Southwest Florida Pipeline Submittal Review

for

The City of Punta Gorda, Florida
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# Table of Contents

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Pipeline Design Issues</td>
<td>2</td>
</tr>
<tr>
<td>Potential Impact to Watershed</td>
<td>10</td>
</tr>
<tr>
<td>Potential Impact to Water Treatment Plant</td>
<td>19</td>
</tr>
<tr>
<td>Karst Activity</td>
<td>26</td>
</tr>
<tr>
<td>Florida Environmental Protection Review</td>
<td>32</td>
</tr>
<tr>
<td>Summary of Findings</td>
<td>36</td>
</tr>
</tbody>
</table>
Introduction

The City of Punta Gorda asked Kimley-Horn and Associates, Inc. to review Southwest Florida Pipeline Company’s (SWFPL) application information as it pertains to the potential impact to the City’s sole water supply. This report documents the information reviewed and presents our opinion of the findings.

SWFPL is proposing a 10-inch pipeline across 130 miles from Tampa to Fort Myers. This pipeline will transport refined fuel products such as gasoline, diesel, and jet A fuel at an initial capacity of approximately 38,000 barrels per day. Approximately 11.5 miles of the pipeline will be located within the Punta Gorda watershed and will be laid parallel and adjacent to State Road 31.

The Punta Gorda watershed is comprised of streams and wetlands (surface waters only), with Shell Creek and Prairie Creek as major components of the area’s water system. Both of these creeks, as well as other tributaries, flow from east to west into the Shell Creek Reservoir (Hendrickson Dam). The proposed pipeline traverses these water bodies approximately 15 miles (measured at stream centerline) upstream of the reservoir where the City draws drinking water for treatment.

Our report is divided into the following subcomponents for review:

- Pipeline Design Review
- Potential Impact to Watershed
- Potential Impact to Water Treatment Plant
- Karst Activity
- Florida Environmental Protection Review
- Summary of Findings
Pipeline Design Review

Introduction

This section focuses on design criteria and general comments regarding the proposed pipeline through the Punta Gorda watershed. The documents reviewed include SWFPL’s submitted permit information, as well as industry reports and published documents. In addition, Mr. Curtis Shamlee of the SWFPL was interviewed by telephone on April 18, 1996. It is worth noting that specific design information was not available in some instances because SWFPL has not completed the final design.

Procedure

The largest percentage of pipeline ruptures are caused by external forces. The actual percentage of incidents will vary depending on the information source. Based on our review of several documents approximately 43% of all pipeline ruptures are caused by external forces. Given this high number, and noting that the best way to limit spill contamination is to prevent the spill from occurring in the first place, a number of pipeline protection options can be presented for consideration.

The most obvious of these options is to increase the pipe wall thickness. This will accomplish two objectives: 1) increase corrosion allowances and 2) increase
allowable external stresses. The proposed pipeline design (10 3/4" O.D. X 0.219" W.T. x-52) is within DOT CFR Part 195 requirements as a 0.72 design factor. Gibb Ellison, Inc., a pipeline engineering firm, recently reviewed a national client's (name withheld) report that indicated a two-fold drop in pipeline rupture incidents when the pipeline wall thickness is greater than 0.300 inches versus a wall thickness less than 0.300 inches. This study went on to state that to a great extent the pipe yield strength is a minor variable in the analysis of impact loading. One SWFPL document stated that "In certain areas, the 10 3/4-inch O.D. pipe will have a minimum wall thickness of 0.500-inch and a minimum yield strength of 46,000 psi. This type of pipe generally will be employed in certain watersheds". This document was signed by J.R. Arnold (representative of SWFPL) on February 5, 1996, and addressed to the Florida Department of Environmental Protection (FDEP). However the document does not specify any particular watershed in Charlotte County or southern DeSoto County where Punta Gorda's watershed is located. SWFPL's Completeness Summary Response dated March 1, 1996, stated that "0.500-inch wall thickness for a distance of 300 feet each side of the Class I water crossings (Shell and Prairie Creeks) and Myrtle Slough" would be used within Punta Gorda's watershed. This enhances the pipeline's pressure capacity and corrosion allowance and increases the span length of the pipeline should a sinkhole develop. However, none of the documents reviewed addressed increased wall thickness for the balance of the watershed. The majority of the proposed pipeline within the Punta Gorda watershed is in proximity of streams, drainage ditches, and/or wetlands. While the Class I water crossings have been addressed with 0.500-inch pipe wall thickness, the balance of the area should also be upgraded. Ideally the pipeline design would specify a pipe wall thickness over
.300-inch and use a lower design factor (i.e. similar to the requirements set for natural gas pipelines in DOT CFR Part 192) for the pipeline in the watershed.

