

The Challenge

Since 1976, when Marathon's Garyville, Louisiana refinery facility was completed, there have been no major refineries built in the United States. Marathon Oil Corporation recently announced that it will essentially rebuild the Garyville facility to expand capacity, meet new environmental regulations, and leverage the infrastructure already in place. Arizona Clean Fuels, a private sector initiative, has been working for several years to identify a site, secure air quality permits, conduct the necessary project feasibility and environmental analyses, and contract with oil producers in order to build the first new oil refinery facility in the nation since the Garyville facility. Arizona Clean Fuels was recently successful in securing their air quality permit, and the U.S. Bureau of Reclamation has now released a final Environmental Impact Statement (EIS) that moves the project one step closer to acquiring a site.



Since no refining facilities have been built in the United States in over 30 years, there were no existing site selection criteria to assist in this evaluation. In order to develop appropriate evaluation criteria for the DRA region, numerous research studies about refining operations and required infrastructure, federal regulations and numerous data sources were reviewed to assist in identifying counties and parishes suitable to construct a new oil refinery facility.



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Introduction

The Delta Regional Authority (DRA) was established by Congress in 2000 to enhance economic development and improve the quality of life for residents of the DRA region. As shown in Figure I, the DRA encompasses 240 counties and parishes in Alabama, Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri and Tennessee. Led by a federal Co-Chairman, Pete Johnson, appointed by the President, and confirmed by the Senate, the DRA is creating partnerships throughout the region designed to improve the lives of people in the region and enhance economic opportunity.

According to the U. S. Department of Energy (DOE), Energy Information Administration Annual Energy Outlook 2007 with Projections to 2030, “Despite the rapid growth projected for biofuels and other non-hydroelectric renewable energy sources and the expectation that orders will be placed for new nuclear power plants for the first time in more than 25 years, oil, coal, and natural gas still are projected to provide roughly the same 86 percent share of the total U.S. primary energy supply in 2030 that they did in 2005.” Based on this high percentage and even with the additional refining capacity that is now under construction, it is clear there is a significant demand for new refineries and major oil refinery expansions to meet future U.S. and global requirements for petroleum products.

The DRA understands the importance that petroleum resources play in the national economy and in the economic development of the DRA region. The DRA region is home to a significant number of the nation’s oil reserves and refining facilities. These facilities require major oil-related infrastructure, such as major crude oil trunk pipelines and transportation networks, to ensure products can be efficiently produced and transported across the country. Due to the existing infrastructure in the DRA region, it is an ideal location for a new oil refinery facility.

In the aftermath of Hurricanes Katrina and Rita, when 23 percent of the nation’s refining capability was shut down, gasoline prices fluctuated widely. Many of the 32 refineries in the DRA region were impacted in some way by these storms, along with some four thousand oil platforms and related oil production, transportation, and marketing facilities. It is for these reasons that the DRA secured funding from the United States Department of Agriculture (USDA) and hired Wilbur Smith Associates (WSA) to evaluate the opportunities for locating a new oil refinery facility in the Delta region.



