on the water surface. Anoxia has been a primary cause of large fish kills in many pipeline accidents. Gasoline releases can temporarily disrupt the use of waterways for recreational purposes.

A large release, if not properly remediated, could cause low-level, long-term water quality problems due to contaminants trapped in surface soils slowly leaching to surface waters. As discussed in Appendix 7E, a 1.1 million-gallon crude oil spill on the Crane-to-Houston EPC pipeline in Kimble County apparently was not properly remediated. This incident, the largest spill on the EPC pipeline, illustrates (1) the secondary impacts that can occur under improper remediation, and (2) the persistence of crude oil as a soil contaminant.

7.6.2.4 Gasoline Versus Crude Oil

Use of surface waters for domestic purposes would be impacted to a greater degree by a gasoline spill, due to the toxicity and rapid diffusion of gasoline constituents in the water column. Crude oil and gasoline will have differing adverse affects on aquatic habitat - gasoline would cause more short-term aquatic toxicity, while crude oil would cause more persistent damages. Crude oil is likely to have a greater impact on recreational and agricultural uses due to its persistence. MTBE in gasoline could have a major impact on water potability apart from toxicity, and would cause potability problems from some spills which would not otherwise impact drinking water supplies.

7.6.3 Zone of Impact

7.6.3.1 Rivers and Streams

As part of this EA, stream flow modeling was conducted to represent rivers and streams crossed by the pipeline in the Lower Colorado River Basin. This study is contained in Appendix 7F and included the Colorado River crossing east of Bastrop, the Onion Creek crossing in the southeastern portion of Austin, and the Pedernales River crossing in Blanco County. The intent of this modeling was to determine the following:

- The distance downstream from a release at which benzene and MTBE could exceed threshold criteria for drinking water quality (the Texas MCL of 5 ppb for benzene and the EPA advisory level of 20 ppb for MTBE), under different leak volume and stream flow conditions;

- The duration for which a sensitive surface water intake could be exposed to a contaminant level in excess of the threshold criteria for drinking water quality as the contaminants flow downstream; and
- To determine the amount of benzene and MTBE that could enter Lake Travis via the Pedernales River crossing under varying river flow conditions.

The results of this modeling show that for the major crossings modeled, it is possible, under certain flow conditions, for the gasoline released during an instantaneous leak at the crossing, to cause a plume with contaminant concentrations in excess of threshold criteria to travel far downstream. A spill at the Colorado River crossing could cause contamination to reach Texas coastal waters, while a spill in the Pedernales River could cause contamination to reach Lake Travis. Impacts from spills in the Pedernales watershed are discussed in 7.6.3.2.1. From a spill on the Colorado River, by the time the contaminant reaches the coast, the dilution and volatilization effects would be such that the contaminant would not be a threat to the estuarine environment.

Adverse impacts to drinking water were based on the potential for contaminant concentrations in excess of threshold criteria reaching drinking water supplies and on the duration for which a release may render a drinking water supply not potable. The target for determining water contamination was set at 5 ppb for benzene and 15 ppb for MTBE, instead of at the non-detectable level, because use of motorized recreational watercraft throughout the larger watersheds crossed by the pipeline, particularly in the Highland Lakes, already results in seasonally varying hydrocarbon contamination of these resources. This reflects the public willingness to accept some water quality degradation as long as human health standards are not compromised.

Surface water contamination of drinking water intakes on the Brazos River and below Longhorn Dam on the Colorado River in Austin are likely to be short-term in duration. While stream modeling performed for this EA indicated that a contaminant plume containing benzene concentrations of greater than 5 ppb would travel over a hundred miles downstream under certain flow conditions, this plume would travel past the affected water intakes in a time span between 10 and 20 hours in duration. Since a large-volume leak could generate these concentrations in a plume and quickly be detected, there would be time for downstream water supply systems to prepare for the spill.

Standard water system design and engineering principles dictate that communities should have excess storage capacity. The Brazos River Authority and the LCRA maintain substantial communications networks for alerting communities and water users about these hazards.

7.6.3.2 Lakes

The Highland Lakes could theoretically be impacted by a large-volume leak upstream, resulting in a period of time when concentrations of MTBE and benzene would exceed regulatory MCLs and guidance criteria. This would involve a large volume traveling from a crossing in the Barton Creek or Pedernales River watersheds, causing Town Lake, Lake Austin, or Lake Travis to exceed threshold drinking water criteria. Impacts to Lake LBJ from spills in the Sandy Creek or Llano watersheds are unlikely.

7.6.3.2.1 Lake Travis and Pedernales Watershed Studies

In order to assess the risks to these lakes and the potential for gasoline spills in their watersheds, a computer model was constructed to represent Lake Travis downstream of the confluence with the Pedernales River. In conjunction with the LCRA, various places in the LCRA watershed were evaluated to determine the most sensitive point with respect to the risk of significant contamination of one of the LCRA's water supply reservoirs. In the draft EA, preliminary calculations suggested that concentrations of up to 83 ppb could be achieved in Lake Travis following a release. Since this reservoir serves as the water supply for up to a million people served by the LCRA and City of Austin, LCRA was concerned that highly protective assumptions should be developed to evaluate the potential for the contamination of Lake Travis.

A new scenario (Pedernales River model) was evaluated that included a major release at the Pedernales River crossing, 35 miles upstream of Lake Travis. While there are shorter pathways from the pipeline to the lake, particularly where the pipeline crosses Flat Creek and from certain overland flow drainages in Pedernales Falls State Park, the Pedernales River crossing also represents a worst case because of the potential for high flow rates in the river, given the size of the basin upstream from the pipeline crossing. In Table 7-4, the Pedernales River crossing is compared with other crossings in the watershed with respect to (1) distance to the potentially affected Highland Lake, (2) the maximum pipeline spill size at the location, (3) the sensitivity rating assigned for the crossing in the draft EA, and (4) the level of concern, including a qualitative comparison of sensitivity for lake contamination with the Pedernales River crossing. Draindown and topographic profile of crossings in this area are depicted in Figure 7-2.

The Pedernales River model followed the same methodology used for modeling the Colorado River and Onion Creek in the draft EA. The COE Riverine Emergency Management Model (REMM) was used for incorporating Pedernales River-specific factors, including flow data from the LCRA.

The purpose of the modeling was to assess LCRA concerns regarding the threat to the water in Lake Travis meeting drinking water quality standards. This threat is a function (1) of the mass loading of benzene and MTBE that could be present in the Pedernales River where it enters Lake Travis following a major rupture and (2) of the behavior of benzene and MTBE in Lake Travis following a large inflow of the contaminants.

Two size spills were modeled for the Pedernales River crossing along with two base river flow rates. The lower Pedernales flow rate, 200 cubic ft per second (cfs), represents the median flow in the river at this point. The higher flow rate, 5,000 cfs, reflects a flow that would be achieved in the river approximately 2 days a year. This 5,000 cfs level would be representative of about 0.5 percent of the flows recorded on an annual basis.

The lower of the two spill sizes modeled, 1,970 bbl, would represent a rupture at the Pedernales River crossing if the check valve to the west of the crossing and the motor operated valve to the east of the crossing both function properly. The larger spill size, 6,476 bbl, was a very conservative release volume reflecting the amount of gasoline that would spill if the check valve on the west side of the Pedernales River crossing failed. While this is not expected to occur because check valve failures are extremely rare events, this higher volume is intended to demonstrate the effects of some other pipeline event that could result in a volume greater than 2,000 bbl being discharged. Also, the 6,476-bbl release partially reflects the effects if the release occurred at one of the small tributaries to either side of the Pedernales River crossing.

The river model interfaced with the Lake Travis model in the Pedernales arm of the lake and 10 miles upstream from the actual confluence with the lake, where the Pedernales arm begins to deepen and widen, approximating lake behavior. Three methods were used for modeling the mixing of water from the Pedernales REMM to the water quality model used for Lake Travis (see Appendix 7G). A model of Lake Travis was set up using bathymetric, climactic, and flow data provided by the LCRA. The COE's CE-QUAL-W2 two-dimensional water quality model was used to incorporate two-dimensional, longitudinal/vertical, hydrodynamic transport of benzene and MTBE through the lake.

In one condition, concentrations of MTBE and benzene in the single-layer river model mixed evenly into the different depth layers in the lake model. In a second condition, all benzene was partitioned into the layers above the thermocline, which forms in Lake Travis over most of the year. The purpose of this approach was to achieve maximum conservativeness with respect to potential impacts to Lake Travis surface water users such as the Lago Vista system. In a third condition, in order to achieve maximum conservativeness with respect to potential impacts to water users downstream of Lake Travis, including the City of Austin, all benzene was partitioned into the layers below the thermocline, which acts as a barrier to losses of these constituents through volatilization. The penstocks which transport water from Lake Travis to Lake Austin are below the thermocline.

The results of these analyses, summarized in Table 7-5, show that when the contaminants in a warm influent enter the lake above the thermocline, the concentration of benzene in the Lago Vista public water supply would reach a maximum of 12 ppb if the maximum spill size (6,476 bbl) and maximum Pedernales flow rate (5,000 cfs) occurred simultaneously. This would occur approximately 85 to 90 days after the rupture, and the surface water at Lago Vista would exceed the drinking water quality standard of 5 ppb for approximately 25 days, from day 75 to day 100. Surface water intakes farther down the lake from Lago Vista would encounter reduced peak concentrations of benzene. If the volume of gasoline from the rupture was 1,970 bbls, the mass of benzene entering Lake Travis would be approximately 30 percent of the mass from the larger release, and the maximum concentration at Lago Vista would be less than 4 ppb. Conversely, if the Pedernales River is modeled at mean flow conditions of 200 cfs, the mass of benzene reaching the lake under any release scenario is only a small fraction (0.6 percent) of the mass achieved at higher river flow rates. The mass reaching the lake under higher flow rates is much higher for two reasons: (1) the travel time from the crossing to the lake at 200 cfs is about 24 hours, while the travel time at 5,000 cfs is 7.6 hours; and (2) the greater volume of water available to dissolve benzene and MTBE.