Where potential excavation activity is likely, the setting of "red concrete" slabs should be used. This a good method for protection from digging operations. The balance of the line should have a plastic "warning tape" placed within the backfill soils approximately 1.5 feet above the pipe. This is often an effective method to warn excavation crews.

The applicant’s submitted information indicated that the pipeline would be buried three feet below the surface and four feet under streams. A more conservative approach that is cost effective to implement would be to specify a depth of five feet under stream crossing and four feet under nonstream areas within the watershed. Concrete coating the pipe is a good method for protection and has been proposed by SWFPL for use at the Shell Creek and Myrtle Slough crossings. However, this protection is also recommended for improved ditches that are tributaries to Prairie Creek, Shell Creek, and Myrtle Slough.

Directional drilling is indicated as a possible stream crossing method for the Prairie Creek crossing. This option does place the pipeline deeper to a typical depth of 15 to 20 feet below the surface. However, the potential for increased environmental problems is illustrated in the following example. A leak, undetected by the monitoring system, develops. It is not noticed until the product reaches the ground surface (presumably by pipeline operations personnel). Subsurface migration of the liquid product could be tremendous at this point.
Cathodic protection problems (corrosion) are the second most predominant cause of pipeline leaks. Cathodic protection system configurations are dependent on many factors, including the type of pipe, coating, soils, and moisture. Therefore, using more than one type of coating system will require different cathodic protection considerations.

The submitted design information indicated a bitumastic coating for the “thin wall pipe” and a fusion bonded epoxy (FBE) for the “heavier wall pipe”. Bitumastic is often referred to as "tape glass outer wrap times three" (TGO3). The TGO3 coating system is often judged as 1970s technology and is considered generally less expensive than other pipe coatings. However, FBE is regarded by many industry designers as a better coating and is as a general rule, cost competitive. TGO3 also has a temperature limitation in that it begins to melt at approximately 120°F. Pipe materials can reach this elevated temperature just downstream of compressor stations. In general, the industry is reluctant to use bitumastic coatings due to their perceived lower effectiveness versus other coatings and having to use two different types of cathodic protection systems. Different coatings require different cathodic protection systems or configurations. Therefore, special cathodic protection design reviews should be made if two or more protective coatings are used. There was no information found in the documents reviewed that addressed this issue.

Isolation valves located in the pipeline at water crossings and other key points are essential in limiting the amount of fuel spills. If a spill is reported or detected, the valves would be closed to limit the amount of fuel released into the environment. SWFPL’s Completeness Summary Response dated March 1, 1996, stated that
remote controlled valves would be located at strategic locations in the Punta Gorda watershed. However, the number of valves and locations were not specified. Isolation valve control from a remote location is proposed by SWFPL. However, there was no isolation valve design information found in the documents reviewed. Typically, isolation valves for this application would use a pneumatic actuator to operate. The compressed gas for functioning the valve is within a nitrogen bottle located on the valve assembly. The activation signal is transmitted with a wireless communication system which needs a low power source. Power is normally supplied by solar recharged batteries.

Isolation valves can be programmed to close, open or remain in last position in the event of failure. Obviously for this application a "fail close" design would be desirable. Manual overrides for valve operation are needed in case the remote control system fails or on-site personnel need to function the valve. If there was a pipeline rupture and a remote control function failed, then the valve would have to be closed manually. The time needed to notify personnel and subsequent travel could be substantial while fuel continued to flow from the rupture.

Attempting to stop a 20-mile-long column of fluid by suddenly closing a valve would create a potentially dangerous surge pressure (hydraulic hammer). A valve's response time on liquid pipelines is limited by the potential for hydraulic hammer. Pipeline design variations result in systems that require valve closure times ranging from less than two minutes to as long as 30 minutes. The SWFPL design should allow for hydraulic hammer effects under different potential conditions and minimize valve closure times.
Spill rates and, consequently, the amount of spill are a function of pipeline pressure, the product being transported, pipeline topography (not necessarily natural ground topography), the size of the rupture, time, and the pipeline system design. The applicant's submitted documents indicate the system will have a delivery capacity of 38,000 barrels per day. If the pipeline is completely severed and flow is unrestricted and/or undetected this would be the maximum spill rate of the leak. Conversely, if the product is between "batches" it is conceivable that the spill rate could be zero. These scenarios are the extremes for spill rates and are unlikely. If a leak does occur, it is more likely to be very small and caused by an external force. The leak detection system on the pipeline would, if at all, probably not register this type of leak until well after the company was notified by the person who caused the leak. This is due to the margin of error inherent with the measurement systems, which are typically accurate to within 3% of actual conditions, and the time required to transport the product from one meter site to the next. The time for pipeline operators to react is also a factor in minimizing the spill. The time for operators to close isolation valves would be minimal compared to the potential time necessary for leak notification to be made. This assumes that the valves are actuated by remote control and that the system is working properly.