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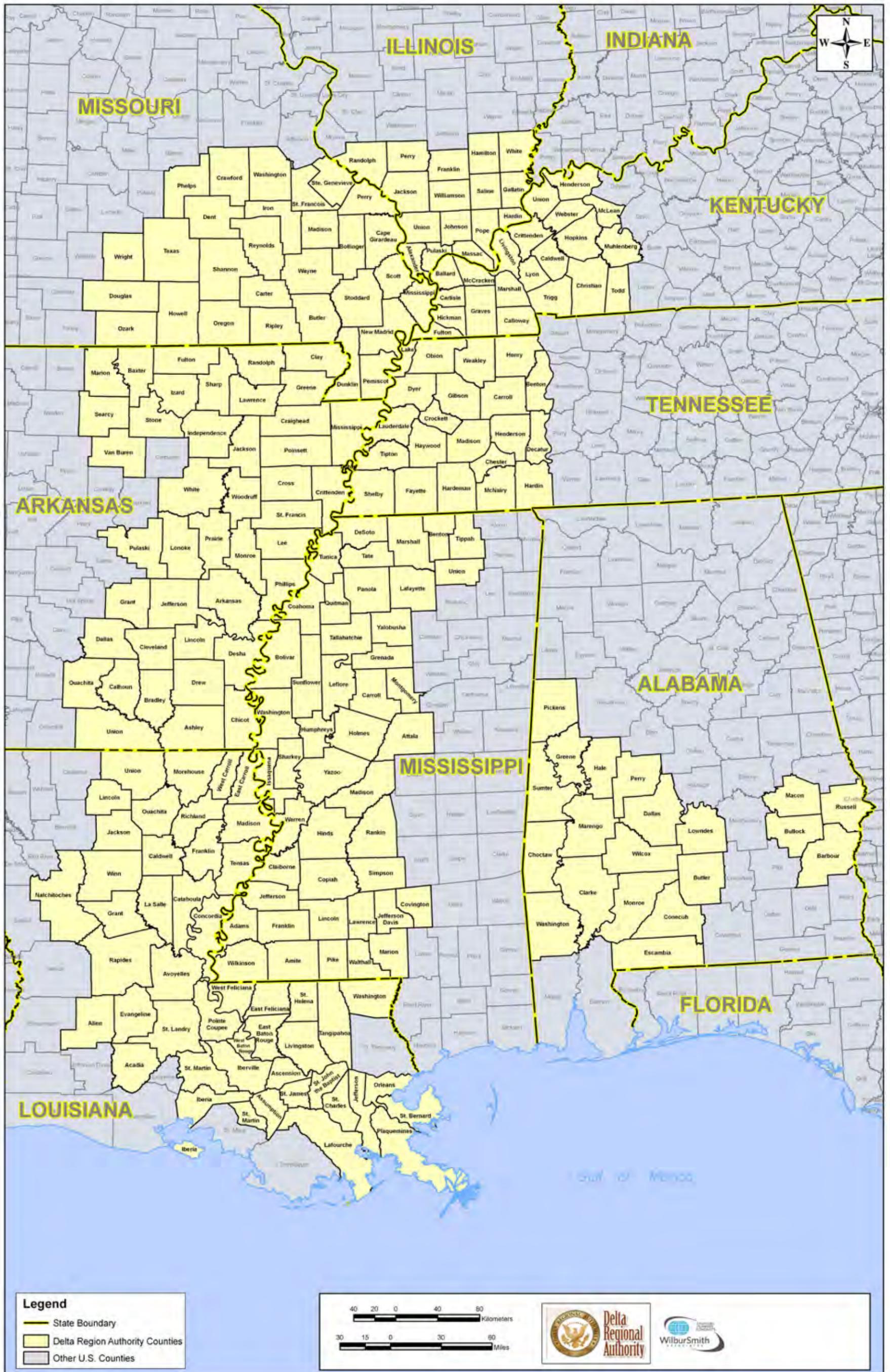
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The first step in this process was to develop evaluation criteria to assess the primary location requirements for an oil refinery facility and then based on the process, identify potential counties and parishes within the DRA region that could support this facility. Thus, the following four critical process factors were developed, which included numerous evaluation criteria:

- Fatal Flaw Factors;
- Environmental Factors;
- Infrastructure Factors; and
- Community Factors.

This process is the first step in determining a suitable site location for a new oil refinery facility in the DRA region.

Figure I: Delta Regional Authority Region



The Approach and Methodology

To create a site selection matrix and site-identification strategy for an oil refinery facility in the DRA region, it is necessary to first understand the operational elements of an oil refinery facility and the required infrastructure associated with the raw material supply process, the oil refining process, and the transportation delivery systems. Oil refinery facilities are large and vast industrial complexes with extensive piping. In the past, they posed significant air emissions concerns, odor problems, and certain health risks, but new technologies are now available to address these problems. This information assisted in developing evaluation criteria and a basic understanding of the location requirements for an oil refinery facility.

SITE SELECTION FACTORS

In a traditional industrial site selection process, the primary site selection factors typically revolve around workforce issues, highway accessibility, incentives, and corporate tax structure. Oil refining operations employ highly-skilled technical and professional employees. While the local workforce is an important factor, the primary skill base of the local workforce is not the primary selection factor. The primary selection factors for an oil refinery facility include raw material availability, environmental factors and regulations, availability of a large-acreage site, existing infrastructure and other related factors.