In the case of a 6,476-bbl spill entering the Pedernales River during high flow (5,000 cfs) conditions, and a cold Pedernales flow mixing into the lake below the thermocline, the maximum concentration of benzene at Mansfield Dam in any layer would be approximately 8 ppb, and the concentration at the penstock would be approximately 6 ppb. While these concentrations are above the 5 ppb drinking water criteria, additional volatilization would rapidly occur at the point of discharge from the penstocks to Lake Austin. A smaller (1,970 bbl) release would result in less than 2 ppb benzene passing through the penstocks, and if a high volume release occurred during mean flow conditions in the Pedernales River only barely detectable concentrations of benzene would be expected.

It is important to note that the conclusions from these studies did not contradict any of the impact determinations made in the draft EA, but rather supported and refined them. These refinements are noted as follows:

1. The draft EA stated that concentrations of up to 83 ppb MTBE could be present in Lake Travis if a 5,000-bbl release proceeded, unencumbered to the reservoir. Modeling demonstrated that this conclusion was correct and that under high flow conditions in the Pedernales River (5,000 cfs, as opposed to the average flow rate of 200 cfs), a release of approximately 6,500 bbl at the Pedernales River crossing could result in 65,000 kg of MTBE and 670 kg of benzene entering the reservoir. With this mass of MTBE entering the reservoir, a peak concentration of about 80 ppb MTBE would reach the Mansfield Dam penstocks, approximately four months following the spill.

2. The draft EA noted that it was necessary for MTBE and benzene to proceed unimpeded to the Highland Lakes for a severe impact to drinking water quality to occur. Modeling bore this out – at normal flow stages in the Pedernales River (200 cfs), over 99.9 percent of the benzene and MTBE would be volatilized from the river prior to any contaminants reaching Lake Travis. In the absence of flood conditions, no major impacts are expected to any of the Highland Lakes as a result of any spill scenarios along the Longhorn pipeline. The flood stage modeled, 5,000 cfs, represents a flow level which may be expected to occur 0.4 percent of the time on an annual basis, or approximately twice per annum.

3. The draft EA designated 7.6 miles of pipeline in the Pedernales River watershed as sensitive, including 2.7 miles of hypersensitive watershed. In the Sandy Creek watershed, 1.86 miles of pipeline was designated sensitive and 0.79 miles were designated as hypersensitive. In the Llano watershed, 5.3 miles were sensitive and 1.88 miles were hypersensitive. Each of the areas judged in this follow-up study to pose serious impacts to Lake Travis or Lake LBJ water quality were already rated as sensitive or hypersensitive in the draft EA. Therefore, the original screening was successful at identifying places along the pipeline that posed the greatest risk for significant impacts. Closer scrutiny suggests that the original designations were over-conservative, because it does not appear that any portions of the Llano watershed would be considered hypersensitive if specific modeling were done on the behavior of MTBE and benzene in the river. Also, numerous crossings in the Sandy Creek and

Pedernales watersheds, which were originally scored as hypersensitive, are not likely to pose a significant long-term threat to drinking water quality in the area.

4. The original purpose of the sensitive and hypersensitive area designations was to identify places where significant impacts could occur from accident scenarios and the potential for these occurrences. This enabled the Lead Agencies to determine if mitigation measures were appropriate for the level of risk and potential impacts. Refinement of the model and watershed study have provided additional data to specify appropriate and more protective mitigation measures, such as improving valve configurations and responding to flood conditions in the Highland Lakes watersheds through operator alerts and reduced maximum pipeline product capacity during flood stages in the rivers.

7.6.3.2.2 Sandy Creek/Llano River and Lake LBJ

It is not expected that a release into the Sandy Creek or Llano River watershed would result in a large amount of contamination reaching Lake LBJ. While not modeled, flow rates in Sandy Creek are expected to be lower than in the Pedernales River because of the smaller size of the watershed upstream of pipeline crossings, and because of the creek's sandy bottom which is not conducive to the flow velocities achieved in the larger rock-bottomed Pedernales River. Conversely, while the flow velocities in the Llano River may equal or exceed those found in the Pedernales River, the distance from the Llano River crossing to Lake LBJ is on the order of 85 miles, and even under high flow conditions, the time of travel from the crossing to Lake LBJ should substantially limit the amount of gasoline that could enter the lake.

7.6.3.2.3 Barton Creek Watershed and Town Lake

There are a number of factors to consider with respect to the potential impacts of gasoline contaminants on Town Lake. First, the Green Water Treatment Plant provides 11.3 percent of the City of Austin water supply on an annualized basis (1999 basis). Ulrich and Davis water treatment plants, which supply 88.7 percent of the water supply, are upstream on Lake Austin. Second, Town Lake is unlike the other Highland Lakes in that it has a much lower volume of water. This lower volume of water makes it easier to artificially reduce the concentration of MTBE and benzene in the lake by increasing withdrawals and inflows. Third, Town Lake is wider and more shallow than Lake Travis and Lake Austin. MTBE and benzene volatilization would take place more rapidly.

There are complicating factors in evaluating releases in the Barton Springs recharge zone and contributing zone. Much like the Pedernales River, Sandy Creek, and Llano watersheds, under normal flow conditions in the Barton Creek watershed, no major impacts to drinking water quality in Town Lake would be expected due to a release. The crossing of Barton Creek and its Long Branch tributary occur 32.7 and 31.8 miles upstream of where Barton Creek enters Town Lake, and respectively, under normal flows, it is predicted that losses to volatilization will prevent any substantial amount of contaminants from reaching the lake.

However, according to one source, recharge features in Barton Creek may allow a maximum recharge rate of 250 cfs to the Edwards Aquifer (Barrett, 1996). The actual maximum recharge rate may be higher, according to the Edwards Aquifer Conservation District. In the case of a 5,000-bbl spill at the Barton Creek Crossing (slightly higher than the maximum-modeled spill), theoretically, much of the spill could be absorbed into the aquifer and transported to springs that feed Town Lake with little volatilization. This possibility is bounded by two constraints.

First, under low-flow conditions in Barton Creek, most of the spill constituents will either volatilize or absorb in soils before traveling the 23 to 24 miles from the Barton Creek or Long Branch crossings to the westernmost edge of the Barton Springs recharge zone.

At flood stage, the flow in Barton Creek may be approximately ten times higher than the maximum recharge rate for the Barton Creek section of the recharge zone as a whole. Therefore, while higher flows will transport more contaminants to the recharge zone, the recharge rate into the aquifer is still limiting. It is not possible to accurately characterize the amount of gasoline constituents that could enter the aquifer through these mechanisms without a more comprehensive model of Barton Creek, including historical flow data and projected recharge rates under various river conditions.

7.6.3.3 Overland Flows

In addition to rating the stream crossings, a database was prepared, incorporating topographic and land use data from the entire length of the pipeline, to rate the probability of a release at any point along the pipeline reaching a surface water body. These data were combined with receptor stream factors to create a separately scored factor for drinking water, recreational use, and agricultural use of waters crossed by the pipeline.

This modeling was done using Digital Elevation Models available in electronic form from the US Geological Survey. The models provide electronically formatted contour lines.

These contours were used to generate a downhill flow path for a leak at any point along the pipeline. Flow paths, or traces, were then generated every 100 meters along the entire length of the pipeline. Two important decisions were made with respect to each trace:

- The likelihood of whether a contaminant trace from a release would reach a surface water body before it could be contained or controlled; and
- Whether the water body it could reach would be considered sensitive.

The first decision is a product of a number of factors—the length of the trace, the terrain slope from the pipeline to the surface water body, and resistance to flow due to land use and cover in the pathway between the pipeline and the surface water body.

The entire pipeline route was divided into 2,515 segments of varying length. In general, segments were drainage-specific, with individual flow traces grouped by receptor water body and by overland flow scoring. The 288 stream crossings along the pipeline were also located within the data set and associated with each trace.

The stationing and overland flow scoring for each segment is maintained electronically. Further discussion is in Appendix 7H. As seen in Table 7-1 for the entire pipeline, and more illustratively in Table 7-4, with respect to potential contamination of the Pedernales River, flow pathways were rated sensitive where it was determined that the distance, terrain, and topography would make it more likely for gasoline occurring at a specific point along the pipeline could cause contamination of a sensitive or hypersensitive surface water body.

7.6.3.4 Urban Drainage

At many points in the Houston and Austin metropolitan areas, where urban encroachment on the pipeline ROW has resulted in curbed roads crossing or near the pipeline, the potential exists for a rapid release of gasoline from a rupture entering a storm drain system. These systems generally channel water to a stream or river, either with or without temporary retention facilities, and provide an additional pathway for gasoline contamination of surface waters. The storm drain systems along the pipeline were not specifically mapped out or evaluated for this exercise. However, these curbed roads are found in residential developments which are otherwise rated as sensitive for population density, and therefore, would receive a higher level of mitigation corresponding to the population rating. Thus, while not explicitly rating as sensitive areas in the Austin area where storm drains could carry gasoline from a rupture to a sensitive stream such as Onion Creek, Boggy Creek, Slaughter Creek, Barton Creek, or Long Branch, it is noted that contamination of these waterways could result from runoff via storm drains that were not captured in the overland flow analysis.

7.6.4 Sensitive Areas

In the identification of environmentally sensitive areas in Chapter 4, surface water bodies were studied with respect to three separate factors in order to determine the vulnerability to spills. Surface water impacts were differentiated based on the flow characteristics of the stream, on the ability of the stream to be isolated for cleanup, and on the downstream water uses.

These three factors, which were determined for each stream crossed by the pipeline, were combined to provide an overall rating of the potential for a release incident causing significant damages to the stream impact categories.

Ability to transport a spill was evaluated as a function of four factors:

- Location along the pipeline;
- Size of water body at crossing;
- Size of watershed; and
- Mean annual flood.

Ability to isolate the spill for cleanup was ranked based on the potential for a spill to be controlled before it entered a major river or caused contamination of an underlying aquifer. Main river stems with high flows and stream crossings within highly sensitive karst aquifers were assigned a maximum sensitivity rank. Streams above a main river stem, or in the contributing zone to a karst aquifer, were assigned lower risk rankings based on the distance to the aquifer recharge zone or river and on karst or alluvial sensitivity.

The overland transport scores for each of these segments were combined with the receptor water body sensitivity and used to assist in ranking the surface water sensitivity for each 100-meter stretch along the pipeline.

