OSRADP Report #

Research and Development of a GIS of Oil and Gas Transmission Pipelines In the Lafayette, Louisiana Vicinity

By

Louisiana State University

Louisiana Geological Survey

For

Louisiana Oil Spill Coordinator's Office/Office of the Governor

Oil Spill Research and Development Program

Research and Development of a GIS of Oil and Gas Transmission Pipelines In the Lafayette, Louisiana Vicinity

Submitted to the

Louisiana Oil Spill Coordinator's Office/Office of the Governor
Oil Spill Research and Development Program

By
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Louisiana Geological Survey

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Research and Development of a GIS of Oil and Gas Transmission Pipelines In the Lafayette Louisiana Vicinity

Abstract

This project is intended to supplement emergency response and planning for hazardous materials spills emanating from petrochemical transmission pipelines in and around Lafayette Parish, Louisiana. The 1,547 miles of pipelines mapped within the study area constitute a major source for potential oil spill emergencies. Assessment of digital petrochemical pipeline data is crucial for effective energy planning, environmental monitoring, disaster prevention, and emergency preparedness.

Any pipeline leak, large or small, can be dangerous to the public. Consequences of pipeline failures include explosions or inhalation hazards causing injury or even fatalities. Similarly, hazardous liquids leaks can migrate through the permeable geology that lies beneath the study area and into the aquifer system. Crude or refined product spills can cause extensive environmental and property damage. There are many causes of pipeline failure. "Combined data for 2002-2003 indicate that "outside force" damage contributes to a larger number of pipeline accidents and incidents than any other category of causes…The data show that for hazardous liquid pipelines and gas transmission pipelines, the largest portion of outside force damage results from excavation damage." (Office of Pipeline Safety Communications: Pipeline Failure Causes, http://primis.phmsa.dot.gov/comm/FailureCauses.htm)

Accurate pipeline maps and a Geographic Information System (GIS) compiled in this project will enable increased response efficiency by allowing emergency response teams to quickly assess the product, diameter, and operator of specific pipelines. Emphasis was on transmission pipelines rather than those associated with gathering or distribution systems. Generally, the investigator considered transmission pipelines to be those with diameters of four inches or greater. However, some gathering pipeline features were developed where the investigator could determine the location of the pipeline through investigations of warning posts and map documentation.

A method to digitally verify and/or create pipeline features has been developed by the Louisiana Geological Survey (LGS). Utilizing Global Positioning System (GPS) technology, point data were collected at pipeline warning sign locations that were observed near pipeline crossings of public roads. These GPS records contain accurate positional data, pipeline operator, and commodity transported by the pipeline. These point data were compared to existing hard copy maps and digital pipeline data. Pipeline features were developed with heads up digitizing techniques utilizing aerial and satellite imagery, GPS point data, digital and hard copy maps or diagrams submitted by operators, and reliable third party maps.

Through detailed source data research, field investigation with GPS, remote sensing, and GIS analysis, a method to develop pipeline features or to adjust any spatially incorrect data has resulted in a comprehensive petrochemical pipeline GIS for the vicinity of Lafayette Parish, Louisiana. The data developed for this project is intended for emergency response as well as environmental and energy planning.

1.0 Introduction

1.1 Background

The Louisiana Geological Survey (LGS) has been compiling a digital pipeline database for the state for many years. Numerous maps and other geographic data concerning pipelines have been collected and cataloged. Most of these data have been in hard copy format, maps and other diagrams submitted by pipeline operators. Many of these submissions have poor spatial control and are not suitable for input into a GIS. These maps were helpful reference materials with the development of pipeline features in this study. Documentation on pipelines is difficult to acquire due mostly to the attacks on the United States by terrorists. Those data submitted to the Louisiana Geological Survey (LGS) have been mostly hard copy maps submitted prior to September 11, 2001. Maps with good geographic control were digitized and used for reference in this study.

Other digital data used as reference were acquired from the Federal Office of Pipeline Safety, National Pipeline Mapping System (NPMS). Generally, these data have very good spatial resolution, however, some data sets were found to contain errors. Much concern has been placed on pipeline safety and the Department of Homeland Security considers pipelines as part of our critical national infrastructure. Many pipeline operators have not submitted any data to the LGS or the NPMS. The LGS uses the digital NPMS data and operator submitted data only as reference materials. The LGS has developed digital pipeline data uniformly for all operators following guidelines created by the NPMS. Data developed for this project include intrastate pipelines as well as interstate. The NPMS data are not accessible to the public. Also, the NPMS data do not contain emergency contact telephone numbers, an important tool for emergency response to a pipeline incident. The data developed in this project can be loaded into emergency response databases and accessed quickly.

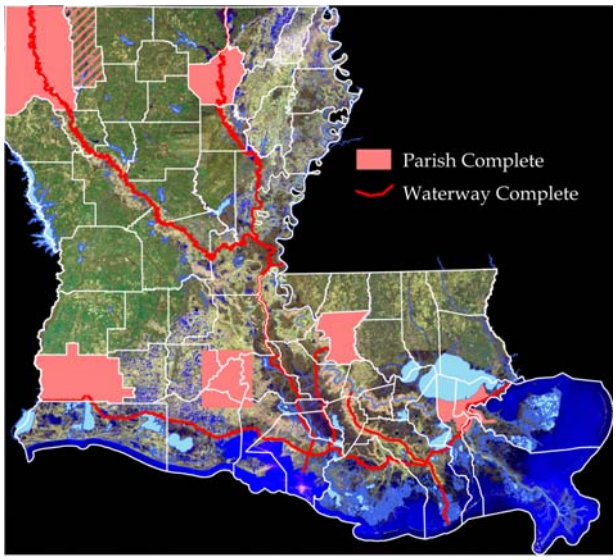


Figure 1.1.1OSRADP Funded Pipeline research to date

The LGS has been developing pipeline data for emergency response for five years. Our projects include metropolitan pipeline data as well as river crossing pipeline data. These efforts include cooperative pipeline GIS development with Dr. Michael Camille of the University of Louisiana at Monroe (ULM). Dr. Camille and his team have developed pipeline data for the Monroe and the Shreveport metropolitan areas (Figure 1.1.1).

1.2 Objective

Creating a GIS of hazardous materials pipelines is detail intensive. Evaluating the existing digital and hard copy data submitted by pipeline operators was first on the list of many tasks. Digital as well as traditional hard copy maps were intensively examined to determine their spatial integrity. Third party maps were very useful in determining location and commodities transported of many pipelines. Most of the existing LGS pipeline data needed to be further developed to conform to the digital mapping standards set forth by the NPMS. These data standards were adopted by the LGS for our pipeline mapping efforts. Details on the standards can be found in section 1.3.

Some pipeline data have proven difficult to incorporate into a GIS for lack of adequate spatial control. The various types of data submissions, digital and hard copy, have both displayed multiple problems. The focus of this study is to acquire GPS point data of pipeline intersections of primary and secondary public roadways and compare these attributes to available digital pipeline data and other maps and aerial imagery to develop a comprehensive pipeline GIS for the Lafayette vicinity.

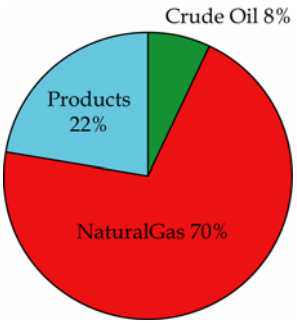


Figure1.2.1 Developed Pipeline commodities

Pipeline feature development was completed with the use of GPS technology. Field crews collected point data on pipeline warning posts observed near pipeline crossings of public roadways. The point data were overlaid on digital orthophoto quarter quadrangle (DOQQ) imagery. Pipeline features were developed using heads up digitizing techniques. 1,547 miles of pipelines were mapped in this project (Table 6.1). A greater number of natural gas pipeline were developed with 1,086.78 miles. 351.8 miles of petroleum products pipelines were developed with 108.42 miles of crude oil (Figure 1.2.1).