EVALUATION CRITERIA

Once the site selection factors were identified and coordinated with regional agencies, the following evaluation criteria were developed to assist in identifying locations to construct an oil refinery facility in the DRA region:

- Weather Impacts and Geological Zones;
 - Hurricanes and high winds;
 - Earthquakes;
- Environmentally Challenged or Sensitive Areas;
 - Air quality;
 - Endangered species;
 - Recreational areas;
 - Historic areas;
 - Water boundaries;
 - National monuments;
- Infrastructure;
 - Pipelines;
 - Ports;
 - Highways;
 - Power generators;
- Community Constraints;
 - Historic registered sites;
 - Local environmental constraints; and
 - Churches, schools and cemeteries.

Each evaluation criterion is explained in the Evaluation Process section. By identifying a series of evaluation criteria important to the location of an oil refinery facility, a site selection matrix was developed and used in coordination with GIS data to evaluate and identify potentially suitable oil refinery facility locations in the DRA region.

Evaluation Process

The evaluation process began by considering all 240 counties and parishes in the DRA region. The evaluation criteria were placed into one of the following four evaluation factor levels to assist in a detailed analysis to determine a suitable site for a new oil refinery facility in the DRA region.

Level 1: Fatal Flaw Factors

Fatal Flaw factors included the following:

- Weather Factors - Counties and parishes within the ASCE 7-98 50 - 100 year Peak Wind Speed Bands for 90 mph winds or greater, and hurricane damage impact zones;
- Geological Factors - Counties and parishes where 65 percent or more of the county or parish was within the New Madrid Seismic Zone structural damage zones VI, VII, and VIII;
- Air Quality Factors - EPA air quality non-attainment areas; and
- Recreational Factors - National and state parks, national and state forests, wildlife resource areas and national wilderness areas.

Level 2: Environmental Factors

Environmental factors included the following:

- Historic districts and historic regions;
- Identified endangered species;
- Hydrology, recreational rivers, streams, and water bodies;
- Indian reservations and Bureau of Indian Affairs data;
- Falls, forests, other park areas, and woodlands; and
- National monuments.

Level 3: Infrastructure Factors

Infrastructure factors included the following:

- General location of primary crude oil trunk pipelines;

- Primary port facilities;
- Major U.S. highways; and
- Power generators.

Level 4: Community Factors

Community factors included the following:

- Environmental Justice;
- Historic register sites;
- Locations of churches, schools, and cemeteries;
- Local environmental constraints; and
- Soil and geological information where available.

Each evaluation level of the matrix includes multiple assessment factors as noted above, and at each level of evaluation, counties and parishes were eliminated from further consideration based on data collected about these assessment factors. Each county and parish eliminated during the four-level evaluation process are identified in Appendix A, B, C and D.

I. FATAL FLAW FACTORS

The initial evaluation criteria included Fatal Flaw factors, such as weather, geological, air quality and recreational factors that represented serious situations that either could not be mitigated or represent risk conditions.

Weather Factors

Hurricanes and High Winds

Weather impacts are an important factor to evaluate when identifying potential oil refinery facility locations in the DRA region. In the past ten years, there have been six major hurricanes that created significant disruption in petroleum production: Opal (1995), George (1998), Lili (2002), Ivan (2004), and Katrina and Rita (2005). Since 1995, the Atlantic and Gulf Coast regions have experienced above normal hurricane activity and the National Oceanic and Atmospheric Administration (NOAA) has predicted those conditions may continue into the future.



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In August 2005, Hurricane Katrina left a path of destruction throughout the DRA region and Hurricane Rita created similar devastation along a different path less than a month later. The impact of these storms will be felt for years across the Gulf Coast as communities continue to cope with the loss of life, population displacements, property damage, and the catastrophic impacts to local economies and commercial activities.

The damage to the U.S. energy sector from these storms was unprecedented. According to the U.S. Department of Energy, after Hurricane Katrina:

- 2.7 million electrical customers were without power;
- 32 oil refineries were impacted;
- 11 petroleum refineries were shut down;
- 4,000 oil platforms and related production, transportation and marketing facilities were impacted;
- 5 pipelines were shut down;
 - Louisiana Offshore Oil Port (LOOP);
 - Capline crude pipeline;
 - Colonial pipeline;
 - Plantation pipeline;
 - Dixie petroleum product pipeline; and
- 23 percent of the nation's oil refining capacity was shut down.

By September 25, 2005, the impacts from both Katrina and Rita left over 1.5 million electrical customers without power; 20 petroleum refineries were still shut down.