Leak detection systems (LDSs) often give false alarms, especially during the startup period of a pipeline system; these systems can take a year to adjust and debug. Uneven flow conditions, called transients, can contribute to the false alarms. Transients are temporary deviations in a pipeline's pressure that cause false alarms and inhibit the effectiveness of the LDS. These false alarms can desensitize pipeline monitoring personnel. Most pipeline operators interviewed felt that the critical link in reducing the number of incidents and the volume of
pipeline spills lies with dispatcher training. They frequently indicated there is no substitute for a well trained dispatcher, even with a programmable logic controller (PLC) or other software routine designed to function automatically. The dispatcher is often the final decision maker in the process of leak detection and pipeline shutdown. If dispatchers fail to recognize a problematic situation and do not intervene, unchecked spills are likely to be large. Some of the largest spills not due to third-party damage are due to operator error. In fact, losses due to operators are approximately twice the losses due to corrosion.

As a general rule, the pipeline industry addresses the issue of preventing a leak as more important than spill containment. However, operators recognize that containment programs are essential and therefore most participate in "one call" systems, maintain their rights of way and pipeline markers, assist contractors in locating the existing pipeline prior to excavation work, and have personnel on site during activities near the pipeline. It is recommended that SWFPL participate in these activities, as well as give pipeline neighbors public notices outlining "tell tale" signs of potential pipeline trouble at least once a year. This notice may include phone numbers, pipeline information, and what to look for if potential problems exist. In addition, SWFPL should coordinate annual drills to practice emergency response activities. This would include the dispatcher response teams from counties, municipalities, and the pipeline emergency response contractor(s).
Conclusions and Recommendations

The submitted pipeline design is vague in many respects, but appears to meet federal regulations where applicable. It is recommended, however, that the issues identified in this report section be addressed specifically in the areas of protection from external forces, operator procedures, and cathodic protection.
Potential Impact on Watershed

Introduction

This section of our report focuses on the potential impact of a pipeline break or leak into the Shell Creek/Prairie Creek watershed upstream of the Hendrickson Dam. The proposed pipeline route is to follow State Road 31 which runs north/south through the watershed. This watershed is the only source of water supply for the City of Punta Gorda; the City draws its water from the Shell Creek Reservoir.

Although spills from a pipeline break at any location within the watershed could potentially degrade the City’s water supply, the most critical locations would be at the creek crossings. Spills from pipeline breaks that occur in the ground away from the creeks would contaminate the soils and groundwater. The flow time for the contaminated groundwater to reach the surface water is variable and is dependent on the groundwater hydrology and distance to surface waters. Spills from pipeline breaks occurring in wetlands could reach the creeks relatively fast (when compared to groundwater flow) as the contaminants would follow natural wet weather flow drainage patterns. Early leak detection is important with spills occurring in the groundwater or wetlands, but it is critical if a spill were to occur into one of the creeks. As such, this evaluation is limited to potential surface water spills where the travel time to the reservoir is the shortest.
Procedure

Three creeks have been identified along the State Road 31 corridor: Prairie Creek, Shell Creek, and Myrtle Slough (tributary to Shell Creek). In reviewing the USGS quadrangle maps, it appears that drainage improvements have occurred (photo revision of 1987) and ditches that lead to the creeks have been cut. These ditches could allow for quick transport of contaminants just as the individual creeks could. Our focus, however, is directed toward a potential spill in a creek as the creeks appear to have a shorter distance to the Punta Gorda water supply when compared to the ditch distances. We estimated the lengths of the three creeks to help us establish travel times to the reservoir. The estimated distances from the proposed pipeline creek crossings at State Road 31 to the reservoir are as follows:

<table>
<thead>
<tr>
<th>Creek</th>
<th>Approximate Distance from SR 31 to the Washington Loop Road (Stream Miles)</th>
<th>Approximate Distance from SR 31 to the Dam (Stream Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prairie</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Shell</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Myrtle/Shell</td>
<td>11</td>
<td>15</td>
</tr>
</tbody>
</table>

These stream lengths are less than the length reported by SWFPL, who estimated an average distance of 17 stream miles to the reservoir.