1.3 Data Standards

The U.S. Department of Transportation, Office of Pipeline Safety had created the National Pipeline Mapping System to “support the development of a reasonably accurate digital pipeline system” (www.npms.rspa.dot.gov or http://primis.phmsa.dot.gov/comm/Index.htm). The standards for data submission created by the NPMS allow for no more than a 500 foot margin of spatial error for digital pipeline data. The LGS has adopted these guidelines for our pipeline GIS development, but is striving to develop data that are within 50 to 100 feet of true spatial location. The standards request data provided to be in digital format with accompanying metadata. If digital data are not available, then the operator may submit hard-copy data. All submissions are to contain geospatial data (location data), attribute data (descriptive information), and metadata (description of the content, quality, condition, and other characteristics of the submitted data).

The coordinate system used is based on the North American Datum (NAD) 1983. Unprojected data that employs a common projection, such as Universal Transverse Mercator (UTM), will be accepted. Digital data that does not employ real world coordinates cannot be accepted. These would include CAD files that have origin points of 0,0. Measurement data can be metric or english units. Base maps used to develop the digital data should have scales of

1:24,000 to 1:1,200. The spatial accuracy of the digital data should be stated in the accompanying metadata.

The digital submissions should be of the following formats, ESRI's Arc/Info .E00 export files, ESRI's ArcView shapefiles (.shp), Intergraphs FRAMME and .DGN formats, MapInfo .mif files, and AutoCAD .dwg with required attribute data.

Hard-copy data submissions are accepted, using appropriate base maps, in the following formats. USGS topographic maps, 7.5 minute/1:24,000 scales are the preferred base maps. Pipeline inventory and alignment sheets are acceptable if they have a scale between 1:24,000 and 1:1,200 and contain a minimum of four georeferenced control points per sheet. Also, any third party base maps can be used if the above scale and control parameters are followed. These third party maps must also include projection parameters, datum, and graphic scale in order to be acceptable.

Unfortunately, the LGS is no longer an active part of the NPMS and have received little data from pipeline operators since the late 1990's. The NPMS data are not available for download and have displayed problems with spatial accuracy. These data need to be field verified for quality control.

2.0 Methods

The following outline describes the methodology in the pipeline feature development.

2.1 Project Method Outline

I Data collection route planning
- A) Develop preliminary GIS populated with data from LaGIS CD
- B) Study existing data for potential stops (design a route plan)
- C) Examine aerial imagery for confirmation or other stops
- D) Review traffic scenarios

II GPS data collection and compilation
- A) Compile data dictionary (list of operators and commodities)
- B) Complete route plan
- C) Ensure all data is collected and documented thoroughly

III Data projection and conversion
- A) Upload GPS point data to GIS
- B) Export features as ArcGIS Shapefile
- C) Load shapefiles into ArcGIS Project

IV Spatial feature GIS overlay and analysis
- A) GPS point data theme
- B) LGS digital pipelines theme
- C) Other digital pipeline data
- D) DOQQs and other themes from LaGIS CD to aid in analysis

VII Assess spatial accuracy of digital pipeline data
- A) Load digital point and linear pipeline data per operator into one view
    a. GPS point data shapefiles developed per operator/commodity
    b. Pipeline features, LGS and NPMS, per operator

c. Analysis unique to each operator and commodity

B) Develop pipeline features utilizing heads up digitizing

V Database normalization and quality assurance

A) Review digital attribute tables

B) Ensure database integrity (Quality Control)

C) Create metadata

VI Create CD containing GIS files and report

2.2 GPS Point Data Integration

Figure 2.2.1 Collecting GPS point data

The use of Global Positioning System (GPS) technology for the assessment of pipeline data quality has been of great value. The LGS has collected GPS point attribute data for pipeline crossings on primary and secondary roads within the study area. Most of the recorded data were found upon pipeline warning posts that are placed above the buried pipelines (Figure 2.2.1). These include, but are not limited to, operator name, commodity transported, diameter of the pipeline, and emergency telephone number. Most warning posts have the operator, commodity, and phone number listed. However, few of these warning signs have pipeline diameters listed. GPS point data were collected as close as possible to warning sign locations. The GPS data are used to verify digital pipeline spatial integrity and for pipeline feature development. Most warning signs are in plain view and well labeled (Figure 2.2.2), unlike warning signs observed elsewhere (Figures 2.2.3, 2.2.4, and 2.2.5).

Other data are automatically recorded when logging data into the GPS. These include GPS time and Position Dilution of Precision (PDOP). The PDOP is calculated to show predicted accuracy of the recorded data. These errors result from atmospheric interference and satellite geometry. Other sources of error in GPS data are multipath reflections of GPS signals, such as bouncing off buildings, and electronic interference, as with power lines. The GPS receivers were set to average a minimum of five points per location. This “averaging” technique allows for a more accurate point file. Differential correction was applied to the GPS data upon return from the field. Post processing the data was easier than real time differential due mostly to the added equipment needed to perform real time corrections. The Continuously Operating Reference Station (CORS) used to correct the collected GPS data is KJUN. It is located in Lafayette and is operated by the LSU Center for GeoInformatics.

Figure 2.2.2 Well labeled warning posts

Figure 2.2.3 Downed warning sign

Figure 2.2.4 Illegible warning sign

Figure 2.2.5 Unlabeled vent pipe

Many of the highways in the study area are without safety shoulders upon which to stop and collect data. In the areas of congested pipelines and/or no shoulder access, the vehicle was parked and the investigator walked along the road collecting the GPS point data. Great effort was taken to place the GPS antenna directly over the pipeline under feature development and as close as possible to the warning sign. Evaluation methods for spatial accuracy of existing digital data were developed using the collected point data as a standard analysis process. GPS data were loaded into the GIS and compared to digital pipeline data. The accuracy of the GPS data, after differential corrections were applied, was found to be within 3 feet.

Digital photographs were taken for reference at each stop. These photos were especially useful in resolving problems with pipeline feature development. The digital photos aid in clarifying areas with pipeline clusters or where hazardous data collection conditions exist. All field data were recorded on field notes for backup and referencing purposes.

2.3 GPS Data Collection

The geographic parameters used in data collection are Universal Transverse Mercator (UTM) coordinate system, zone 15, NAD 83 datum. The GPS point data were collected using Trimble Geoexplorer III and GeoXT GPS receivers (Trimble Navigation, Westminster, CO) and uploaded to computer via Trimble Pathfinder Office software. The Pathfinder Office software allows for the development of a data dictionary, a custom file containing operator name, commodities transported, satellite geometry, pipeline diameters, or any other list data deemed important. This file is scrolled through when recording point data in the field. Collected data is exported from the Trimble Pathfinder Office software as shapefiles, the format used by the GIS software utilized in this study (ArcGIS 8.3, ESRI Inc., Redlands, CA). A strong 90% of the recorded PDOPs throughout the field measurements are well within an acceptable error range. Recording spatial data on hard copy forms serves as a backup data source and are important to pipeline analysis. Thus, pipeline attributes are recorded in the GPS and on hard copy forms.

One of the most difficult issues to resolve in data collection was the many corporate mergers, acquisitions, and divestures in the pipelines industry. Many observed witness posts did not match any digital or hard copy data. An example of this is Louisiana Intrastate Gas Company, L.L.C. Crosstex Energy, L.P., a midstream narural gas company, acquired LIG Pipeline Company and its subsidiaries (Figure 2.3.1). These problems may have major repercussions if emergency contact phone numbers are changed without notification to emergency responders.