Many factors influenced the ultimate impact these storms had on the energy sector. Some of those included the path of these storms coming directly over many production facilities and oil refineries, the significant loss of electrical power in a broad region, and the temporary loss of employees





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who were evacuated from the area for their safety. The effects of these hurricanes demonstrated the significant impact that energy costs and availability have on the national, regional and local economy. Mr. Red Cavaney, President and CEO of the American Petroleum Institute (API) said, “In the era of globalization and a tight supply-and-demand global crude oil market, any supply interruption or even a threat of interruption will affect gasoline prices in America’s heartland.” In the days after Katrina, gasoline prices increased significantly.

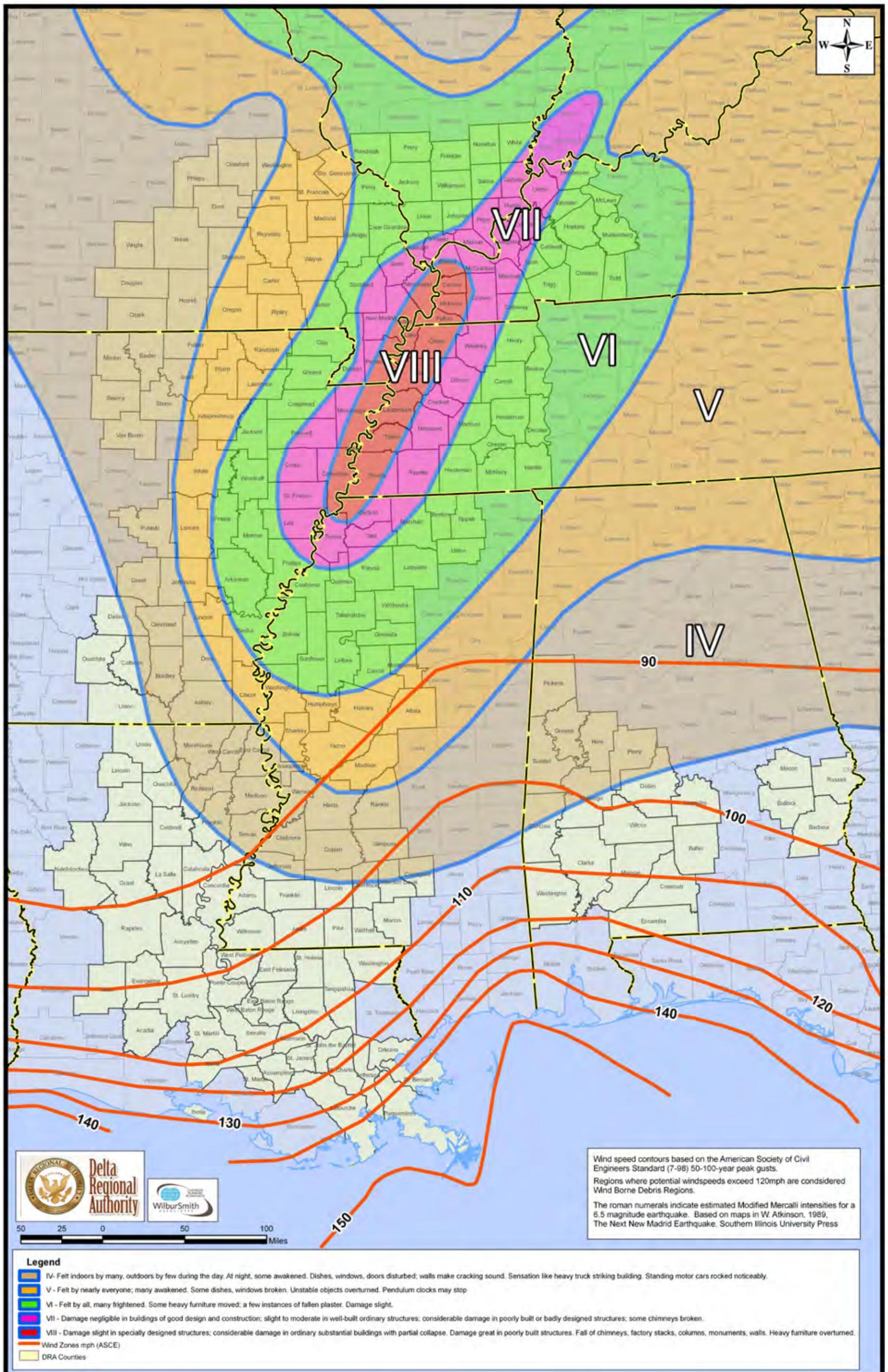
A challenge in developing the DRA oil refinery facility site selection matrix was identifying geographically based, quantifiable, and well researched evaluation criteria that provided multistate data to identify areas that were less impacted by major weather events but still had the required infrastructure needed to support an oil refinery facility. Weather related impacts from Hurricanes Katrina and Rita on existing refineries were analyzed during the development of the oil refinery facility site selection matrix process. Certainly in the aftermath of these storms, storm surge and flooding was a significant factor for refineries in areas of the DRA region. There was direct physical damage to production platforms, import terminals, and refineries caused by 20 to 25 foot storm surge and wind. According to the DOE, Energy Information Administration, much of the shut-down capacity in the energy sector after these major storms resulted from storm-related damage to the electric grid, which was principally caused by high winds and wind-driven storm surge. According to Mr. Dane Revette, Director of Energy Development for the Louisiana Department of Economic Development, “Power disruption is the worst enemy of refining operations.”