7.6.4.1 Drinking Water Impacts

Drinking water sensitivity was assigned based on distance from the crossing to the point where the water might be used for drinking water and on the overall importance of the water withdrawals at that point. The following streams were judged to present the greatest risk of contamination of a very important water supply source:

- Streams between Flat Creek and Buffalo Creek in the Pedernales watershed, with travel distances of less than 50 miles to Lake Travis.

The following streams constituted a second group, posing slightly less risk to drinking water:

- Streams between Hickory Creek up to, but not including, Youngblood Creek, in the Pedernales watershed, with travel distances less than 80 miles to Lake Travis;
- Streams between Sandy Creek and Walton Draw, but not including Rocky Creek in the Sandy Creek watershed, with travel distances less than 80 miles to Lake LBJ;
- Barton, Long Branch, and Slaughter creeks (Slaughter, for contribution to the Edwards [BFZ]) for their potential to cause contamination of Town Lake in Austin upstream of the Green Water Treatment Plant; and
- Crossings of the Colorado River Alluvium deemed to have potential to cause drinking water problems based on proximity of downstream alluvial PWS wells, including crossings of streams in the Onion Creek watershed east of the Edwards Aquifer BFZ recharge area.

A third set of streams, posing even less risk, include:

- Rocky Creek, Gentry Creek, Bear Creek, and West Bear Creek, in the Llano watershed, greater than 90 miles from the Highland Lakes; and
- Crossings of the San Saba watershed, upstream of water rights held by Menard.

Finally, crossings of the Brazos River and tributaries, which are less than 60 miles upstream of a major municipal water right held by the Galveston County Water Authority, constitute a fourth category. As described earlier, because of flow rates in the Brazos River, any impacts to this water right would be expected to be on the order of a few days in duration.

These ranking determinations for each river or stream crossed by the System are listed in Table 7-6. A scoring of 1 to 10 was used to rank risk to drinking water, with 10 indicating greatest risk.

7.6.4.2 Agricultural Impacts

Impacts to irrigation or stock use of surface water downstream of a pipeline rupture will be comparable to the impacts on public water supplies. It may be necessary for a temporary cessation (up to 24 hours) of river or stream water use downstream of a release. A rupture or leak which contaminates ground water supplies may result in contamination of a spring or seepage fed livestock tank. This effect would be analogous to the impacts to a well used for stock purposes as described in Section 7.3.

7.6.4.3 Recreational Impacts

Recreational uses were evaluated based on specific recreational facilities along the pipeline ROW and those that could be affected by a release of product. From east to west, these are (along with the surface water bodies of concern):

- Buescher State Park (Hunt Creek);
- McKinney Falls State Park (Marble Creek, Onion Creek, Boggy Creek, Slaughter Creek);
- Barton Springs Pool, Town Lake (Long Branch, Barton Creek);
- West Cave Preserve, Hamilton Pool, Hamilton Pool Preserve, Flat Creek, and Pedernales River;
- Pedernales Falls State Park (Pedernales River, creeks in Pedernales watershed upstream of the state park);
- Lake Travis and Lake Austin;
- Enchanted Rock State Recreation Area (Sandy Creek); and
- Lake LBJ.

The streams mentioned above were given a maximum score for impacts to recreational areas. The Colorado River was also scored at a maximum because this stream segment has been designated as "exceptional" aquatic habitat by the TNRCC and has correspondingly higher water-quality standards. This portion of the lower Colorado River also tends to receive additional recreational use because of the existence of the LCRA Colorado River Trail in this area.

Other rivers and streams that discharge to the Highland Lakes were scored lower because of the potential for impacts to the lakes, although because of dilution and evaporation, impacts to recreational uses of the lakes are expected to be much less than impacts to drinking water. In addition, other major rivers crossed by the pipeline (Brazos and Pecos rivers) were rated for recreational impacts, because of the short-term reduction in water uses and potential kill of recreational fish populations that could result during a major release. Scoring determinations for each river or stream crossed by the pipeline are listed in Table 7-6.

In the case of ignition during a release, the impacts to recreational use could be much greater. Ignition of a major release could result in destruction or scorching of recreational facilities and natural areas along the waterway. Ignition could also cause temperature changes and remove oxygen from the river or stream resulting in fish kills downstream of the release point.

Contamination of the Highland Lakes resulting in threats to water potability, particularly to Lake Travis as described above, may have the secondary impact of limiting the use of motorized recreational watercraft on the lake following a major rupture. The use of motorized vessels adds a background level of gasoline contaminants to the lake. Therefore, in order to guarantee potable water supplies to lake water users who draw from the surface layers of the lake (most impacted by motor boats), motorized vessels would be restricted. This secondary impact is noted, but is not used as a criteria for identifying sensitive areas along the pipeline, because those areas by nature would already be rated sensitive for potential drinking water contamination.

7.6.4.4 Impacts to Wetlands

National Wetland Inventory (NWI) maps were evaluated to determine numbers (density per linear mile), types, and (to the extent possible) aerial extent of wetlands that are within 1,250 ft of the Longhorn pipeline. Results of the evaluation are provided in Appendix 4G.

The evaluation determined that 105 riverine and 846 palustrine wetlands are crossed by the pipeline, or within 1,250 ft of the pipeline. The greatest concentration of wetlands is along the eastern portion of the pipeline, between MP 30 and MP 175, from Harris County to eastern Travis County. The density of wetlands decreases steadily west of Travis County.

Approximately 25 percent of the 105 riverine wetlands are along lower perennial streams, and 75 percent are along intermittent streams. Approximately 36 percent of the 846 palustrine wetlands along the pipeline are classified as open water, 21 percent are comprised of emergent vegetation, and 11 percent are classified as forested.

A release of product to wetlands could have acute or chronic effects on the biota in the area, depending upon spill quantities and wetland types affected. A release to forested wetlands is likely to have greater adverse impacts than a release to palustrine or riverine wetlands. Forested wetlands typically provide greater habitat diversity and have a higher trophic value than other wetland types; consequently, a release of product is likely to have more widespread and far-reaching effects on the food web than a similar spill in other wetland habitats. Forested wetlands typically are comprised of a canopy of trees that provide habitat for raptor and passerine avian species that is not present within palustrine wetlands. Forested wetlands also often provide a dense understory of shrubs and forbs that provide habitat for a greater variety of reptilian and mammalian species that are not found in other wetland communities. The importance of forested wetlands is further noted from mitigation requirements for replacement of losses that are generally at, or greater than, a 4:1 ratio. Furthermore, a product released to a forested wetland would be more difficult to remediate than that of a similar release to other wetland types.

7.6.5 Route Alternatives

7.6.5.1 Austin Re-route

Surface water resources along the Austin Re-route were identified and described in Chapter 4. The Austin Re-route has 14 stream crossings, eight more than the bypassed portion of the existing route. A number of these streams were rated as “medium” or higher for flooding, indicating that flooding in these streams could aid movement of contaminants from a pipeline release downstream before they could be controlled. All 14 stream crossings along the Austin Re-route are upstream of, and relatively near, important water supplies, therefore, these crossings are rated as sensitive for surface water impacts if a release occurred at these points.

Each of these streams can contribute to the Colorado River Alluvium, and thus a release contaminating any stream could impact Bastrop and other alluvial water supply wells downstream of Onion Creek. In addition, there is a small PWS intake on Onion Creek downstream of the creek crossing as well as the creek’s confluence with a number of tributaries that are crossed by the Austin Re-route.

Construction-related impacts to surface waters associated with the Austin Re-route is not expected, because stream crossings would be directionally drilled.

7.6.5.2 Aquifer Avoidance/Mitigation Re-route

Three major surface water basins would be crossed by the AA/M Route Alternative. These are the Brazos, Colorado, and Rio Grande. Eight major channels of major sensitive rivers or streams would be crossed.

Major Water Body Crossings by the AA/M Route Alternative

Creek/River	Drainage Basin	Creek/River	Drainage Basin
Middle Yegua Creek	Brazos River	Lampasas River	Brazos River
Yegua Creek	Brazos River	Colorado River	Colorado River
Little River	Brazos River	South Concho River	Colorado River
Leon River	Brazos River	Dove Creek	Colorado River

Most of the areas traversed by the AA/M Route Alternative do not have access to an abundant source of ground water by nature of the route design. Therefore, there is greater reliance on surface waters by many of these communities.

Because of this, a number of PWS reservoirs would be threatened by a major release from the AA/M Route Alternative. Most notable are:

- Twin Buttes Reservoir, 16 miles downstream on the South Concho River from the crossing of the AA/M Route Alternative. The Twin Buttes Reservoir is a major water supply for San Angelo.
- Waco Lake, 14 miles downstream on the South Bosque Creek from the crossing of the AA/M Route Alternative. Waco Lake serves as the primary water supply for Waco.
- Sommerville Lake, 12 miles downstream on Middle and East Yegua creeks from the AA/M Route Alternative. Sommerville Lake serves as the primary water supply for Brenham.
- Cameron City Reservoir, 7 miles downstream from the crossing of the AA/M Route Alternative on the Little River. Cameron City Reservoir is the primary water supply for Cameron.

Two factors combine to increase the sensitivity of these reservoirs to impacts from gasoline spills in their watersheds. The first factor is the short travel distances from the pipeline crossings to the reservoirs, which would allow a larger mass of benzene or MTBE from the gasoline to enter the reservoir. Second, each of these reservoirs is about an order of magnitude smaller than Lake Travis; thus, an equal mass of contaminants entering the reservoir would be expected to result in much higher concentrations in the reservoirs, creating a greater chance that any specific pipeline accident upstream of the reservoir would result in rendering the water non-potable and in extending the time span that water would be non-potable.

In addition, the Twin Buttes Reservoir is in an area where lower rainfall rates in the Upper Colorado watershed would limit the amount of dilution that could reduce contaminant concentrations in the event of a release to below drinking water standards.

Other public water supplies downstream of AA/M Route Alternative crossings, that are less likely to be impacted by a spill, include:

- The PWS for the city of Goldthwaite in Mills County, 80 miles downstream of the Colorado River crossing;
- Stillhouse Hollow Reservoir, 75 miles downstream of the Lampasas River crossing; and
- Belton Reservoir, 50 miles downstream of the Leon River crossing.