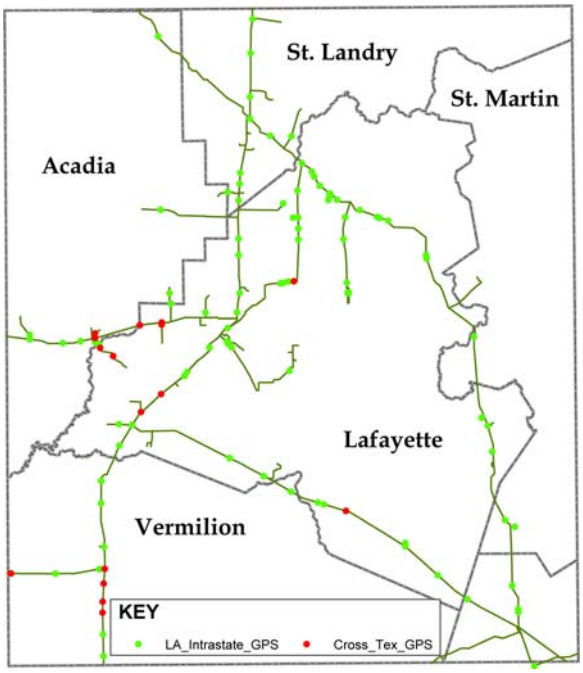


Figure 2.3.1 CtossTex and LIG GPS points

Some remote data were recorded solely on hard copy field forms. The emergency telephone numbers were difficult to key into the GPS datalogger and were added to the respective tables in the office. Occasionally, encounters with unknown or undocumented pipeline operator witness posts caused problems with documentation. These had to be recorded in the GPS as unknown and well documented on field forms. The GPS data dictionary is constantly revised to reflect all pipeline operators observed within the study area. Over 35 pipeline operators were investigated in this project with 27 operators' pipelines developed for use by emergency responders (Table 6.2). These include some gathering systems where the pipeline features were visible on aerial imagery and/or sufficient documentation verifying pipeline location. Pipelines for Hillcorp Energy Company and other gathering system operators were not included in the GIS due to the lack of documentation, but their emergency contact telephone numbers are include, where determinable, in the contacts list. Two large natural gas distribution companies operate within the study area and have extensive distribution pipelines throughout Louisiana. Centerpoint Energy has pipelines on the western edge and southeastern corner of the study area. No data

were received from the operator by the NPMS or LGS, although several requests for data were sent by LGS. Atmos Energy also has distribution pipelines throughout the study area. Determining where the distribution network and midstream pipelines interconnect and mapping the midstream lines was very difficult.

2.4 GPS Point Data Analysis

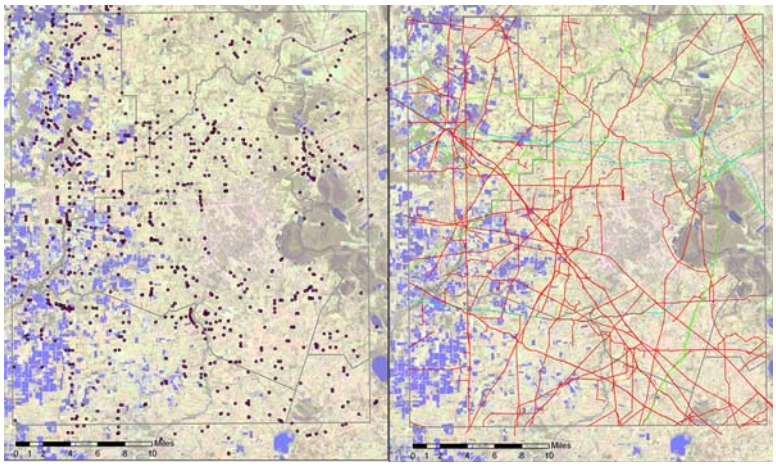


Figure 2.4.1a GPS point data and pipeline features developed

Upon completion of field investigations, the over 1,700 collected GPS point data were loaded into the GIS for analysis and pipeline feature development (Figure 2.4.1a). This was accomplished by first creating unique pipeline and GPS point attribute files per operator. GPS data were exported unique to commodity per operator for pipeline feature development. However, many pipeline warning posts vary in their specific commodities. Many of the observed posts were clearly labeled with a specific commodity, such as natural gas, crude/ petroleum, or ethylene. Many posts are labeled LPG (Liquefied Petroleum Gas), HVL (Highly Volatile Liquid), and NGL (Natural Gas Liquids). These are generic labels applied to commodities as propane, butane, butylenes, and crude oil. Primary commodities transported by these pipelines were identified with references such as hard copy map data submitted by operators, the digital NPMS data and the DTC Industrial Atlas. The differences in transported commodities between NPMS, the DTC Industrial Atlas, and observed witness posts caused problems with feature development and with estimating pipeline mileage, especially for specific commodities such as propane and ethylene. Primary commodities labeled on warning posts were not consistent and were difficult to map. The only consistent labeling was for crude/petroleum and natural gas. This project employs the database design developed by the NPMS that allows for three commodities to be listed in the attribute tables. It is commonplace for several commodities to be transported through a pipeline.

Group layers within ArcMap (ArcGIS 8.3, ESRI Inc., Redlands, CA) were created for each operator, and populated with requisite aerial imagery, GPS point data, existing digital pipeline data, road data, and other helpful themes from the LAGIS CD. Pipeline features (Figure 2.4.1b) were created utilizing heads-up digitizing techniques in ArcMap. Referencing NPMS data, the DTC Atlas, and other hard copy data, feature attributes were carefully digitized into the pipeline GIS. Collected GPS point data were used for verification of existing pipeline data, hard copy or digital. Concern for safety of the field crew and the time required to complete the point data collection were factors in the time spent at each location. The collection of point data can be a time consuming task. Each point collected could take more than ten minutes to record digitally,

document on hard copy forms, and digitally photographed. This does not include travel time from stop to stop and equipment preparation.

On occasion, poor satellite geometry or other interference would inhibit GPS data collection. This is most apparent when surrounded by buildings, trees or other obstructions. Multipath interference, reflection of satellite signals off obstructions, could affect GPS point data quality. Accuracy in point data collection is important, especially where pipelines are clustered in groups. Each pipeline was recorded in the GPS data collection unit, with each pipeline, commodity, emergency phone contact, time, and road/location also recorded on hard copy forms.

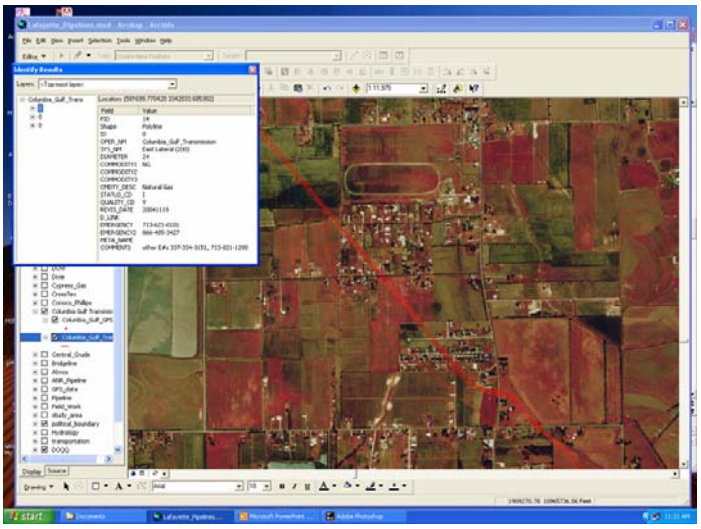


Figure 2.4.1b Pipeline feature development

2.5 Pipeline Feature Development

Pipeline features were prepared using heads up digitizing techniques in ArcMap 8.3. Using the edit function in ArcMap, pipeline features were developed utilizing GPS point data and DOQQ imagery downloaded from the Louisiana State Universities CADGIS Lab Atlas website (http://atlas.lsu.edu/rasterdown.htm). The combination of the 1 meter resolution of the DOQQs, GPS point data, and reliable third party and operator pipeline maps enabled the development of pipeline features in this project.

Great effort was taken to map pipelines as continuous linear features. Pipeline features are mapped to facilities such as pumping stations or compressor stations. Valve stations are not mapped in this effort because of the vast numbers of them and their inaccessibility.

Pipeline feature attributes were then created and populated. There were discrepancies between source data. The most common differences in data were for pipeline diameter and commodity transported (other than natural gas). Primary data sources included those of the NPMS data. These data were developed and submitted by the pipeline operators or their representatives (contracted GIS developers). If no data were submitted to the NPMS, then research into hard copy maps submitted to LGS over the years would show direction, commodity, and diameter of pipelines. However, many pipeline operators have not submitted data of any sort to NPMS or LGS. These features and attributes were determined by investigations into third party maps, mostly the DTC Industrial Atlas (Design Techniques Corporation, Houston, TX).

Attribute tables were developed after the digitizing efforts were complete. These tables are modeled after the NPMS database design template. The investigators are developing pipeline data that are compatible with data developed by other entities that are also following the NPMS guidelines. Attribute tables are created with the same field characteristics and definitions for pipeline data consistency (Table 6.3).