Based upon the research, the American Society of Civil Engineers (ASCE) wind band data (7-98) was used because it:

1. Provides data for the entire United States;
2. Is researched, re-evaluated, and updated; and
3. Is used by many organizations, such as the National Institute of Standards and Technology (NIST).

The ASCE 7-98 standard for the Gulf of Mexico Hurricane Coastline 50–100 year peak wind gust data is shown on Figure 2.

Figure 2: Wind Impacts and Geological Zones





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Given the projected wind speed provided by the ASCE 7-98 data, it was determined that structural damage resulting from high winds could be detrimental to an oil refinery facility. Thus, counties and parishes within the ASCE 7-98 50 - 100 year Peak Wind Speeds Bands for 90 mph or greater, and hurricane damage impact zone were eliminated from consideration.

GEOLOGIC FACTORS

Earthquakes

Geological impacts are an important factor to evaluate when identifying potential oil refinery facility locations in the DRA region. Portions of the DRA region reside within the New Madrid Fault Seismic Zone, which represents a 150-mile long fault system extending through four DRA states (Illinois, Missouri, Arkansas, and Tennessee).

The first recorded earthquake in North America occurred in the winter of 1811-1812 along this fault line. According to the United States Geologic Service (USGS), these magnitude 8.0 earthquakes centered near the town of New Madrid, Missouri and these earthquakes devastated the surrounding region. In fact, evidence of these earthquakes still remain today. According to a USGS report, scientists estimate there is a 7 to 10 percent chance of a magnitude 7.5 to magnitude 8.0 earthquake occurring in the New Madrid Seismic Zone within the next 50 years and a 25 to 40 percent chance of an earthquake of a magnitude of 6.0 or greater occurring in the next 50 years. Research from a study entitled, "Seismic Threat Posed by the New Madrid Seismic Zone," indicates that the potential destruction levels resulting from an earthquake in the New Madrid Seismic Zone could be disastrous in certain areas along the primary fault line. Thus, if this should occur, the areas surrounding this 150-mile fault line would be devastated again and quite disastrous to an oil refinery facility.

Earthquakes cause great damage to structures and if a strong earthquake occurred along the New Madrid Seismic Zone structural damage would be created by the following:

- Surface fault rupture hazards;
- Ground waves and fling effects;
- Topographic enhancement of seismic energy;
- Site amplification effects; and
- Long-period motion and resonant frequency effects.

To account for New Madrid Seismic Zone earthquake impacts, the Mercalli Scale zones were used in the site selection matrix to identify areas within the DRA region that could not support the location of an oil refinery facility because of the anticipated structural damage resulting from an earthquake. The Mercalli Scale assigns a roman numeral to zones within the New Madrid Seismic Zone and identifies specific impacts to these areas. The University of Missouri Natural Hazards Mitigation Institute also published New Madrid Seismic Zone damage predictions and these were included in the site selection matrix as follows:

- Zone VI – An earthquake within this zone would result in damage to structures; potential destruction level is serious.
- Zone VII – An earthquake within this zone would result in significant damage to buildings of good design and construction and major damage in ordinary structures; potential destruction level is “ruinous”.
- Zone VIII – An earthquake within this zone would result in damage to specially engineered structures and would create catastrophic damage in ordinary buildings; potential destruction level is “disastrous”.