Without knowing the cross-sectional area of the creeks, it is difficult to estimate the stream flow velocities. Scour velocity in open channel flow is typically at
2 feet per second (fps). Assuming that the natural (and improved) stream bed facilitates flows at a 2 fps scour velocity, we have further assumed velocities of 1, 2, and 3 fps to estimate the travel times under low flow, average flow, and storm flow conditions. Estimated travel times for a spill at State Road 31 to reach the Washington Loop Road just upstream of the reservoir for these velocities vary as follows:

<table>
<thead>
<tr>
<th>Creek</th>
<th>1 fps</th>
<th>2 fps</th>
<th>3 fps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prairie</td>
<td>16</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Shell</td>
<td>15</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Myrtle/Shell</td>
<td>16</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

Tracer studies must be performed to estimate travel times under varying stream flow conditions. There is no way to know how to contain a spill without understanding the pollutant travel times. Under drought or dry conditions, the travel time would be greater, but there is reason to believe that fuel would become stored up along the banks and in ponded areas. The next rain could flush these areas and add a second, third, or indefinite number of slugs through the stream channel. Storm event tracer studies must also be performed to document travel times under higher velocity/lower travel time conditions.

Because fuel is "lighter" than water (specific gravity is less than 1) there will be a tendency for the spilled fuel to travel down the stream on or near the surface. This will be the case under steady uniform flow conditions. Average stream velocities which would be estimated from tracer studies may differ from and
would likely be less than the actual velocity of a fuel transported on the surface. Horizontal and vertical velocity profiles are dictated by the channel bed shape, slope, surface roughness coefficient along the bottom and/or banks, and wind. There are likely turbulent zones through portions of each creek where unsteady, nonuniform flow conditions exist. At these locations, the fuel is likely to become mixed throughout the water column. The tracer study should be conducted to account for the fact that the fuel is lower in specific gravity than the surrounding water.

Kimley-Horn reviewed the SWFPL Draft Emergency Response Plan. The emergency response contractors identified in the plan are listed as follows:

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;A Coastal Pollution Clean-up Services</td>
<td>Tampa</td>
</tr>
<tr>
<td>American Compliance Technologies</td>
<td>Lakeland</td>
</tr>
<tr>
<td>Florida Spill Response Corporation</td>
<td>Cocoa</td>
</tr>
<tr>
<td>Sea Spill Services of Lee County</td>
<td>Cape Coral</td>
</tr>
</tbody>
</table>

The closest contractor to Punta Gorda appears to be located in Cape Coral, followed by Lakeland, Tampa, and then Cocoa. The plan states that the Cape Coral contractor could respond to a spill within one hour. This is one hour after a spill has been detected. The definition of "respond" (to a spill) is not provided. We question if respond means to be at the site within one hour, mobilize and leave the office within one hour, or have booms and equipment set up at the appropriate locations within one hour. Should a pipeline break occur at a creek crossing, it would be virtually impossible to contain the entire spill at State
Road 31 because containment would need to be simultaneous with the spill. Assuming that the Cape Coral contractor could be notified and be mobilized to be on-site within the hour, the spill (at a 1 to 3 fps velocity) would have already traveled one half mile to two miles downstream of State Road 31. (Tracer studies are necessary to confirm the travel times.) The contractor should also be knowledgeable about each stream at each containment location under varying flow conditions so they will know the size of boom needed to span the containment site. The higher the flow, the greater the chance of a wider surface, depending on the stream cross-section at each location.

In reviewing Map 1 - Planning Map for Boom and Recovery Points taken from the SWFPL Emergency Response Plan, access to most of the containment points may be delayed because the contractors will be using unimproved roads through private property. Under wet conditions, these roads may be impassable. We did not perform a reconnaissance of each containment point, but we did observe the two on Loop Road (CP 9 and CP 10) near the reservoir. SWFPL should obtain easements to gain access to the containment points not only for the event of potential spill but also for running drills. Each contractor identified should be familiar with access and site conditions at each contaminant point.

Review of documents concerning a pipeline failure in 1985 near Lake Alfred documented that 37,000 gallons of refined product (gasoline) were released into a canal that was tributary to Lake Haynes. The emergency response crew had to construct a road to access the spilled fuel. An estimated 22,000 gallons of fuel was lost due to inadequate cleanup and the contamination persisted for months.
A primary concern is of a potential spill reaching the reservoir, which could happen with a spill that goes undetected or if the contractors are unable to fully contain the spill. Once in the reservoir, a significant spill could cover the entire surface.