3.0 Analysis Results

3.1 In-House Data Analysis Results

The analysis of the LGS digital pipeline data revealed many problems with spatial data accuracy. The most notable problems are a result of inadequate data received from operators. Much of the data received prior to the implementation of the NPMS do not meet the standards for operator submissions set forth by the NPMS. Most of the problems encountered were with submitted maps of inadequate scale and detail level. Data digitized at less than 1:24,000 scale lead to excessive cartographic displacement. In some areas, this spatial displacement has been close to a mile. Also, line work representing pipeline features were often drawn with a very thick line introducing substantial spatial error.

Source data gathered by the LGS fell into three categories: large-scale or engineering diagrams with geographic control suitable for digitization, maps of small scale and poor geographic control that were not digitized (useful as reference material), and undocumented pipelines. Some 1,600 operator submitted maps are cataloged in the LGS inventory. One source of hard copy data, however, was found to be very helpful in route planning and pipeline feature development. The DTC Industrial Atlas clearly shows most of the pipeline infrastructure within the parish. The small scale of these maps, however, introduces errors of up to half a mile in some areas. These maps are copyright protected and were used solely as reference material. Other hard copy references were of limited use for they were out of date.

NPMS data has been helpful in identifying operators and commodities. However, as with previous projects, these data are not spatially accurate in many cases. Many pipeline operators have submitted data to the NPMS without verifying the data quality. Also, many operators have not submitted data to the mapping system at all. Ironically, much of the data submitted to the NPMS by operators are of intrastate designation. The NPMS was designed to map the interstate pipelines. This is a good example of the confusion in defining interstate and intrastate.

3.2 Lafayette Vicinity Pipelines

Compared to Calcasieu Parish, there are relatively few large industries within the Lafayette, Parish vicinity. Most of the transmission pipelines are part of distribution or gathering systems. Efforts were made to effectively map all pipelines with diameters greater than 4 inches (some 2 and 3 inch gathering system pipelines are included where the investigator could reasonably determine spatial location). The following section describes the pipeline operator and their respective pipelines mapped in the study.

3.2.1 Atmos Energy of Louisiana

Atmos Energy of Louisiana is the largest natural gas distributor within the state and fifth largest in the country. Atmos has completed significant acquisitions since 1986 when they purchased Trans Louisiana Pipeline Company. Research shows Atmos Energy of Louisiana, a newly created business unit of Atmos Energy Corporation, will integrate existing Atmos Energy of Louisiana assets with those of Trans Louisiana Pipelines, Louisiana Gas Service, and Mississippi Valley Gas Company.

Figure 3.2.1a Old TransLA warning sign

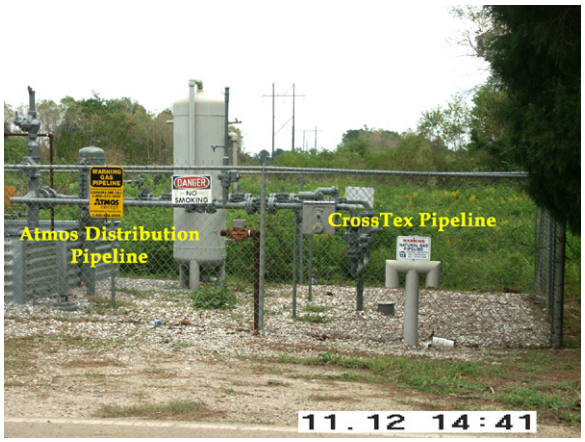


Figure 3.2.1b Natural gas midstream pipeline interconnect with distribution pipeline

A significant portion of their pipeline system is distribution of natural gas to consumers. These pipelines are less than 4 inches in diameter and encompass a wide area. The midstream portion of this pipeline system was mapped as well as possible. There were no operator supplied data to the LGS or NPMS. Third party maps were of limited use. Features for two pipelines for Atmos were developed, a 6 and 8 inch diameter. In total, 10.62 miles of natural gas pipelines were mapped.

Warning signs for Atmos Energy are numerous throughout the study area. Many signs for Trans LA were also found within the study area. Some were old (Figure 3.2.1a) and no corroborating data were found in any map source. Time and budget constraints inhibit the collection of GPS point data on every warning sign for distribution pipelines in the study area. Interconnects with midstream suppliers were documented for future mapping efforts (Figure 3.2.1b).

3.2.2 Bridgeline Holdings, L.P.

On March 1, 2000, a joint venture between Texaco Pipeline and Enron North America effectively combined their respective subsidiary assets, Bridgeline Distribution L.L.C. and Louisiana Resources Company (LRC), to form the new Bridgeline Holdings, L.P. Throughout southern Louisiana, this intrastate pipeline system consists of over 1,000 miles of natural gas transmission and distribution pipelines. A mere 12.35 miles of these pipelines are within the study area.

Data submitted to the NPMS are of good spatial quality but are listed as operated by LRC. Field verification, as well as research into each company, indicates these pipelines are operated

Figure 3.2.2 Bridgeline Holdings, L.P. warning sign

by Bridgeline Holdings, L.P. (Fig 3.2.2). Data submitted to the LGS are of limited use for the small scale of the map data. These data, when digitized, did not meet the standards for pipeline mapping and were unusable in a GIS without field verification.

3.2.3 Central Crude Inc.

A total of 10 GPS points were collected for this operator. No records of this operator were found in the LGS data. Internet research showed no website for Central Crude Operating Company nor does the NPMS data reflect pipelines operated by them. However, research into operator submitted data and third party data reveal pipelines previously operated by Exxon Pipeline Company that correspond to the GPS point data for Central Crude. 31.12 miles of crude oil pipelines features were developed for Central Crude Operating Co., Inc. These pipelines originate in the oil and gas fields north of the city of Lafayette. This crude oil gathering system makes its way to the ExxonMobil Sunset pumping station in St. Landry Parish.

3.2.4 Columbia Gulf Transmission Corporation

Through its 4,200 mile pipeline system, Columbia Gulf Transmission Corporation (CGT) serves natural gas markets in Louisiana, Mississippi, Tennessee, and Kentucky. These interstate pipelines are considered midstream. CGT does not produce natural gas, they transport the commodity through pipelines to distribution interconnects with other operators. Within the study area, CGT has roughly 152 miles of firm and interruptible natural gas pipeline service. These lines are large in diameter and extend from the southeast of the study area to the Rayne processing facility and beyond.

CGT submitted data to the LGS in engineering diagram format. The scale of these data is well suited for GIS input. The NPMS data for CGT is very good, but is represented as line segments. This project is focused on pipeline features being continuous as long as there are no interruptions in the line (plant and other facility locations).

Figure 3.2.4 CGT warning sign

3.2.5 ConocoPhillips Corporation

The ConocoPhillips Corporation has worldwide activities. Within Louisiana, they are involved with production, transportation, and refining of petroleum and derived products. Within the study area, ConocoPhillips is involved with production of crude oil. 8 gathering pipeline features were developed totaling 13.16 miles. Supportive data for these pipeline features were not submitted to the

Figure 3.2.5 ConocoPhillips warning sign

NPMS. The spatial quality of NPMS data for ConocoPhillips is generally very good. However, the pipelines in this area are not interstate in designation, thus no data were submitted to the NPMS by ConocoPhillips. The pipeline features included in the project data were developed with the GPS point data and third party maps. Data submitted to the LGS for these pipelines are generalized and are useful as reference material only. Some GPS point data could not be matched to other source maps and were not developed into pipeline features.

3.2.6 CrossTex LIG, L.L.C.

Figure 3.2.6a Old LIG warning sing

In April, 2004, CrossTex Energy, L.P., (CTE) a midstream natural gas company, acquired Louisiana Intrastate Gas Company (LIG) through its subsidiary CrossTex Louisiana Energy, L.P. The acquisition more than doubled the company's pipeline assets to 4,500 miles. LIG Louisiana assets included more than 2,000 miles of natural gas gathering and transmission pipelines. New CTE warning signs, as well as old LIG signs, are evident throughout the study area. 144 GPS point data were collected for CTE and LIG along public roads, with 23 being new signs and 121 old LIG signs. Most of the old LIG signs are weathered and difficult to read (Figure 3.2.6a). Most of LIGs pipeline rights of ways are not maintained very well, limiting the use of aerial imagery for pipeline feature development. This is evident in both figures 3.2.6a&b. Follow the flags in the figure 3.2.6b, notice the lack of a clearing where the flags (pipeline) lead.