Figure 2 shows the counties and parishes within the DRA region that are located within the New Madrid Seismic Zone where structural damage would be significant in the event of a magnitude 6.5 earthquake. Given the projected earthquake intensities along the New Madrid Seismic Zone along with research from USGS and several universities, it was determined that structural damage resulting from an earthquake within Zones VI, VII, and VIII would be extensive, in addition to the damage to pipelines and transportation modes. Thus, counties and parishes with 65 percent or more of their territory within New Madrid Seismic Zones VI, VII, and VIII were eliminated. Based on this evaluation, counties and parishes located within these zones were susceptible to significant damage in the event of an earthquake and thus did not meet the site selection criteria for constructing a new oil refinery facility.

Mr. Gary Patterson, an earthquake expert with the USGS Center for Earthquake Research and Information at the University of Memphis, says the New Madrid Seismic Zone contains three to five major fault segments laying on top of each other in a relatively small area, which can produce more damage than earthquakes along the west coast because the west coast fault lines are not layered in small geographical areas. According to Mr. Patterson, “It won’t take a catastrophic earthquake to do catastrophic damage” in the New Madrid Seismic Zone. One of the most potentially damaging effects of an earthquake in this area will be the liquefaction of soil near the



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surface creating essentially quicksand and eliminating the soil's ability to support the load bearing requirements of structures. This will cause buildings to collapse as the soil gives way underneath them.

Dr. Martitia Tuttle and other USGS geologists have identified sites in northeastern Arkansas and southeastern Missouri where earthquake-induced liquefaction has already occurred. According to Dr. Tuttle, ground failure that resulted from liquefaction during the New Madrid earthquakes was severe with vertical displacement of three to six feet and lateral displacement up to 33 feet. "A recurrence of that type of event would have severe consequences even for engineered structures," said Tuttle.

Liquefaction is devastating to structures because it has collapsed buildings, caused dams and bridges to fail, and created landslides. The destructive effects of liquefaction were seen in the 1964 earthquake in Japan, the 1989 San Francisco earthquake, and numerous Alaska earthquakes. Figure 3 shows the range of the New Madrid Fault Liquefaction Field in the DRA region. Given the significant adverse effects of seismically induced liquefaction and the existence of a large liquefaction field in the New Madrid Seismic Zone, the DRA counties and parishes within this field have been excluded for consideration because the structural damage that would occur from both vertical and lateral displacement in a seismically induced liquefaction would be devastating for an oil refinery facility. Thus, the subsurface conditions in these DRA counties and parishes are not suitable to support the construction of an oil refinery facility.

ENVIRONMENTAL FACTORS

While there are a number of environmental factors associated with locating any major industrial complex, there is no clear consensus about the array of environmental regulations that will come into play in actually constructing a new oil refinery facility. Air permitting regulations are influenced by air quality in the surrounding areas and a determination of Best Available Control Technology (BACT) for most industrial emission sources. BACT is a pollution control standard created by the Environmental Protection Agency (EPA) and is used to determine what air pollution control technology will be used to control a specific pollutant to a specified limit. When a BACT is determined, factors such as energy consumption, total source emission, regional environmental impact, and economic costs are taken into account. Any existing air quality issues in an area will impact future permitting requirements for a new oil refinery facility. Air quality