Overall, the AA/M Route Alternative poses much greater risks to the use of surface water for PWS than the proposed route.

7.6.5.3 El Paso Montana Avenue Alternative

There are no surface water crossings of either the proposed Fort Bliss or Montana Avenue routes. Due to storm drains, some possibility exists for product from a major release along the Montana Avenue route reaching the Rio Grande, although this is unlikely.

7.6.6 Mitigation Measures

Because all the major impacts discussed involve a release of gasoline that would contaminate surface water bodies at and downstream of the pipeline crossing point, any measures that reduce the probability or potential volume of a gasoline release to surface waters would have a positive impact on reducing risk to these resources posed by the pipeline. In particular, capabilities for enhanced detection and location of smaller leaks may be valuable in protecting water resources from the impacts of continuous low volume releases.

In addition, enhanced emergency response could provide an additional factor of safety in the event of a release. Enhanced emergency response would reduce the amount of gasoline reaching surface waters and reduce the downstream impacts.

Water quality monitoring may provide benefit if applied at strategic points in a watershed to aid in determining if a small leak, undetected by the leak detection system, is occurring. Analysis of trend data over time could provide a means for identifying data outliers, and provide a stimulus for additional investigation of upstream branches and tributaries to locate the source of the hydrocarbons.

Finally, since in some watersheds the flow rates of the major rivers crossed by the pipeline may have a major role in determining how much contaminant could travel from a pipeline crossing to a reservoir, studies to determine if operational controls such as reducing gasoline flow rates and pressures in the pipeline during flood stages may be valuable.

7.7 IMPACTS TO AIR QUALITY AND METEOROLOGY

7.7.1 Introduction

The EPA has established National Ambient Air Quality Standards (NAAQS) for six pollutants: ozone, lead, carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_x), and respirable particulate matter ($PM_{2.5}$). Of these contaminants, only the ozone precursor VOC is expected to be emitted during the operation phase of this project. The primary NAAQS are the levels of air quality that EPA judges necessary, with an adequate margin of safety, to protect public health. The secondary NAAQS are the levels that EPA judges necessary to protect the public welfare from any known or anticipated adverse effects. Ozone is not emitted directly into the air, but formed through chemical reactions between natural and manmade emissions of VOC and NO_x in the presence of sunlight, and VOC emissions are indirectly regulated through the ozone standards.

7.7.2 Impacts

In July 1997, the EPA announced a new NAAQS for ground level ozone of 0.125 ppb. Four areas in Texas—Houston-Galveston-Brazoria, Beaumont-Port Arthur, Dallas-Fort Worth, and El Paso—are in non-attainment of the one-hour standard. El Paso is classified as a serious non-attainment area for ozone, with a threshold value of 50 tons per year (tpy) of VOC.

7.7.2.1 Construction Emissions

Construction of new pump stations and replacement of pipe segments can result in fugitive dust emissions from soil disturbance as well as emissions from construction equipment. The construction activities and equipment used in pipeline construction are referred to as a "spread." Equipment would include machinery such as trenchers, welding machines, X-ray trucks, tracked side booms, bulldozers, and other support vehicles. Where a large number of new pipeline miles were being constructed, multiple spreads would likely be employed.

Pipeline construction emissions can be distinguished as onsite and offsite. Onsite emissions during construction would principally consist of exhaust emissions from mobile heavy-duty diesel and gasoline-powered construction equipment as well as fugitive particulate matter (dust) from material handling. Offsite emissions would result from the transportation of workers, pipe, excavation spoils, and other materials to and from the site.

Estimates of maximum daily pipeline construction emissions from a single spread for various air pollutants is included below (Aspen, 1998).

- VOC: 32.1 pounds per day (lb/day);
- NO_x: 339.0 lb/day;
- SO_x: 32.5 lb/day;
- CO: 233 lb/day;
- PM_{10}: 22.5 lb/day; and
- Fugitive Dust Emissions: 101.2 lb/day.

Construction activities along the existing route would be limited to the repair or replacement of existing pipeline.

7.7.2.2 Operational Emissions

Operation of valves and pump stations along the pipeline as well as storage facilities at the terminal in El Paso, would create fugitive emissions of volatile organic compounds (VOCs), including hazardous air pollutants (HAPs), under normal service.

7.7.2.2.1 Pumping and Storage

Project emissions were compared to various federal and state emission thresholds to determine applicability to major source classification and potential new source review regulations. New large pollutant sources in areas where the NAAQS are met (all areas except for Houston and El Paso non-attainment areas) are subject to EPA Prevention of Significant Deterioration (PSD) review as administered by the TNRCC. However, the magnitude of project emissions (including fugitives) for the sources within the attainment counties, are well below these major source designation levels, and the proposed sources are not subject to these requirements.

Emissions of VOCs from the El Paso Terminal are estimated at 48.14 tpy in the 72,000-bpd base case, which is under the threshold value for new sources of 50 tpy. The estimated total fugitive emissions of VOC for the El Paso Terminal at the full pipeline operation capacity of 225,000 bpd are projected to be approximately 66 tpy (see Appendix 7I). Since this source is located in a non-attainment area and the VOC emissions exceed the major source threshold for ozone (as VOC) of 50 tpy as the expansion of the pipeline/terminal progresses, this source will be subject to the Non-attainment New Source Review (NNSR) requirements. These requirements include that this source will need to comply with the Best Available Control Technology (BACT) Lowest Achievable Emission Rate (LAER) for ozone (as VOC).

To comply with LAER, emissions from the El Paso Terminal:

- Must not exceed applicable New Source Performance Standards (NSPS) (0.125 ppb of VOC) – (As per emission impact table, El Paso Station has a VOC concentration of 0.479 ppb)*;* and
- Must meet the most stringent limitation contained in the State Implementation Plan or the most stringent emission limitation achieved in practice.

To evaluate potential impacts on air quality, the VOC emissions were estimated based on light liquid petroleum product emission factors provided in the EPA protocol for Equipment Leak Emission Estimates (1995 EPA protocol). To estimate the impacts of those emissions, an atmospheric screening model (SCREEN3) was employed to predict the maximum one-hour ground level concentrations of VOCs under the maximum release conditions. Air quality impacts from the VOC emissions should be minor based on TNRCC's Effects Screening Level threshold levels for VOC for all project sources.

Emissions of hazardous air pollutants at the El Paso Terminal were also estimated and modeled. Estimates for hexane, benzene, toluene, 2,2,4-trimethylpentene, xylene, and ethylbenzene were based on percentages of VOC emissions from EPA Guidance (EPA – Gasoline Distribution Industry). Combined emissions of hazardous air pollutant from storage, loading, vapor recovery unit operation, equipment fugitives, and from the oil/water separator, are estimated at 5.34 tpy, including 1.06 tpy benzene, 1.93 tpy toluene, and 0.24 tpy ethylbenzene.

7.7.2.2.2 Transportation

Truck traffic would be generated to deliver the Longhorn pipeline's products to the distribution points. This would result in air emissions, as discussed in Section 7.7. The numbers (160 trucks per day, rising to 248 over the next 20 years) suggest that the resulting emissions would be a minor addition to El Paso's traffic. The total gasoline truck transport in the El Paso area is independent of the existence of the pipeline or new terminal. With the pipeline in place, the tanker trucks filling up at the Longhorn terminal would have replaced an equivalent amount of truck traffic that formerly supplied retail outlets from other terminals. Truck traffic volumes would remain the same; only the routes will change.

7.7.2.3 Accidental Releases

Accidental releases may cause short-term exposure of local residents to harmful emissions from pooled gasoline contaminated soils. This is discussed in detail in 7.2.2.3.

7.7.2.4 Noise

Noise impacts may be compared to Housing and Urban Development standards of 65 A-weighted decibels exterior day-night average sound pressure levels at the nearest noise sensitive receptor. Impacts are therefore a function of local land uses and the timing and duration of the noise generating activities.

Construction impacts are due to the noise generated by construction equipment. Construction impacts would generally last only a few days for any individual receptor and would occur only during daylight hours.

Operational impacts, by contrast, would be continuous but limited to areas surrounding pump stations. Noise would be due to pump operation.

7.7.3 Zone of Impact

The airsheds such as Houston and El Paso, which are both non-attainment for NAAQS and contain pump stations or tankage, have the highest potential for major impacts from operational emissions.

Emissions of gasoline vapors following an accidental release would have impacts based on local population density, and therefore are evaluated with other health and safety issues in Section 7.2.

7.7.4 Sensitive Areas

7.7.4.1 Air Quality

All emissions from pump stations, valves, and construction of pump stations along the pipeline would be minor in nature. None, including impacts of hazardous air pollutants, would exceed 10 percent of the Texas Effects Screening Level thresholds, at which the TNRCC projects nuisance or hazardous conditions as a result of an emissions source.

Under the proposed 72,000 bpd startup case, emissions from the tank farm would be minor, as they would not exceed 20 percent of the TNRCC Effects Screening Levels and would not be in excess of the threshold emissions rate for new sources in a non-attainment area.

As the capacity of the pipeline increases, operation of the El Paso Terminal as currently projected would exceed the major source thresholds and require compliance with BACT LAER. In this case, the emissions would be required to be completely offset resulting in no net increase in emission level.

7.7.4.2 Noise

Lands around the Odessa Lateral, around the pipeline entering El Paso, and near proposed pump stations are sparsely populated. Similarly, pump stations are not located or planned in areas of high population density. The continuously generated noise would not be greater than 65 A-weighted decibels at any sensitive receptor, although station noise may be audible at some receptors depending on background conditions.

Therefore, no impacts are anticipated from construction or operation of the pipeline. Impacts from nitrogen purges are minor because they are infrequent, and short-term and for any location along the pipeline, they are unlikely.

7.7.5 Alternative Routings

It is estimated that construction would proceed at about a mile per day for each spread. Emissions from construction of any alternative routing would be largely a function of the amount of distance covered by new pipeline.

7.7.5.1 Austin Re-route

The 22 miles of new pipeline construction along the Austin Re-route would therefore take about 22 construction days for a single spread (group of workers and equipment). The on-site construction-related emissions from the spread are included in the table below. These emissions would take place within the Austin airshed. There would be no additional or new pump stations constructed for the Austin Re-route.