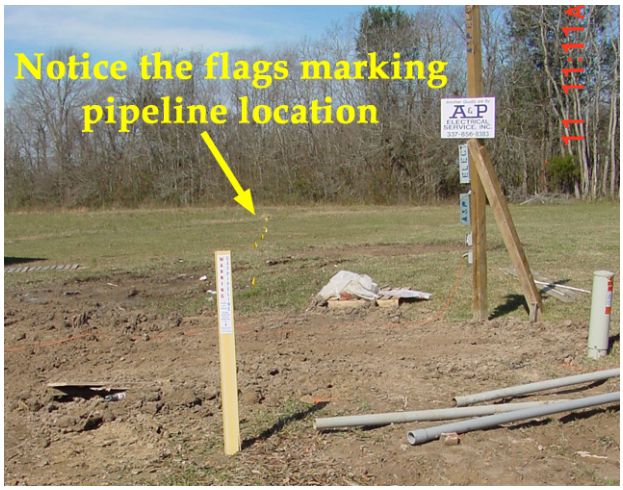


Figure 3.2.6b Efforts to mark pipelines

187.47 miles of natural gas gathering and transmission pipelines features were developed for CrossTex LIG, L.L.C. Data submitted to the LGS by LIG were useful as reference maps. The scale of these submitted data were too small to effectively digitize. The LaDOTD parish maps, used as the base maps, have proven to yield excessive spatial error upon field verification of digital pipeline features.

NPMS data contains most of the pipeline features for this operator. These pipeline data, however, are full of spatial errors (although the operator has listed in the pipeline attribute table that the data are good). Analysis of post processed GPS point data and NPMS data shows these errors to be in excess of the spatial error allowed by the

standards for digital submissions set by the Federal Department of Transportation, Office of Pipeline Safety. These data were probably developed from the same data source as those of the LGS. Recommendations to the operator should include field verification of pipeline locations, as well as right of way maintenance. Some efforts are underway to mark the pipeline locations by the operator (Figure 3.2.6b). These "flagging" efforts are usually to show property developers where pipelines are located. It is required for all, developers and home owners, to call Louisiana One Call to verify if there are pipelines or other underground utilities in the vicinity of any excavation.

3.2.7 Cypress Gas Company

Research indicates Cypress Gas Company, with 577 miles of pipelines, is owned and operated by Enterprise Products Partners L.P. Through connections with other pipeline systems, this intrastate gathering system transports natural gas to local gas distribution companies and industrial markets. All warning signs in the study area are labeled with Cypress Gas, not Enterprise. The signs, Cypress and Enterprise, are labeled with different emergency telephone numbers thus compelling the investigator to develop features uniquely focusing on emergency contacts as opposed to pipeline ownership. A total 52.37 miles of intrastate natural gas pipelines were developed for Cypress Gas in the study.

Figure 3.2.7 Cypress Gas warning sign

NPMS data show these pipelines as intrastate pipelines operated by Acadian Gas Pipeline Company. These features are spatially within the guidelines set for digital data submissions. Generally, errors were found not to exceed 100 feet. However, through post processed GPS point data analysis, the pipeline data developed in this project have a spatial accuracy tolerance more rigid than those of the NPMS guidelines.

LGS operator submission for Cypress Gas was of poor spatial quality. This map was developed by the original operator, Monterey Pipeline Company. The hard copy map has a very small scale and is more of a diagram than a map (no projection). Digital development of this map category is not recommended other than for illustrations.

3.2.8 Dixie Pipeline Company

Enterprise Products Partners L.P. has 19.9% interest in this NGL transporter. Phillips Petroleum is the primary operator. Dixie Pipeline transports propane from fractionators and refineries in Texas, Louisiana, and Mississippi to markets in the southeast. Of the 1,300 miles of pipelines operated by Dixie, 30.27 miles are within the study area. Of the 40 GPS data points recorded for Dixie, only 6 are labeled as propane, the rest are labeled petroleum. Research into

third party maps and NPMS data show the primary commodity transported through this pipeline as propane. Although the layman thinks of propane as a gas, the commodity transported through the pipeline is in liquid form and is under very high pressure.

NPMS data for Dixie Pipeline are spatially good. However, as with most submissions to the NPMS, pipelines are depicted with numerous line segments. This can be problematic for effective pipeline GIS development and implementation. These data were used as reference material in the development of pipeline features.

No data were submitted to the LGS by Dixie Pipeline Company. Pipeline features were developed utilizing aerial imagery, GPS point data, and third party maps.

3.2.9 DOW Chemical USA

Figure 3.2.9 DOW USA warning sign

DOW has petroleum products, labeled as LPG on warning signs, and natural gas pipelines in the study area. The 25.99 miles of intrastate products pipelines run through the southeast portion of the study area, as well as the 33.39 miles of intrastate natural gas pipelines.

Data submitted by DOW to NPMS has good spatial quality, however, analysis did reveal some errors that were addressed in this project. GPS point data revealed errors as great as 500 feet. The point data collected by the LGS have proven to be very helpful in determining the spatial quality of digital pipeline data submitted by operators.

DOW submitted hard copy map data to the LGS but it is of small scale thus useful as reference material only.

3.2.10 El Paso Energy

In 1988, Burlington Resources spun off El Paso Natural Gas. El Paso Energy Corporation was then formed in 1996 after the company's acquisition of Tenneco Energy. Tenneco had extensive pipeline systems within Louisiana. Three years later, El Paso merged with Southern Natural Gas Company (SONAT with 8,000 miles of pipelines). In 2001, the company changed its name to El Paso Corporation and completes a merger with The Coastal Corporation. This merger brought ANR Pipeline Company, with 10,600 miles of pipeline in the U.S., and Tennessee Gas Pipeline, with 14,200 miles of pipelines, into El Paso Corporation (as well as other out of state pipeline companies). El Paso also has 50% ownership interest in Florida Gas Transmission (Citrus Corporation, with 4,804 miles of pipelines).

Each of these operators have different emergency contact phone numbers, thus their respective pipeline features were developed uniquely according to warning post signs. ANR pipeline features were developed as El Paso ANR reflecting the warning signs (Figure 3.2.10), Southern Natural Gas Company was mapped as Southern Natural Gas Co. because the signs read as such, and likewise Tennessee Gas was mapped as Tennessee Gas Pipeline. All have unique emergency telephone contact numbers. This project is not focused on the intricacies of pipeline acquisitions and mergers. We are concerned with emergency contacts for oil spill and first responder emergency units.

Figure 3.2.10 Note the different emergency contact numbers

El Paso Field Services (EPFS) comprises of pipelines that were operated by Union Texas Petroleum Corporation (note the "pasteover" sign for EPFS in Figure 3.2.10). These pipelines transport a host of commodities. Natural gas, LPG, and petroleum were encountered on warning signs. The NPMS data are complete and have very good spatial quality.

3.2.11 Enterprise Products Partners, L.P.

Enterprise Products (EP) is also comprised of several pipeline operating systems. Within Louisiana, EP owns Acadian Gas Pipeline, Cypress Gas Pipeline, and has 49.5% interest in Evangeline Gas Pipeline. These systems transport natural gas from onshore and offshore developments to local distribution companies, such as Atmos and Centerpoint, industrial customers, and power generation facilities. EP operates 17,351 miles of natural gas pipelines in the U.S. Only a small fraction of this is reflected in the 3 miles of natural gas pipelines mapped in the project study area.

EP is also involved with NGL fractionation. This process separates mixed NGL, either from natural gas production or crude oil and condensate production, into purity components. EP currently operates 13,130 miles of NGL (Figure 3.2.11) and petrochemical pipelines in the U.S. 770 miles of crude oil pipelines are also operated by EP in the country. Over 85 miles of NGL and petrochemical (herein referred to as products) were mapped for EP in this project.

Figure 3.2.11 Enterprise warning sign

3.2.12 ExxonMobil Pipeline Company

ExxonMobil Pipeline Company and its affiliates transport over 3 million barrels of crude oil and products through approximately 11,000 miles of pipelines in North America. The system that runs through the study area is part of the Eastern Crude and Products System. 42.13 miles of crude oil pipeline features were developed for ExxonMobil within the study area.