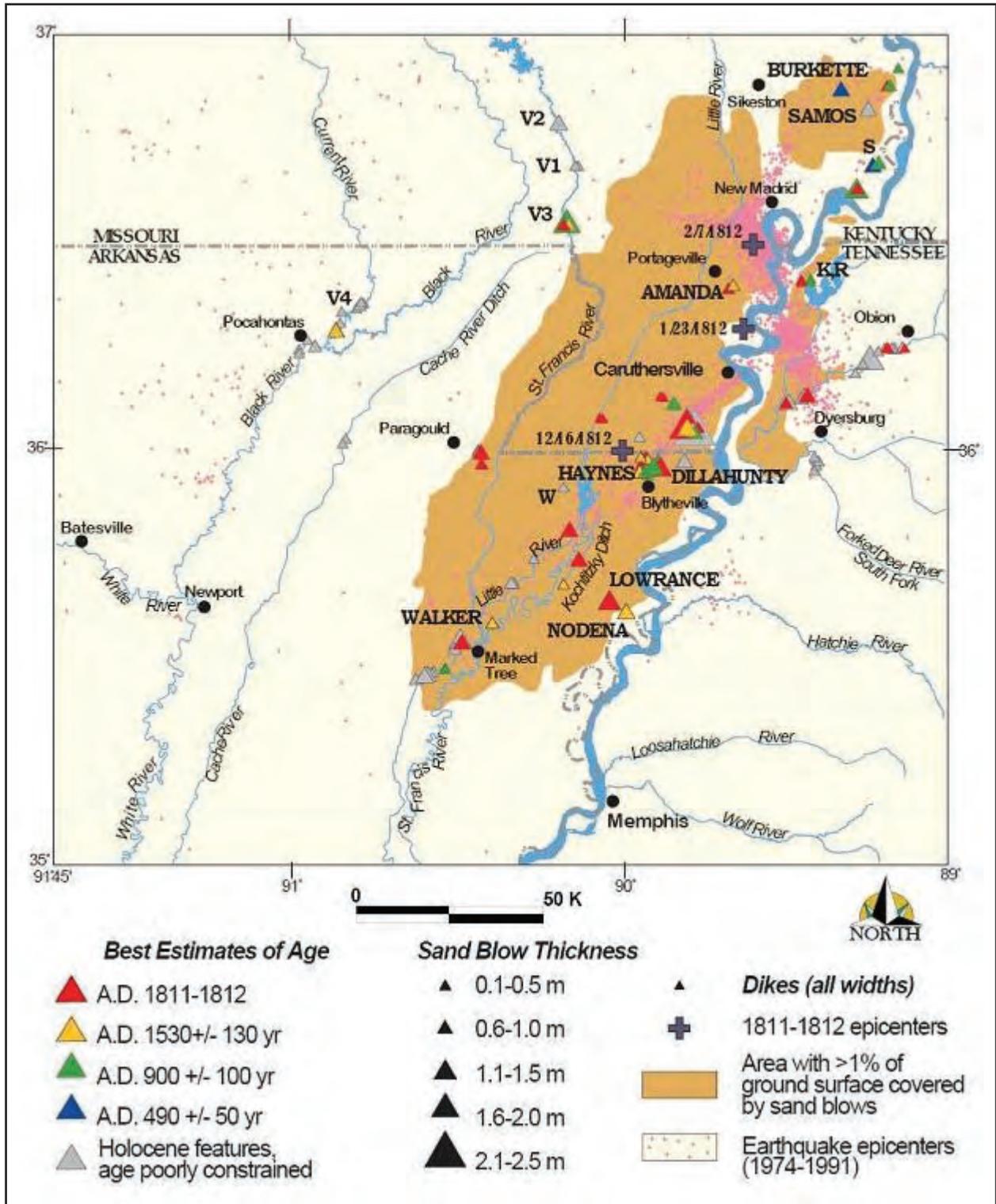


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Figure 3: New Madrid Fault Liquefaction Field



conditions are also impacted by visible haze effects, particularly in sensitive Class I areas such as wilderness areas, national parks, national monuments, and other classified zones. Individual states have established ambient air quality criteria in addition to the standards established by the EPA, and those requirements will differ in various areas depending on a range of existing pollutants, sensitive areas, existing point sources, and other factors.

AIR QUALITY FACTORS

Air quality is an important factor to evaluate when identifying locations for an oil refinery facility, to ensure potential risks and impacts to the environment and public health are identified. Environmental concerns associated with the location of an oil refinery facility include emissions of criteria air pollutants, liquid and solid waste from the process, effluent treatment and disposal, water quality issues, and a wide range of other environmental considerations. The technology requirements and infrastructure to mitigate known environmental impacts and public health issues are diverse and are regulated by federal, state, and local agencies when a final oil refinery location and design is proposed.

In addition to the regulations contained in the Clean Air Act, refineries must also comply with standards and requirements established in a number of other regulations, including:

- Mobile Source Air Toxics;
- Clean Water Act;
- Toxic Substances Control Act;
- Safe Drinking Water Act;
- Oil Pollution Act of 1990;
- Resource Conservation and Recovery Act;
- Emergency Planning and Community Right-to-Know Act;
- Comprehensive Environmental Response, Compensation, and Liability Act; and
- Occupational Safety & Health Administration (OSHA) standards.