7.7.5.2 Aquifer Avoidance/Minimization

It is estimated that construction would require approximately 370 spread-days, over approximately 12 to 18 months. The following table also includes estimates of the total on-site construction-related emissions for the AA/M Route Alternative construction. These emissions would take place primarily in rural areas.

Construction	VOC	NO_x	SO_x	CO	PM_{10}
Austin Re-route	0.35 tons	3.7 tons	0.36 tons	2.6 tons	0.25 tons
Aquifer Avoidance Minimization Route	5.9 tons	63 tons	6.0 tons	43 tons	4.2 tons

The AA/M Route Alternative would also require three new pump stations to be constructed prior to startup as well as an additional seven to ten pump stations during scale up to a maximum 225,000 bpd throughput.

7.7.5.3 El Paso Montana Avenue Alternative

Due to dry soils, mitigation measures would need to be applied along any El Paso route to minimize air impacts due to particulate matter. Because of proximity to surrounding receptors, construction noise would have greater impacts along the Montana Avenue route than along the proposed Fort Bliss route. Neither route is expected to result in any normal operating air emissions or noise. In the event of a large pipeline rupture, the short term air quality hazards, which would result from pooling of gasoline, would have higher potential consequences along the Montana Avenue route, because of the higher potential for human exposure along this route.

7.7.6 Mitigation Measures

In order to remain below the major source threshold levels for the El Paso Terminal as throughput levels increase, Longhorn may need to implement additional controls on fugitive emissions, such as modifications to reduce volatile emissions from storage tanks or from tanker truck loading.

7.8 IMPACTS TO TRANSPORTATION

7.8.1 Introduction

Potential transportation impacts of the System include disruption of traffic flows and access, especially emergency access on roads and railroads influenced by the pipeline. These include roads and railroads crossed by the pipeline. Nearby roads and intersections could also be affected by project-related traffic from construction or maintenance activities or by disruption from an accidental release of product.

7.8.2 Impacts

7.8.2.1 Construction

During construction, a spread approximately 50 ft wide and 1 mile in length would proceed along the ROW. Since roads crossed by pipeline ROW would be either bored or drilled, there should be no road closures during construction. However, if the pipeline runs parallel or longitudinally within a roadway, portions of the roadway that are currently used for traffic circulation and/or parking may be temporarily displaced, requiring detouring. During construction activities in urbanized settings, a short-term increase in the potential for accidents involving motor vehicles, bicycles, and/or pedestrians may occur. In rural areas, construction may temporarily restrict access to private properties that are accessible only via non-paved roads, which would be crossed by trenching.

In addition to restrictions on road usage due to construction spreads, additional traffic would be generated in the area of construction as construction workers, equipment delivery trucks, and excavation equipment travel to and from the construction zone. The volume and nature of these vehicles (particularly slower moving construction equipment) would cause short-term disruptions to local traffic.

7.8.2.2 Normal Operations

There is typically only a minimal amount of surface activity required to operate and maintain a pipeline after construction is complete.

Additional personnel associated with System operations would minimally affect local transportation activities in Houston, Austin, El Paso, pump stations, and related facilities. The System would be remotely operated; therefore, the number of employees required for routine operations would be limited to periodic site visits for monitoring, maintenance, and repair purposes along the extent of the pipeline.

Gasoline distribution from the El Paso Terminal would be with 8,000 to 10,000-gallon tanker trucks. Projected tanker truck activity at the facility, estimated using information provided in Chapter 2, indicates that approximately 160 tanker trucks daily would be loaded at the facility during initial years of operation. By 2010, tanker truck activity is expected to reach approximately 209 trips per day and by 2020, daily tanker truck trips could reach approximately 248, or more than 10 per hour assuming continuous transport.

7.8.3 Accidental Releases

In the improbable event of an ignition or large leaks in a densely populated area, temporary traffic impacts would result because of safety concerns and access for emergency response crews. These could include shutting down roads in the vicinity of the release and rerouting traffic. No long-term problems should result from such incidents. No major transportation impacts were identified in this analysis. Most impacts would be minimal and/or of short duration.

7.8.4 Zone of Impact

Traffic impacts would be a function of local conditions, including traffic density on roads which may require temporary closure and available alternatives.

7.8.5 Sensitive Areas

No areas are rated sensitive for potential traffic related impacts, as these are expected to be short-term in duration.

7.8.6 Alternative Routings

7.8.6.1 Austin Re-route

The Austin Re-route would cross Farm-to-Market (FM) Road 1327, FM 1626, State Highway 45, and Interstate Highway 35. These would be crossed by directional drilling as well as one major railway crossing. A number of smaller roads would also be crossed by boring.

7.8.6.2 Aquifer Avoidance/Minimization

The route would cross areas of moderate population density and several roads and highways requiring boring or directional drilling. The number of pipeline crossings required by this route is not known. Pipeline crossings have been identified from large-scale maps. The crossings that have been identified by Longhorn are as follows:

- 102 bored county roads;

- 45 bored FM roads;
- 9 directional drilled state highways;
- 14 directional drilled US highways;
- 1 directional drilled interstate highway; and
- 2 bored railroads and 4 directional drilled (with highways) railroads.

7.8.6.3 El Paso Montana Avenue Alternative

Both routes would entail temporary impacts associated with pipeline construction. These include short-term noise, dust, and interruption of traffic flow. However, because the Montana Avenue Alternative would be constructed along a busy El Paso arterial, it would have greater impacts.

The Montana Avenue Alternative would require construction along an 8-mile portion of Montana Avenue to an industrial area near the El Paso International Airport. Approximately 1.5 miles of the western portion of the route would be on the south side of Montana Avenue; the remainder of the alignment would be along the north side of the road. Montana Avenue would be crossed at two locations by directional drilling. Loop 375 would be crossed at one location by directional drilling. Access to a mobile home park (Quail Run), several industrial/commercial sites, and county administration facilities would be crossed by trenching.

The Fort Bliss Route would require construction within Fort Bliss to a proposed tie-in site along Loop 375 (Joe Battle Boulevard). A gravel road that is used as access along the south side of the Fort Bliss property line would be crossed by trenching; Loop 375 would be crossed by directional drilling. The Fort Bliss Route would avoid developed areas as shown in the land use map and descriptions in Chapter 4.

7.8.7 Mitigation

Since no major traffic-related impacts are expected, no mitigation measures are proposed.

7.9 IMPACTS TO LAND USE

7.9.1 Introduction

The proposed project could alter the current and planned land uses along the new pipeline segments and stations, both during and following construction. The following analysis is divided into project effects on land use, compatibility with land use regulations and plans, and impacts on recreation facilities and use.

7.9.2 Impacts

7.9.2.1 Construction

Potential impacts from new pipeline or station construction include:

- Establishment of a new pipeline ROW, potentially involving condemnation proceedings against private land owners;
- Proposed ROW or station is neither compatible nor consistent with land use plans, regulations, or controls adopted by local, state, or federal governments;
- Agricultural land conversion due to the future Longhorn pipeline pump stations or alternatives; and
- Permanent alteration of land within developed recreational facilities, state or national parks, or wildlife refuges.

7.9.2.2 Operations

Operation of the Longhorn pipeline may result in alteration of long-term development trends in urban growth patterns. In addition, under some conditions maintenance of the pipeline ROW may affect the control and safety of exotic species on private land.

7.9.2.3 Accidental Releases

Leaks and spills may damage land uses. These may include damage to private property from soil contamination, damages related to remediation activities, and property damaged in the event of a fire. Longhorn would be financially responsible for these damages. In addition, accidents could impact the quality of recreational activities because of decreases in game population or damages to public lands.

7.9.3 Zone of Impact

7.9.3.1 Parks and Natural Areas

A number of stretches of the pipeline cross parks or natural areas and streams contributing to the parks or natural areas. For some of the parks considered, such as Buescher or Pedernales Falls, the major attractions are centered around water-based activities. At Enchanted Rock State Natural Area, severe impacts to Sandy Creek would cut the facility off from public access until cleanup was completed. A severe impact to Sandy Creek would also effect the use of wells in the Sandy Creek Alluvium at Enchanted Rock. Revegetation would be included in the cleanup and restoration plans for lands affected by spills. In addition, restoration of vegetation would be completed in the event that maintenance or construction activities disturbed vegetation alongside the ROW.

7.9.3.2 Urban Areas

There is limited literature on the subject of pipeline easement effects on property values. An article written by independent appraiser Edmund D. Cook, regarding the effect of a High Pressure Gas Transmission Line on Real Estate Values in the New Jersey Metropolitan Area concluded that the pipeline easement had no detrimental effect on the sale price of dwellings subject to the gas pipeline easement found no difference in price between those dwellings adjacent to the easement and those several bocks away (Cook, 1998). Another article written regarding properties in Salt Lake City, Utah also examined residential lot sales with respect to their proximity to high-pressure natural gas lines and crude oil lines. This article found no significant difference in the sale value of lots that were crossed by the pipeline easements (Lang and Smith, 1998). In addition, it was noted that the easement and pipelines were in place before the lots were developed, indicating that developers did not see any adverse marketing factors.

Similarly, a study was performed on property values at a site where ground water contamination was apparently caused by a combination of pipeline leaks and storage tank leaks near the Norwalk Station in the city of Norwalk, California (Aspen, 1998). Homes in or adjacent to a contaminated area and similar homes outside the contaminated area were compared on a dollar per square foot basis during a time period following identification of the contamination, but when property values were stable. The results of the comparison indicated that for the homes included in the study (in the general area, values range from $92 to $170 per sq ft) the range of property values was similar within and outside the area of contamination. The study refrained from making a determination as to whether contamination had an impact on property values, noting that other factors not evaluated in the study would be required. It is conceivable that in the short term, a highly publicized pipeline accident would have a depressing effect on property values proximal to the pipeline.

The former EPC pipeline (now part of the System) was also in place before the adjacent subdivisions in Travis and Harris counties. The presence of the pipeline was not a deterrent to the land developers, to local governments that permitted the residential and school lots to be developed next to the easements, nor to home buyers who should have been aware of the pipeline easement.