Pipeline warning signs in the area are well marked. 58 GPS data points were collected during the field surveys. These pipelines run through active agriculture areas that effectively erase "scarring" evidence of pipeline features. This problem is common in the study area and it hinders the use of aerial imagery for digitizing along pipeline right of ways. ExxonMobil had submitted hard copy map data to LGS early in our digital mapping efforts. Although the scale and projection of the maps do not meet the standards for digital development, they were very helpful in determining direction of the pipelines and the commodity transported. These maps were also helpful in determining the system of crude oil pipelines for Central Crude, Inc.

NPMS data for ExxonMobil are very good. Digital data developed by the operator has spatial quality that is maintained throughout their pipeline data.

3.2.13 Florida Gas Transmission

With approximately 5,000 miles of natural gas transmission pipelines running from Texas to Florida, Florida Gas Transmission (FGT) has 75.86 miles of pipelines mapped in the study area. This midstream natural gas company provides services to distributors and electric generation plants in peninsular Florida. FGT is owned by Citrus Corporation through a venture with CrossCountry Energy, who operates the pipeline system. Citrus Corporation is held 50% by Southern Union and 50% by Southern Natural Gas, an El Paso Corporation affiliate. Some warning signs indicate previous owner/operator as Enron (Figure 3.2.12).

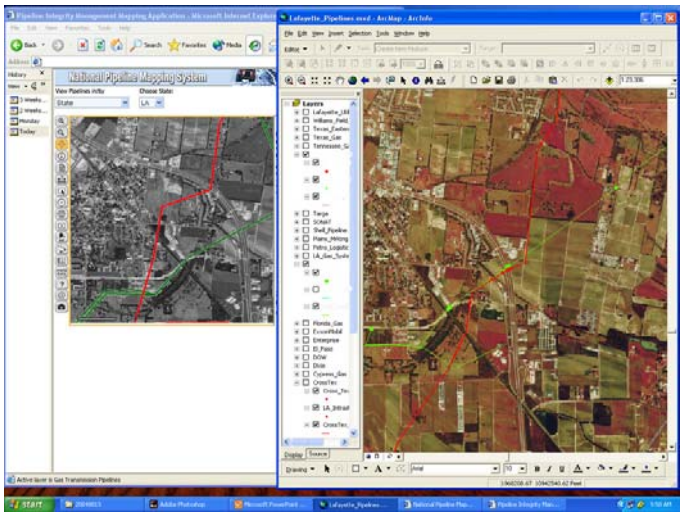
Figure 3.2.12 Florida Gas warning sign

NPMS data are spatially good. However, pipeline features developed in this project are field verified and have improved spatial quality.

3.2.14 Gulf South Pipeline

Gulf South Pipeline operates 6,800 miles of interstate natural gas pipeline system that extends from Texas to Florida. Supporting these pipelines are 1,200 miles of gathering systems and storage facilities throughout the Gulf Coast. Loews Corporation has purchased Gulf South from Entergy-Koch in late 2004, adding to its pipeline holdings of Texas Gas Transmission. Although Loews owns the two pipeline operators, each was mapped independently reflecting the unique emergency contact telephone numbers.

169 miles of natural gas pipelines were developed for Gulf South in this project. These features are both gathering and transmission pipelines. Warning signs for this operator are generally well marked throughout the study area.



NPMS data for Gulf South (as KOCH in NPMS) is spatially inaccurate. Errors in excess of 1,500 feet are commonplace (Figure 3.2.14). These data were likely developed by a third party using hard copy maps that are of small scale and limited projection definitions. LGS received similar maps and development of these submissions resulted in the same large spatial errors. Recommendations to the operator should include field verification of pipeline locations.

Figure 3.2.14 NPMS data errors, green line is Gulf South (KOCH) and red line is Texaco.

3.2.15 Lafayette Utility System Pipeline

The Lafayette Utility System has 9.24 miles of transmission pipeline that interconnects with a 20 inch Texas Gas Pipeline located inside of Acadia Parish. This intrastate pipeline supplies the city power plant with natural gas for the generation of electricity. CrossTex Pipeline also feeds the generator with 3 pipelines.

Figure 3.2.15 Warning sign for Lafayette Utility System gas pipeline

3.2.16 Louisiana Gas System (Targa Resources)

Research into this operator reflects the operator of these pipelines is Targa Resources. System maps for Targa reflect the pipelines mapped for Louisiana Gas System (LaGS). These pipelines were developed as Targa_LGS. 42.1 miles of natural gas pipeline features for Targa_LGS were developed. LaGS was an affiliate of ConocoPhillips until April of 2004, when Targa Resources purchased these midstream natural gas assets from ConocoPhillips.

Figure 3.2.16a Note the paste over information

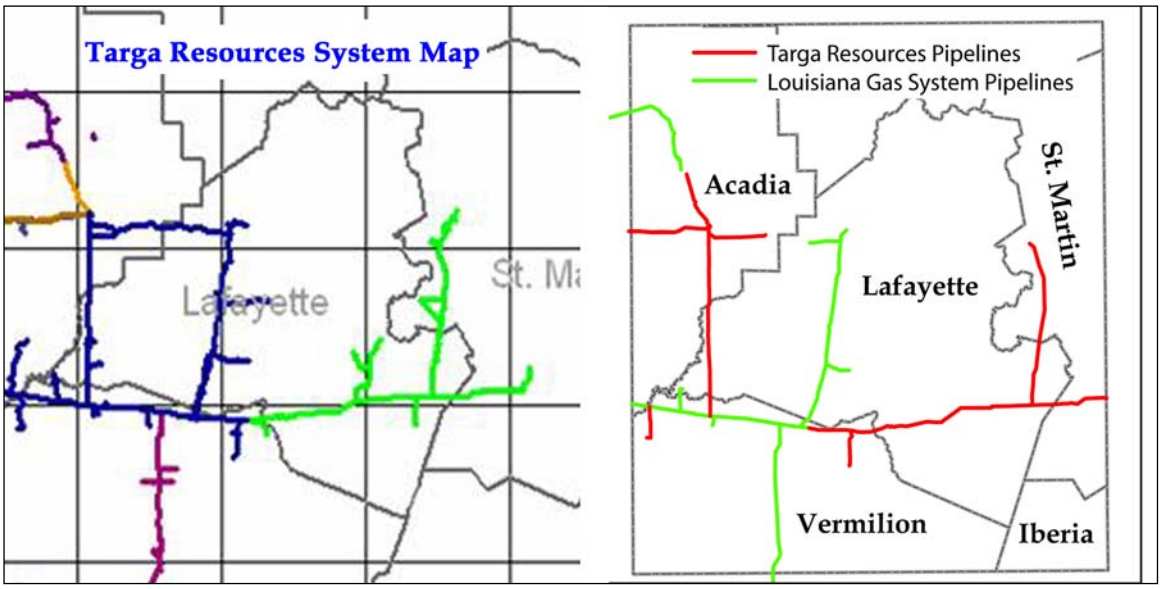


Figure 3.2.16b Targa Resources system maps reflect the pipelines developed for Louisiana Gas System

Warning signs throughout the study area are weathered and occasionally reflect the acquisition of LaGS (Figure 3.2.16a). However, the signs for this LaGS and Targa respectively line up to match pipelines on third party maps and Targa Resources system maps (Figure 3.2.16b). Updates for these and other pipeline data developed are not scheduled for the lack of funding. This is a major concern for this investigator. The data mapped for LaGS (Targa) should be reviewed (field verified) in the next year to verify emergency contacts.

3.2.17 PetroLogistics Olefins, L.L.C.

Late in 2004, PetroLogistics LLC acquired all ownership interests of Williams Olefins, LLC and certain Louisiana distribution and storage facilities. These assets include the 30.41 miles of olefins (products) pipelines that run through the study area. The commodity transported is ethane (Figure 3.2.17).

11 GPS points were logged as PetroLogistics with 17 old signs showing Williams Olefins as the operator. However, as with many mergers and acquisitions, the emergency contact telephone number is the same for both operators.