Non-attainment is a classification used by the Environmental Protection Agency (EPA) to describe the air quality in a given area, based on the presence of six common pollutants (also known as criteria pollutants). EPA designates areas of non-attainment if there have been violations of, or significant contributions to violations of, the national 8-hour ozone standard during any 3-year



period. Given all of this, it would be difficult to locate an oil refinery facility within a non-attainment area.

The following counties and parishes in the DRA region have been designated a non-attainment area by the EPA:

- Ascension Parish, Louisiana;
- Christian County, Kentucky;
- Crittenden County, Arkansas;
- Iberville Parish, Louisiana;
- East Baton Rouge Parish, Louisiana;
- Livingston Parish, Louisiana;
- Shelby County, Tennessee; and
- West Baton Rouge Parish, Louisiana.

Although these counties and parishes have been designated by EPA as a non-attainment area, these counties and parishes were removed from further evaluation because they are located in either the ASCE 7-98 high wind area or within the New Madrid Seismic Zone area.

In an effort to evaluate the known air quality issues associated with a major industrial facility, the "Criteria Air Pollutant Report" for Mississippi, Louisiana, and Arkansas were reviewed to determine the existence of any serious air quality issues in the remaining DRA counties and parishes. Information from the Criteria Air Pollutant Report for Mississippi, Louisiana, and Arkansas is provided in Appendix E.

Counties and parishes that exceed the National Ambient Air Quality Standard (NAAQS) person-day limits have air quality conditions that are considered harmful to certain populations. Securing permitting for an oil refinery facility within these counties and parishes would be difficult under current EPA guidelines. Also, counties and parishes with heavy existing volatile organic compounds (VOCs) emissions would likely be required to reduce emissions from existing sources before a permit for additional VOC loads would be provided. Each of the pollutants outlined in the Criteria Air Pollutant Report would influence both the permitting requirements and the cost of the pollution control equipment for an oil refining operation. However, counties and parishes listed in the Criteria Air Pollutant Report were not excluded from the evaluation process because it

was determined that there are a variety of best practices and new technologies that could be used, which could enable an oil refinery facility in these counties and parishes to meet EPA permitting requirements.

RECREATIONAL FACTORS

Within the DRA region there are several national parks, national wildlife areas, national monuments, state parks, and similar areas that are classified as environmentally sensitive. Clearly, locating an oil refinery facility in close proximity to any of these areas would not be appropriate or prudent. As these areas were assessed in greater detail, counties and parishes that were significantly affected by various parks and wildlife areas were identified.

Upon closer inspection, many of these specific sites were also impacted by other national resources, such as national trails or national historic sites. While the mere presence of a national park or wilderness area did not result in a county or parish being automatically eliminated from the evaluation, the presence of multiple sensitive environmental areas or large-acreage areas was determined to be a limiting factor to development of the kind proposed, and such areas were removed from further consideration.

Counties and parishes eliminated during this level of the evaluation included Grant Parish, Louisiana, home of Kisatchie National Forest (the only national forest in Louisiana containing more than 600,000 acres of public lands) and Benton County, Mississippi, home of Holly Springs National Forest (containing 147,000 acres of public and private lands held in public trust).

Level I – Fatal Flaw Factors Eliminated Counties and Parishes

Given the potentially significant damage to structures, pipelines, and transportation networks that could result from conditions within the ASCE 7-98 Wind Speed zones and the impacts in the New Madrid Seismic Zones VI, VII, and VIII, as well as air quality and recreational factors, a total of 185 counties and parishes were eliminated from consideration of a DRA region oil refinery facility.



Based on the Level I – Fatal Flaw Factors, all DRA counties in Alabama, Kentucky, Illinois, and Tennessee along with 29 parishes in Louisiana, 17 counties in Arkansas, 22 counties in Mississippi, and nine counties in Missouri were eliminated from consideration. Pike County, Mississippi and St. James Parish, Louisiana were not eliminated from consideration because it was determined through consultation with local experts that the petroleum and transportation infrastructure, as well as the workforce contained within this county and parish were too significant to eliminate from consideration. Appendix A contains a list of each county and parish eliminated based on the Level I – Fatal Flaw Factors.