There are no federal regulations that limit the distance a new building can be placed to an existing pipeline. Some cities have regulations in place, such as one formerly in place in Houston that required a building to have a 15-ft setback of a building from a pipeline carrying flammable materials under pressure. Most cities rely on the easements that the pipeline company has acquired to limit building next to the pipeline.

7.9.4 Sensitive Areas

A number of areas were rated as sensitive for potential impacts to public recreational facilities. These include crossings of Buescher State Park and Pedernales Falls State Park, in addition to the water bodies which could impact recreation described in Section 7.6.4. Urban parks, found in Houston and Austin, were rated sensitive for human health and safety because of the proximity of these facilities to highly populated areas.

Urban areas are not rated as sensitive for damages to property from a release.

7.9.5 Alternative Routings

Over either alternative routing, new pipeline ROWs would need to be established, affecting numerous landowners who are currently not party to this process. The large volume of public comment and participation following issuance of the Draft Finding of No Significant Impacts illustrates the public perception of risk from hazardous liquids pipeline operation and the reluctance to allow these facilities to operate on or near their existing property. Therefore, it can be assumed that condemnation proceedings would be required for at least a portion of any new ROW which would be established.

7.9.5.1 Austin Re-route

Most of the proposed Austin Re-route crosses privately held lands, where future development is envisioned. Approximately the first 11 miles of the Austin Re-route would cross lands included in Austin's "Desired Development Zone" under the City of Austin Smart Growth Initiative, while the remainder of the pipeline lies largely within the designated "Drinking Water Protection Zone." Establishment of a corridor would limit the amount of land available for development within the Desired Development Zone, particularly if Austin develops restrictions on land use proximal to hazardous liquids pipelines. The Austin Re-route does not cross any of the land targeted for future destination parks under the Smart Growth Initiative.

7.9.5.2 Aquifer Avoidance/Minimization

All of the land involved with the AA/M Route Alternative is privately owned except for lands owned by the University of Texas in Reagan County. Recreational activities along this rout alternative include primarily hunting (small and large game and birds), exotic game viewing, fishing, and boating. Hunting occurs throughout the area on private farms and ranches leased by private hunting clubs for deer and waterfowl hunting. The route would not cross any designated recreational areas or facilities, wildlife refuges, or national parks, but many recreational areas would be located in close proximity. Figure 7-1 shows the state parks along this route. In addition, a large amount of hunting occurs on private land.

Of the seven watercourses traversed, only the Colorado River and Little River are considered excellent fishing rivers. (The other rivers are difficult to access due to private land ownership or are not considered particularly good for fishing.) In addition, the Colorado, Little, South Concho, and Leon rivers provide opportunities for canoeing and rafting.

No county would have more than one percent of its cropland disturbed by the AA/M Route Alternative. Landowners would be compensated for losses resulting from delays in planting and harvesting. Shrub and rangeland represents about 40 percent of the land that would be crossed by the pipeline. Temporary gates and other measures would be erected to prevent livestock from escaping. Grazing land would be impacted for only a short period of time; the largest disturbance would occur in Irion County. Grazing would again be possible after restoration. Areas of concentrated residential use would be limited to less than one percent of the total land crossed.

No adverse impacts would occur to designated recreation areas during normal construction and operation activities, although some limits on recreational activities on private lands could occur.

7.9.5.3 El Paso Montana Avenue Alternative

Along either alternative route, a new pipeline ROW would need to be established. This would limit future land use within that ROW. Because of this, the Montana Avenue Alternative, where some development has already taken place and more is likely to take place in the future, would incur greater land use impacts than the Fort Bliss route.

7.10 ARCHAEOLOGICAL AND PALEONTOLOGICAL RESOURCES

7.10.1 Introduction

Section 106 of the National Historic Preservation Act (36 CFR Part 800) requires that EPA and DOT consider the effects on cultural resources and afford the Advisory Council on

Historic Preservation the opportunity to comment. The Council encourages full integration of public participation under Section 106 review with the regulations of other federal agency programs. The EPA's National Environmental Policy Act (NEPA) implementation regulations integrate Section 106 procedures by using established public involvement processes to elicit the views of interested persons (e.g., local governments, Indian tribes and nations [Tonkawa, Comanche, Lipan, Apache, Caddo, Kiowa, Wichita, Tigua, and Mescalero Apache], and the public) with regard to an undertaking and its effects on historic properties.

Programmatic Agreements are appropriate in documenting Section 106 compliance for undertakings where effects cannot be fully determined in advance of federal decision-making. EPA and DOT propose to comply with Section 106 through a Programmatic Agreement on this undertaking, in consultation with the State Historic Preservation Officer, Tribal Historic Preservation Officer, and the Advisory Council on Historic Preservation.

The Programmatic Agreement for this EA is found in Appendix 7J.

7.10.2 Alternative Routes

7.10.2.1 Austin Re-route

As noted in Section 4.4, no features were identified during a review of records that indicated the presence of any significant historical sites which would be disturbed during the construction of the Austin Re-route. Selection of the Re-route would require additional evaluation and modification of the Programmatic Agreement.

7.10.2.2 Aquifer Avoidance/Minimization Re-route

Forty-two cultural resource sites are known to exist within the 100-ft construction ROW for the AA/M Route Alternative. However, numerous additional sites are likely to be within the corridor ROW. Extensive cultural resources investigations would be needed to fully assess and mitigate potential impacts to archaeological and historical sites.

7.10.2.3 El Paso Montana Avenue Alternative

Based on cultural resource surveys, the Fort Bliss Route was aligned to avoid any of the eight historic sites near the area of potential effect of the proposed pipeline. If buried cultural materials are encountered during construction, work will cease until the site has been studied. Therefore, adverse impacts to federally protected resources are not anticipated during construction. If a spill were to occur proximal to an archeological site, remediation and repair could cause undetermined damages to a site.

Similar studies have not been conducted along the Montana Avenue Route Alternative. However, because much of the area along the route has been previously disturbed for development, any cultural resources that would have been impacted have already been affected by road and infrastructure construction.

7.11 OTHER NEPA IMPACT CATEGORIES EVALUATED

Barring accident conditions, the existing pipeline poses little impact to visual resources. The only above ground features include valve locations, pump stations, tanks at the El Paso terminal, and a number of river crossings. A maintained pipeline ROW would leave a distinctive view, particularly when crossing a wooded area. During construction activities, there would be a temporary visual intrusion from mobilization of construction equipment and the trenching.

During and following an accident, there could be disruption to visual resources. This could include scarred and discolored soil, damaged vegetation, and excavation or drilling activities associated with site remediation. Considerable damage to scenic woodlands or to adjacent structures could result if a fire resulted from a release.

Along the current alignment, a ROW has been established. Along much of the route, this ROW is shared with at least one other pipeline, and therefore relocation of the Longhorn pipeline would not change the visual impacts. Along either of the alternative routes, a new ROW would need to be established, creating a new visual impact.

7.12 CUMULATIVE IMPACTS

7.12.1 Cumulative Impacts Description

For each segment of pipeline, cumulative impacts may be accrued across resources. Tables 7-1 and 7-2 list areas that have been determined to be sensitive and hypersensitive for potential impacts to various resources. Mitigation measures can reduce the potential impacts or risk in these areas to an acceptable level (see Chapter 9).

NEPA regulations (40 CFR §1508.7) define cumulative impacts as impacts that result "from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions." There would be no cumulative impacts from pipeline construction for the Proposed Project because only eight miles of lateral pipeline remains to be constructed in

El Paso and less than one-half mile in Odessa. Construction along these routes would not exacerbate impacts from other construction because there is no other known construction in the immediate area. There could be cumulative impacts from future pump station construction. These impacts, if any, would be taken into account through a supplemental Environmental Review that would be prepared once the exact sites for the new stations have been identified.

Similarly, there are no cumulative impacts from routine System operations because there are no impacts (e.g., significant routine releases of air contaminants, noise, waste discharges, etc.) from such operations.

There are potentially serious impacts that would arise from pipeline failure. In this EA, these impacts have been addressed through risk assessment (probability, size, and consequences of spills). The issue is whether there are cumulative increases in risk as a result of other past, present, or reasonably foreseeable impact-causing activities in the vicinity of the pipeline.

Urban and suburban development in west Harris County and in south and west Travis County have risks of increased future population exposure and third-party damage (from road, utility, housing, and building construction). When the Houston-to-Crane EPC pipeline was constructed in 1949 there were very few residences, schools, and other sensitive population receptors within 1,250 ft of the ROW. It is reasonably foreseeable that there would be continued urban and suburban development along the pipeline in the future. Absent land use controls, it is likely that development and population exposed to the Longhorn pipeline would grow in the future. Longhorn mitigation measures described in Chapter 9 (such as meetings, brochures, and public service announcements) would improve public awareness of the pipeline's presence.

7.12.2 Description of Other Pipelines in the Corridor

A second potential cumulative impact from the proposed project could arise from the presence of other hazardous liquid pipelines that run parallel to the Longhorn pipeline. At issue is whether there is an increase in risk from multiple pipelines in a common corridor and whether leaks, spills, and fires from one pipeline could trigger a "chain reaction" causing one or more of the other pipelines to be damaged or result in a release of product. Another concern is that maintenance, repair, or remediation work on one pipeline could result in third-party damage to another pipeline.

The Longhorn pipeline route was reviewed, and locations where such cumulative impacts or chain reactions would theoretically occur were located and tabulated. These locations are listed in one of the following four categories:

- Segments where the Longhorn pipeline is located in the vicinity of adjacent parallel pipeline(s) operated by other companies (shown in Table 7-7);
- Locations where the Longhorn pipeline is known to be exposed and in the vicinity of adjacent parallel pipelines (summarized in Table 7-8);
- Locations where valves on the Longhorn pipeline are exposed above grade in the vicinity of adjacent parallel pipelines (shown in Table 7-9); and
- Locations where the Longhorn pipeline is known to be exposed and in the vicinity of adjacent parallel exposed pipelines (listed in Table 7-10).

As shown in Table 7-7, the Longhorn pipeline shares a general corridor with two other pipelines along parts of its route across Texas, and in some locales, several other pipelines. The greatest density of proximate pipelines occurs in Harris County. Close proximity of pipelines is common, especially in Texas, Oklahoma, and other states with large hydrocarbon production and process industry sectors.