Figure 3.2.17 PetroLogistics Olefins, L.L.C. warning sign

3.2.18 Plains All American Pipeline, L.P.

As one of the largest U.S. independent midstream crude oil and LPG (products) gathering and transportation companies with approximately 15,000 miles of pipelines, Plains All American (Plains) has been gradually moving into the Louisiana market. In 1999, Scurlock Permian was acquired by Plains. This is evident in the study area for the 6 warning signs for Scurlock

documented vs. 3 for Plains (Figure 3.2.18). Other acquisitions from other operators such as El Paso and Capline have increased their Louisiana assets. However, within the study area, it appears that the pipeline assets were those of Scurlock. 22 miles of petroleum (HVL) pipelines were mapped for Plains in this study.

Figure 3.2.18 Plains All American warning sign

3.2.19 Shell Pipeline Company, L.L.C.

Figure 3.2.19 Old sign for Equilon Pipeline

Shell Pipeline Company has been operating pipelines for the transport of crude oil and refined products for over 80 years. 27.25 miles of product (ethylene) pipeline is mapped for Shell Pipeline in this study. This is an interstate system that runs through Baton Rouge from the east and on to Texas.

NPMS data is spatially good. Errors were not found to exceed 100 feet in most cases. Most GPS data were collected as Shell Pipeline Company. However, there are some Equilon warning signs still posted within the study are. The emergency contact telephone numbers are the same for both Shell and Equilon, however, the Equilon signs are labeled as propylene (Figure 3.2.19).

3.2.20 Southern Natural Gas Company

As a wholly owned subsidiary of El Paso Energy Corporation, Southern Natural Gas Company (SONAT) provides interstate transportation and storage of natural gas. Their midstream pipeline operations extend throughout the southeast providing natural gas to distributors, electric generation facilities among other end users. 2.22 miles of 20 inch interstate transmission pipelines pass through the southeast corner of the study area.

NPMS data show SONAT pipelines with good spatial quality. SONAT submitted engineering diagrams to LGS early in our mapping efforts. These data are suitable for GIS input, however, the spatial resolution of developed data were greatly improved upon with GPS field verification and aerial imagery analysis.

3.2.21 Targa Resources, Inc.

Targa Resources, Inc. (Targa) is a midstream energy company that was formed in 2003. In December of 2004, Targa acquired Enron North America's 40% interest in Bridgeline, L.L.C. (not to confused with the Bridgeline Holdings acquisition of Louisiana Resource Company).

Figure 3.2.21 Warning sign for Targa

ChevronTexaco (now Chevron) retains the other 60% interest. In mid 2004, Targa acquired the midstream energy assets of ConocoPhillips, which includes Louisiana Gas System (LaGS). Targa's assets include intrastate natural gas pipeline systems as well as intrastate NGL and crude oil pipeline systems. The Louisiana assets include some 700 miles of pipelines and supplies near 40% of the Lake Charles, Louisiana industrial and refining market. Pipeline features were developed in this project according to warning signs.

60.67 miles of pipelines features were developed for this operator within the study area. Most of these miles were for natural gas with 52.97 miles mapped. The remaining 7.7 miles of mapped pipelines are for products (NGL).

Targa has not submitted data to the NPMS or the LGS. The relative newness of this operator precludes them from the mass requests for data sent by the LGS in the late 1990s. However, the map data received from Conoco as a result of these requests reveal the pipelines in question. Also, replacing warning signs is a time consuming and costly task.

3.2.22 Tennessee Gas Pipeline Company

Tennessee Gas Pipeline Co. (TGP) is one of the five large interstate pipeline transmission companies that make up El Paso Corporation's Pipeline Group. TGP has more than 100 interconnects with other major pipeline systems and roughly 14,200 miles of pipelines. 58.98 miles of natural gas pipeline features were mapped for TGP in the study area. Most of the miles mapped are for two large diameter interstate pipelines.

NPMS data has very good spatial quality. Data in the NPMS are within 80 feet, but generally fall within 30 feet of the mapped features.

3.2.23 Texaco Pipeline, L.L.C.

Although Texaco is a part of Chevron, Texaco Pipeline has retained its name according to warning signs within the study area. Again, the focus of this project is to identify pipeline features and collect the emergency telephone contact data.

NPMS data for Texaco is not very good (Figure 3.2.14). Spatial errors were found to exceed 1,000 feet in some instances. Pipeline features developed for this project far exceed the quality of the operators' data. No data were received by the LGS from Texaco for onshore pipelines in this area. Third party maps, GPS data, and DOQQs were relied upon for pipeline feature development. Suggestions to the operator should include field verification of their pipeline locations.

3.2.24 Texas Eastern Transmission Corporation

The post World War II days marked the beginning of Texas Eastern Transmission Corporation (TET) when the U.S. government sold the Big Inch and Little Big Inch pipeline

systems in east Texas. These pipeline systems were a crucial part of the war effort. In 1989, Panhandle Eastern Corporation acquired the assets of TET, which reorganized in 1996 to form PanEnergy Corporation (PEC). A year later, Duke Energy was formed through a merger with Duke Power and PEC. Duke Energy is involved with the transportation of natural gas and natural gas liquids. The pipeline feature in this project was developed as TET because of the warning signs being labeled as such (Figure 3.2.24). This 14 inch pipeline begins at the Rayne plant and goes to markets northeast of the study area.

The data submitted by the operator to the NPMS is of excellent spatial quality. Most of the pipeline is mapped within 50 feet of the collected GPS point data. The line is consistent and continuous without many breaks.

3.2.25 Texas Gas Transmission, L.L.C.

Texas Gas Transmission (TGT) is a natural gas midstream and gathering pipeline transmission company. As with most of the midstream operators, TGT's market includes distribution, industrial, and energy production facilities. Most of their gathering system is located in south Louisiana, with some located in north Louisiana and east Texas. TGT interstate transmission pipeline systems serve customers in Ohio, Indiana, Kentucky, Tennessee, and Mississippi.

Pipeline markers for TGT within the study area are in good condition and the pipeline right of ways are clear (Figure 3.2.25). This facilitates pipeline GIS development for several reasons. First, GPS point data can be collected without obstructions that block the view of the marker. Field crews can see where the pipeline goes thus enabling an idea where to expect to see more markers. Also, the clear right of way also helps with pipeline feature development because aerial imagery depicts the clearings very well.

Figure 3.2.25 Texas Gas warning sign

The data supplied to the NPMS by the operator has excellent spatial quality. Errors were not noticed to be in excess of 20 feet.

3.2.26 Williams Field Service

Williams Energy is comprised of several energy businesses. Although the four companies are part of one entity, certain assets and activities are separate for financial and regulatory reasons. Williams Energy locates, produces, purifies, and transports natural gas to markets throughout the U.S. with some processing and storage in Canada. Their Louisiana assets are extensive and extend throughout the southern portion of the state as natural gas gathering.

Within the study area, only one of Williams Energy's groups operates, Williams Field Service Group (WFS) is a large natural gas gathering production and processing operation. The acquisition of Transco Pipeline assets expanded WFS pipeline systems to gathering and

production. Although extensive, only a small portion on WFS natural gas gathering system is mapped in this project with 17.06 miles of pipeline. No warning signs were documented with WFS as the operator. The emergency telephone contact remained the same as that of Transco.

NPMS data, submitted by the operator, are spatially erroneous. Pipeline features fall 400 feet away from the collected GPS data. Recommendations to the operator should include field verification of pipeline locations.

4.0 Conclusions

The compilation and spatial analysis of digital pipeline data for the state of Louisiana is a complex process that will take years to accomplish. The quantity and quality of data sources and the unique geographic parameters of each inhibit the rapid development of a full scale pipeline GIS for the state. Assessment of digital data, field investigations and the development of undocumented data are important to the statewide implementation of a pipeline GIS. The most prominent problem with existing digital data is with spatial accuracy. The conflicts between operator supplied data and data observed on warning posts' in regards to transported commodities has also been a problem. Most of the digital data, digitized by the LGS or submitted by the operators, were incorporated into the GIS and displayed numerous problems associated with spatial accuracy. These issues were addressed by developing pipeline features utilizing GPS technology for spatial control. The GPS point data were also used to verify pipeline operator's names and commodities transported.