Segments of the Longhorn pipeline in close proximity to other parallel pipelines are listed in Table 7-8. These segments were identified from Longhorn pipeline alignment sheets. In the Houston area, especially between MP 0 and MP 9, there are more than a dozen parallel pipelines in a large north-south corridor. The Longhorn pipeline also runs parallel to the other two pipelines from approximately MP 125 to MP 392 in Crockett County. These two pipelines are 24-inch diameter crude oil pipelines owned by Equilon Pipeline Company (also known as the Shell Rancho Pipeline), and a 10-inch diameter natural gas liquids (NGL) pipeline owned by Westex 66 Pipeline Company (also known as the Phillips Pipeline). Although the exact composition of the product carried in the Westex pipeline can vary, natural gas liquids can contain hydrocarbon liquids ranging from propanes to higher molecular weight liquids, typically butanes and pentanes.

The proximity creates some risk of interaction between the pipelines in the event of an accident on one of the pipelines, but also provides some benefits with regard to leak detection and third-party damage prevention. Concerns for interaction revolve around the belief that an accident in one pipeline could precipitate an accident in one or both of the other pipelines. The benefits of the Proposed Project on the other two pipelines would result from increased surveillance patrols, public education, and other third-party damage avoidance mitigation measures described in Chapter 9.

Given the concerns about population density and environmental sensitivities, the locations of the pipelines relative to each other were examined in some detail for Harris and Travis counties to provide some insight into relative risks.

7.12.3 Cumulative Impact Assessment

7.12.3.1 Potential Adverse Impacts

The primary potential adverse impact of pipelines in close proximity is the potential that an accident with one pipeline could cause an accident with the other pipelines. Examination of the DOT database on reported accidents for the years from 1986 to 1995 revealed that there were no accidents on a pipeline that caused an accident(s) on an adjacent pipeline(s).

Such occurrences are more likely with high-pressure natural gas pipelines than with hazardous liquid pipelines for several reasons. When a leak occurs in a high-pressure natural gas pipeline, the total inventory would discharge rapidly or over an extended period of time as the pipeline de-pressures. For liquid pipelines there is an initial spurt, followed by a very gradual discharge under the influence of the remaining liquid head in the pipeline. This results in a smaller, immediate discharge and one under less driving force for an extended time period. The result is less chance of ignition, less chance of soil erosion around the spill site, and less potential displacement of the pipe. The result is less potential for damage to surrounding pipelines.

The products carried by the pipelines near the Longhorn pipeline could have impacts similar to some of the impacts from the refined products that would be carried by the Longhorn pipeline. Natural gas liquids are highly volatile and flammable. Crude oil has the potential for environmental contamination of soils, surface waters and ground waters, and potential toxic effects on various species.

The potential influence of one pipeline on another would depend on the separation distances between pipelines. While there are no specific requirements for separation distances in the United States, flammable liquid storage tanks have a minimum separation distance of about 50 to 75 ft (NFPA, 1996).

The locations of the Longhorn pipeline and other pipelines were examined for Harris and Travis counties where safety risks would be greatest. The mileage of shared corridor of one pipeline to the other was determined in each county for two distance size ranges of less than 250 ft and greater than 1,000 ft, as an indicator of which areas might pose the greater risk of potential interaction between pipelines. Of the 50 miles of Longhorn pipeline in Harris County, approximately 9 miles appear to be within 250 ft of another pipeline. Of the 28 miles of Longhorn pipeline in Travis County, approximately 7 miles appear to be within 250 ft of another pipeline. Distances between the Longhorn pipeline and the adjacent two pipelines were measured at several locations in Austin. The measured distances, ranging from 19 to 2,100 ft, are summarized in Table 7-11.

Areas along the Longhorn pipeline where there are adjacent parallel pipelines and the Longhorn pipeline is exposed, where a valve on the Longhorn pipeline is situated above ground, or where adjacent parallel pipelines and the Longhorn pipeline are mutually exposed, would seem to have potentially higher risks of adverse impacts. The locations of exposed lengths of the Longhorn pipeline, as determined from the Longhorn Depth-of-Cover study, are also adjacent to and parallel to other pipelines and are listed in Table 7-8. Some of the exposed segments of the Longhorn pipeline shown in Table 7-8 are deliberately exposed (when spanning streams and ditches, for example).

Several Longhorn pipeline valves are located in those areas where the Longhorn pipeline is parallel and adjacent to other pipelines. The majority of these valves are buried in vaults below grade, but there are some valves that are not buried in this manner. These latter valves, which are exposed above grade, could be more vulnerable to the effects of any accidents that might occur on the parallel pipelines. The six exposed valves in this group are identified in Table 7-9.

There are several locations where the Longhorn pipeline and an adjacent pipeline, or pipelines, are exposed as they spanned a ditch or stream. These 11 locations, listed in Table 7-10, were identified from either the alignment sheets or from photographs provided as part of the Longhorn Depth-of-Cover study. The lengths of pipeline that are mutually exposed range from 18 to 175 ft. Approximate lateral distances between the Longhorn pipeline and adjacent exposed pipelines were estimated from the depth-of-cover photographs. The estimated distances between pipelines at these locations vary from 4 ft to approximately 50 ft.

Multiple pipelines result in a higher absolute risk to a receptor than a single pipeline(s) in the same vicinity. Assuming pipelines pose the same risk, the combined risk would be three times the risk of one pipeline. Although one accident (El Paso, October 1999), currently under investigation by DOT, has occurred where a pipeline explosion caused damage to an adjoining pipeline, a study of the previous ten years of accident reports in the US revealed no similar incidents. Therefore, it is concluded that the likelihood of such an accident is low. In addition, as noted below, there are some ways in which the mitigated Longhorn pipeline can be expected to reduce cumulative safety risks associated with adjacent pipelines.

7.12.4 Potential Benefits of Shared Corridor

Under the proposed Longhorn Mitigation Plan, there would be increased surveillance along the pipeline route. This has the potential to provide some benefit to the other pipelines along the route and contribute to risk reduction for them as well as Longhorn. Likewise, the surveillance of the other pipelines provides some additional benefit to Longhorn. Unfavorable conditions such as unauthorized third-party activity, erosion and exposed pipe conditions, and similar situations have an increased chance of being detected. This applies also to actual leaks, where an observer for one system might discover a problem with another.

Increased public awareness from heightened efforts by Longhorn helps the other pipelines and vice versa. Public awareness should deter individuals from irresponsible acts that might threaten the pipelines and also benefits from the public observing conditions in ROW areas and alerting companies of such conditions.

7.13 IMPACTS OF FUTURE PIPELINE CONSTRUCTION, REPLACEMENT, AND MAINTENANCE

Construction within the existing ROW may have impacts in four areas. First, there are potential biological impacts – these are covered in the FWS Phase I BA and BO. Second, there are potential impacts to surface waters or ground water from uncontrolled runoff, which may occur during the construction process. Longhorn would practice storm water contamination prevention practices to prevent the runoff of sediment to surface streams or karst expressions during construction activities. Furthermore, the ROW would be revegetated following construction. Third, there is a potential impact to caves or other karst features from blasting, cutting, or drilling associated with installing the pipe at an increased depth of cover. These impacts would be minimized by Longhorn's use of ground penetrating radar studies of the pipeline, identification of surface expressions in the vicinity of the pipeline, and taking special precautions where karst features could be damaged. Finally, there may be some small short-term disruptions to local residents during the construction due to construction-related traffic and noise. None of the impacts noted are deemed significant.

Longhorn has conducted a substantial amount of data gathering over the Edwards Aquifer (BFZ), including the use of ground penetrating radar, along both sides of the current pipeline for the entire length of the recharge zone. Ground penetrating radar may not fully disclose the location of all small fissures that could provide a conduit for pipeline products to reach the Edwards Aquifer. However, a much larger formation, such as a cave, would be identified by the ground-penetrating radar. One cave feature was found close to the pipeline, on the eastern segment, south of Deer Lane. In order to maintain pipeline integrity, Longhorn would use special precautions, such as identifying and sealing void spaces in the adjoining limestone when excavating and replacing pipe in this area.

Another area where there would be new construction is future pump stations. The existing pipeline currently has six pump stations which would be in operation at the 72,000 bbl/day base case, plus an additional three stations (Warda, Bastrop, and Eckert stations) which exist but which would be bypassed until pipeline throughput is increased. An additional ten stations are planned, as listed below.

Future Pump Stations	Approximate Location	Sensitive Areas
Buckhorn Station	MP 67.5 - 77.5	Bellville Population - MP 74 - MP 75
Orotaga Station	MP 203.8 - MP 213.8	Pedernales Watershed[1] MP 196 - MP 213
Llano Station	MP 265.0 - 275.0	None
Cartman Station	MP 334.0 - MP 344.0	San Saba North Fork MP 334 Eldorado GW Sensitive Band MP 341 - MP 346
Big Lake Station[2]	MP 373.5	None
Olson Station	MP 410 - MP 420.0	None
Pecos Station	MP 516.2 - MP 526.2	Pecos River Crossing MP 525
Utica Station	MP 543.6 - MP 553.6	None
Cottonwood Station[2]	MP 576.3	None
Harris Station	MP 642.6 - MP 652.6	None

[1] Watersheds include numerous sensitive areas with streams or overland flow that could conduct contaminants to specified river.
[2] Location already determined.

To the maximum extent possible, final siting of pump stations should avoid surrounding sensitive areas. Where pump stations must be located within a sensitive watershed, as is particularly the case with the proposed Orotaga Station, siting criteria should assess the proximity of rivers or streams, and the topographic gradients between the site and potentially affected surface waters. Ideally, a station should be sited to maximize the distance between the station and the sensitive stream or river, in addition to design to provide for adequate containment on-site.

In addition, a number of these pump stations would need to be located above karst aquifers. These include Orotaga and Llano (Ellenberger-San Saba Aquifer), and Cartman (Edwards-Trinity Aquifer). Prior to siting, investigations should identify any local karst features, including caves, fissures, springs, or recharge features, as well as soil thickness. A hydrogeologist with experience in karst should be involved in site location and containment design to minimize the potential for accidental releases at the pump station from reaching the aquifer.

Through proper siting and design, pump stations should pose little threat to surrounding resources.

7.14 EXAMPLES OF POSSIBLE SERIOUS SPILL SCENARIOS

In order to conceptualize the potential impacts from major spill events at highly vulnerable locations along the pipeline, accident scenarios have been constructed. Four scenarios are discussed:

- A pipeline rupture in a densely populated and therefore hypersensitive portion of Houston;
- A pipeline rupture impacting prime agricultural soils in the vicinity of Austin, Waller, or Bastrop counties;
- A pipeline rupture at the Pedernales River crossing upstream of Lake Travis, which is hypersensitive for surface water impacts; and
- A leak proximal to a karst feature in the vicinity of Eldorado, in an area which is ground water hypersensitive.

These four scenarios assume that gasoline is being transported at maximum throughputs of 225,000 bpd. With one exception, complete pipeline ruptures are assumed to occur at the most vulnerable locations for the environment described. The likelihood that any of these events might occur is extremely low. The probability of these spills is discussed in Chapter 9.

7.14.1 Houston Population Event

In the area selected for this scenario, near MP 31.2, the pipeline ROW is adjacent to two school properties (Bang Elementary and Cook Middle School) as well as a park and community recreation center. Within this highly residential area near MP 31.2, the maximum draindown volume from a complete pipeline rupture would be approximately 8,500 bbl. Such a pipeline rupture could result from construction-related excavation such as trenching for nearby utilities. Pipeline failure mechanisms such as corrosion are less likely to produce rupture-type releases.

During the first 5 minutes of such an accident until pipeline shutdown takes place, approximately 800 bbl of product would be released during maximum throughput, with the pressure temporarily causing product to spray into the air. Following the pipeline shutdown, including closure of the motor operated valve upstream (and uphill) at the Satsuma Station (MP

34.1), product would continue to drain downhill at about 80 bbl per minute, gradually slowing as the pipeline emptied.

If the release occurred during a school day, school evacuation would need to commence immediately. Bang Elementary, in particular, is within 600 ft of the pipeline, and depending on meteorological conditions a flammable hydrocarbon and air mixture could form near the school. Rapid evacuation would be necessary not only to remove the risk of fire to the children, but to minimize exposure to toxins such as benzene. Evacuation of nearby homes would also be necessary for the same reasons.

Ignition of the spill would occur if the flammable vapors were exposed to a high heat source such as a spark from a passing vehicle, machinery, or a pilot light. If ignition occurred within the first few minutes following a complete pipeline rupture and before the pipeline was shut down, the product would be ignited under pressure, and a localized pool fire or torch would result. It is unlikely that this fire would reach either school, since the expected spread of the volume that would immediately be released would be approximately 15,000 sq ft, or a spill with a radius of approximately 70 ft. However, heat impacts of 4 kW/hr could reach approximately 720 ft. Over time and without an early ignition to consume the spilled product, this radius would expand as the draindown of the pipe continued. Complicating the analysis of the spread of spilled product would be two factors – first, since the spill would be in a residential area with paved streets and curbs, once the product escapes the ROW and enters a crossing or nearby street, gasoline could flow within the curbed street to a storm gutter. This would create a more widespread release area and might also offer a containment that supports an explosion (although there would be very few ignition sources to initiate such an explosion). Second, a tributary of White Oak Bayou crosses the pipeline in this area – product could flow down the tributary through other portions of the Willowbridge neighborhood, and a certain distance downstream would expose additional receptors to flammable materials.

In the event of a release where no fire results (data suggests that less than 5 percent of gasoline spills ignite, see Section 6.2.4), or where no health impacts occur due to temporarily hazardous atmospheric conditions, use of school property and/or park properties could be impacted for some time following the accident while cleanup took place. Temporary transportation impacts could result from the need to shut off roads for safety and emergency vehicle access. Finally, White Oak Bayou water quality could be impacted from either anoxic conditions produced during a fire, or from product dissolving in water and sediment following a spill, either due to direct runoff into the tributary or to storm drains.

This scenario has a very low probability of occurring. In this specific location, the number of any sited pipeline leaks over 50 years is estimated to be about 0.001.[2] The number of major spills (>5000 bbl) is estimated to be 0.000015[3] in 50 years. Assuming a uniform population density along the entire pipeline, the number of fatalities is estimated to be 0.0000002[4] at this site and the number of injuries is estimated to be 0.000009[5] at this site. These numbers actually represent the frequency (and also the approximate probability) of one or more fatalities/injuries in 50 years along any 0.2-mile length of pipeline. At this specific location, the increased population density could increase the number of fatalities and injuries. This increase is a function of the time of day, day of week, and time of year since these impact the number of individuals in a location at a particular time. If the number of fatalities and injuries is conservatively assumed to be directly proportional to population density, then there would be proportionally more fatalities and injuries occurring with the same probabilities presented earlier. In other words, if this site has a population density 100[6] times higher than the average along the pipeline, then the probabilities of fatality or injury (0.000002 and 0.000009) apply to 100 times more individuals.

7.14.2 Prime Agricultural Farmland Event

A pipeline rupture could occur over prime farmland due to failure of the pipeline, or due to third-party damages from the operation of farm equipment (deep plows, post hole diggers, etc). In the farmlands in Austin County, for example, the total leak volume (pumping losses and draindown) could be in the range of 8,000 to 9,000 bbl. The sudden and complete rupture allows product to rapidly reach the surface. This would result in a spread of about 46,000 sq ft over the flat, highly permeable agricultural soils, contaminating approximately one acre of soils with refined product. Much of the contaminant would volatilize in the first few hours following the spill, but some contaminant would also adsorb into the soils, and become captured in the soil matrix. This soil would require either in-situ remediation or excavation and removal, but in either case, the contaminated acre of soil would remain unavailable for agricultural uses for a period of time on the order of one to two years. Some temporary interference of surrounding cropland would be necessary to facilitate staging of the equipment. Ground water and surface water contamination from this incident would be unlikely, given the absorptive nature of the

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[2] From MP 31.1 to MP 31.3: (0.0001 leaks/mile-year) x 0.2 miles x 50 years.
[3] (1.5 percent spills fraction greater than 5,000 bbl) x (0.001 leaks), using the estimated spill size distribution from Chapter 6.
[4] 0.001 leaks x (44 percent spills fraction greater than 50 bbl) x (0.00046 fatalities per leak)
[5] 0.001 leaks x (44 percent spills fraction greater than 50 bbl) x (0.02 injuries per leak)
[6] A rough calculation based on house counts, traffic volumes, and school populations, and assumed times of day, if necessary, but this is obviously problematic.

soils and the depth to the water table. Human health and safety impacts would be restricted to the users of the equipment who damaged the pipeline, because either the farm machinery or the metal-on-metal contact that causes the pipeline damage could provide an ignition source and cause a fire.

7.14.3 Pedernales River Crossing Event

A release at one of the tributaries of the Pedernales River would occur very close to, but outside the valves that isolate the pipeline river crossing, and could be coupled with a major rainfall event. Without the heavy rain, even a complete release of product during normal flow conditions would result in very small quantities of contaminants reaching downstream water users. Therefore, drinking water impacts to Lake Travis water users require a pipeline rupture to occur at a time of high rainfall for product to be rapidly carried to the Pedernales, and for flood stages in the river to rapidly transport dissolved contaminants towards Lake Travis.

Impacts to communities on Lake Travis would be greatest if a release occurred during a summer flood, when stormwater/Pedernales River water may be warm enough to completely stay above the Lake Travis thermocline upon entering the lake. If MTBE is being transported in the pipeline, under these conditions, the concentration of MTBE in the surface layers of Lake Travis (where local communities draw their water supplies) could exceed an odor threshold level of 15 ppb for time periods on the order of 2-4 months. The contaminant plume would appear at the first downstream community, Lago Vista, approximately 60 days after the release occurred. Benzene concentrations in the surface water layers could exceed the Texas drinking water limit of 5 ppb for a short time where the Pedernales enters Lake Travis, but by the time the water reached Lago Vista, the concentration would be below 5 ppb due to volatilization.

If the stormwater was much cooler than surface layers in Lake Travis, and the contaminants are trapped below the thermocline (preventing volatilization), high concentrations of MTBE (up to 1,000 ppb) could pass through Mansfield Dam to Lake Austin if a complete pipeline rupture occurred coincident with a large storm event. Benzene concentrations entering Lake Austin would be at or below drinking water standards.

At the point of release, and in the Pedernales arm of Lake Travis, fish kills and fish toxicity could result, impacting aquatic biology. No threatened and endangered species are expected to be impacted. Within Lake Travis, no impacts to recreational uses would occur, as levels of contaminants in the lake would not substantially exceed those already observed due to the gasoline spills from use of recreational watercraft. Recreational uses of downstream parks along the Pedernales including Pedernales Falls State Park, Westcave Preserve, and Hamilton Pool could also be impacted for a period of time due to contamination of the river.

7.14.4 Edwards-Trinity Pipeline Leak

The worst case scenario over the karst Edwards Aquifer would be a low volume leak, on the order of 500 to 2000 bbls per week. The location of the spill would occur in a remote area, hydrologically proximal to a karst aquifer recharge feature, in a region where ground water flows could transport contaminants towards water supply wells utilized by a number of people. An example of this is near Eldorado in Schleicher County. In this scenario, a possibility exists for a leak to continue for a few weeks before patrols or leak detection discover the problem. During this time, a substantial volume of product could enter the aquifer. This scenario would probably have higher impacts than a large rapid release, where much of the product would flow to the surface and be captured in the soil matrix or lost through volatilization.

Specific pathways, ground water volumes, and ground water fluxes are not mapped for the entire Edwards and Edwards-Trinity aquifers west of the Balcones Fault Zone, and it is not possible to establish if the ground water wells which supply Eldorado (population approximately 2,000) would be contaminated to a level exceeding drinking water standards. However, remediation of the karst aquifer could be difficult, and, if contaminated, the water from the wells would require treatment for a period of time ranging from months to years. Eldorado currently uses six wells. It is possible that some wells would be impacted while others would not. The city only has about 600,000 gallons storage capacity; therefore, upon detecting contamination, immediate steps to provide alternate or treated drinking water supplies would be necessary. Under this scenario, few other impacts should result, although some minor impacts to surface waters could result from springs or seeps of contaminated ground water into various streams in the area.

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