The GPS point counts generally reflect miles of pipelines. 1741 GPS data points were recorded with 1547 miles of pipeline features developed. The commodities with the most miles of pipeline developed for this project are natural gas, with over 1086.78 miles of pipelines and 1205 GPS data points. This is followed by petroleum products with 351.8 miles of pipeline features developed and 298 GPS data points. Crude oil or petroleum fell last with 108.42 pipeline feature miles and 241 GPS data points.

The data developed through this and future pipeline mapping projects will eventually provide a comprehensive pipeline GIS for the state of Louisiana. As more operators develop and submit pipeline data and as the LGS and cooperative partners develop pipeline GIS, we will eventually have a comprehensive pipeline GIS for the state. However, no plans exist for the maintenance and update of these critical data. With the constant corporate restructuring and economic growth, these data will need updating on a regular basis of at least once a year.

The use of GPS technology is very useful in pipeline mapping. Eventually, with this and other pipeline mapping efforts sponsored by OSRADP and other agencies/programs, the puzzle of pipelines in Louisiana will be put together.

5.0 References

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6.0 Appendices

Table 6.1 Pipeline mileage calculated for Lafayette vicinity

Operator Name	**Total Miles**	**Crude Miles**	**Nat Gas Miles**	**Prod Miles**
Atmos Energy of Louisiana	10.62		10.62	
Bridgeline Holdings, L.P.	12.35		12.35	
Cebtral Crude Inc.	31.12	31.12		
Columbia Gulf Transmission Corp.	152.10		152.10	
ConocoPhillips Co.	13.16	13.16		
CrossTex LIG, L.L.C.	187.47		187.47	
Cypress Gas Co.	52.37		52.37	
Dixie Pipeline Co.	30.27			30.27
DOW Chemical USA	59.38		33.39	25.99
El Paso-ANR	8.32		8.32	
El Paso Field Services	74.76			74.76
Enterprise Products Partners	84.06			84.06
ExxonMobil Pipeline Co.	42.13	42.13		
Florida Gas Transmission Corp.	75.86		75.86	
Gulf South Pipeline, L.P.	169.07		169.07	
Lafayette Utility System	9.24		9.24	
Louisiana Gas System, Inc (Targa)	42.10		42.10	
PetroLogistics Olefins, L.L.C.	30.41			30.41
Plains All American Pipeline	22.01	22.01		
Shell Pipeline, L.P.	27.25			27.25
Southern Natural Gas Co. (El Paso)	2.22		2.22	
Targa Resources, Inc. (w/out LGS)	60.67		52.97	7.70
Tennessee Gas Pipeline (El Paso)	58.98		58.98	
Texaco Pipeline, L.L.C.	71.36			71.36
Texas Eastern Transmission Corp. (Duke)	13.85		13.85	
Texas Gas Transmission, L.L.C.	188.81		188.81	
Williams Field Services	17.06		17.06	
TOTAL MILEAGE	1547.00	108.42	1086.78	351.80

Table 6.2 the following table lists pipeline operators found in the Lafayette, Louisiana vicinity. Also listed are the associated emergency contact telephone numbers. These include observed gathering system operators where documented with digital photos.

Operator Name	Emergency Num	LA One-Call	Emergency Num2
Atmos Energy Corp.	800-654-6669	504-458-7356	800-252-3323
Bridgeline Holdings, L.L.C.	800-762-3404	Not Listed	
Central Crude, Inc.	800-245-8408	Not Listed	
Columbia Gulf Tramsmission Co.	713-621-0101	504-879-3301	866-485-3427
ConocoPhillips Petroleum Co.	877-897-6501	Not Listed	800-231-2551
CrossTEX LIG, L.L.C.	318-445-4568	214-953-9500	318-619-5704
Cypress Gas Pipeline	800-600-6240	800-600-6240	
Dixie Pipeline Company	800-349-4377	225-654-4112	
Dow Chemicals USA	800-223-4412	800-223-4412	
El Paso Field Service Co.	800-979-3391	Not Listed	800-895-2396
El Paso-ANR Pipeline Company	800-895-2396	800-231-2800	713-336-5000
Enterprise Products Partners, L.P.	888-506-8528	888-506-8528	225-675-5378
ExxonMobil Pipeline Co.	800-537-5200	800-220-2701	713-656-1234
Florida Gas Transmission Co	800-238-5066	800-238-5066	
Gulf South Pipeline Corp.	800-850-0051	800-850-0051	
Lafayette Utilities System	800-645-2676	Not Listed	
Louisiana Gas System, Inc.	877-897-6501	Not Listed	318-433-4628
PetroLogistics Olefins L.P.	225-387-0871	225-387-0871	
Plains All American, L.P.	800-708-5071	318-624-1376	337-280-5053
Shell Pipeline Co. L.P.	800-852-7614	Not Listed	800-922-3459
Southern Natural Gas Company	800-252-5960	Not Listed	
Targa Louisiana Pipeline Co.	877-897-6501	337-494-4431	
Tennessee Gas Pipeline Company	800-231-2800	800-231-2800	
Texaco Pipeline L.L.C.	800-762-3404	800-762-3404	
Texas Eastern Transmission, L.P.	800-231-7794	713-598-3150	
Texas Gas Transmission L.L.C.	800-626-1948	800-626-1948	
Williams Field Services	800-440-8475	Not Listed	337-725-3658
Other Operators			
Amerada Hess Corporation	800-554-3574	Not Listed	
Badger Oil Company	337-233-9200	Not Listed	
Breaux Bridge, City of	332-2186	Not Listed	
Burlington Resources	800-592-4822	Not Listed	
Callon Offshore Production, Inc.	800-301-5122	601-881-3009	
Carencro Gas System	896-8481	Not Listed	
CenterPoint Energy	337-783-4933	337-364-8111	318-429-4495
Chevron	318-232-7500	800-762-3404	
Continental Operating Company	713-209-1110	Not Listed	
Energy Development Corporation	713-940-5883	Not Listed	
Gasdel Pipeline System, Inc.	713-940-5883	Not Listed	
Hilcorp Energy Corporation	337-406-2828	337-739-0754	713-209-2400
Jefferson Island Storage & Hub, LLC	800-392-1965	Not Listed	
Karbuhn oil Company	713-583-9700	Not Listed	

Lafayette Utilities System	800-645-2676	Not Listed
Louisiana One Call	800-272-3020	
M.G.P. Company	318-236-8079	Not Listed
Phillips Petroleum Corp.	318-261-4100	Not Listed
Promix KOCH Hydrocarbons	800-292-3146	Not Listed
Reef Engineering, Inc.	972-437-6792	Not Listed
SunOil Production Company	318-233-7933	Not Listed
Vernon E. Faulconer, Inc.	337-332-1726	Not Listed
Westernoil Transmission-Permian	915-683-4711	Not Listed
Wintershall Pipeline Corporation	318-388-2270	Not Listed

Table 6.3 Database definitions for pipeline attributes developed for the Lafayette vicinity.

C=charater, R=real number		
Oper_nm	C 40	Name of pipeline operator
Sys_nm	C 40	Pipeline system name, assigned by operator
Diameter	R 5	Pipeline diameter (two decimal places if possible)
Commodity1	C 3	Abbreviation for primary commodity transported
Commodity2	C 3	Abbreviation for other commodity transported
Commodity3	C 3	Abbreviation for other commodity transported
Cmdty_desc	C 40	Description of primary commodity transported
Status_cd	C 1	Current pipeline status
Quality_cd	C 1	Positional accuracy of features
Revis_date	C 8	Date of feature creation or update (YYYYMMDD)
D_link	C 40	for links to digital files
Emergency	C 12	Emergency telephone contact (on warning signs)
Emergency2	C 12	Other emergency telephone contact
Meta_name	C 20	Name of metadata file
Comments	C 20	other information

Abbreviations for transported commodities: AA=Anhydrous Ammonia, BR=Brine, CL=Chlorine,CO2=Carbon Dioxide, CRD=Crude Oil, HVL=Highly Volatile Liquids, LPG=Liquefied Petroleum Gas, NG=Natural Gas, NGL=Natural Gas Liquids, PRD=Products

Current pipeline status: I=In Service, B=Abandoned, R=Retired' U=Unknown

Positional accuracy: E=Better than 50 feet, V=51" - 300", G=301' - 500', P=501 - 1000', U=Unknown