We have attempted to estimate the quantity of fuel that would have to be spilled into the reservoir to exceed state drinking water standards. In reviewing two reports (Engineers Comprehensive Report of Water Works Project, City of Punta Gorda, Florida, Jan. 1962, by Russell & Axon and Shell Creek Reservoir Expansion Option Analysis, Oct. 1982, SWFWMD) estimates of reservoir surface area can range from 500 to 1,000 acres, depending on stage. Assuming that fuel spilled will remain within the top foot of water surface, the volume of water that would be potentially impacted due to a spill would be 500 to 1,000 acre feet or approximately 160 to 325 million gallons.

The amount of spilled fuel that would exceed the state drinking water standards for the top one-foot layer of the lake is summarized as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>State Maximum Contaminant Level (ppm)</th>
<th>Volume of Contaminant per Gallon of Fuel* (gal.)</th>
<th>Amount of Spilled Fuel (gal.) Required to Exceed State Standards 500 ac.ft 1,000 ac.ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>0.001</td>
<td>0.05</td>
<td>3.2 6.5</td>
</tr>
<tr>
<td>E. Benzene</td>
<td>0.7</td>
<td>0.04</td>
<td>2,800 5,600</td>
</tr>
<tr>
<td>Toluene</td>
<td>10</td>
<td>0.25</td>
<td>6,400 12,800</td>
</tr>
<tr>
<td>Total Xylene</td>
<td>1</td>
<td>0.25</td>
<td>640 1,280</td>
</tr>
</tbody>
</table>

*Obtained from fuel manufacturer's material safety data sheets found in the emergency response plan.
Regardless of the size of spill (10 barrels, 100 barrels, or 1,000 barrels), less than 10 gallons of fuel would need to escape past the containment system to raise the benzene level of the top foot of the lake above the maximum contaminant level allowed by the State.

The length of time for a potential spill to pass through the reservoir could be significant considering that the spilled fuel could become contained within the littoral zones and wetlands in and around the lake. If this occurs, the fuel may continue to bleed into the lake for an indefinite period of time, and water quality at the intake could be degraded for days, months, and even years.

A two- or perhaps three-dimensional model of the reservoir should be provided to determine worst case conditions. The model is needed to better understand what the impact of a spill would be on the reservoir—Would the fuel stay at the surface? Would it degrade? If so, how long will it take to degrade? Would it accumulate in the littoral zones? If so, how long will it take to flush out of these areas? How deep will the fuel penetrate below the surface due to wind mixing? How long will it take for the regulated contaminants to drop below the state water standards? The model should be used to evaluate these issues under wet and dry seasons and also under varying quantities of fuel passing the containment locations. This model should be field-verified (perhaps with tracers) under varying conditions (stream flow, wind speed and direction, and amount of spill).

The emergency response plan calls for trucking in 200,000 gallons of water to supply to the Punta Gorda water users. The basis for the 200,000 gallons is that the current Punta Gorda demand is assumed to be 3.2 MGD and the current
storage is approximately 3.0 million gallons, leaving 200,000 gallons needed for potable water release. The assumption is that a spill will be contained within one day and the City would be without water for only one day. This is unrealistic considering the reservoir water could be contaminated for days, months or an indefinite length of time. A better option to consider is to increase the level of treatment at the water treatment plant (WTP) by adding air strippers to remove the organics in large concentrations for indefinite periods of time. Another option to explore would be to construct an interconnect with a neighboring water plant.

Conclusions and Recommendations

Our conclusions and recommendations are directed toward suggested requirements before proceeding with the project:

- Perform tracer studies under varying stream flow conditions—wet weather flow (five-year and 100-year return flood conditions) and drought—to better estimate travel times to reach the reservoir and water plant intake pipes. Time of travel is critical to emergency response plan design. Without better information on travel times, the emergency response plan is ineffective.

- Provide a two-dimensional model of the reservoir to estimate the length of time the pollutant will remain in and around the reservoir. This needs to be done to better understand containment/cleanup measures as well as how long the state water standards will be exceeded.
- Obtain easements for spill contractors, SWFPL, and Punta Gorda/Charlotte County emergency response personnel to gain access to the potential containment sites. Without easements, access may not be granted in a timely manner, if at all.

- Perform drills for containing spills. The drills should be performed at regular intervals, with at least one dry weather and one storm event condition emergency response drill conducted each year. Use a tracer to estimate the time of travel and compare response to containment effectiveness. The contractors must be aware of all potential obstacles and conditions before a spill occurs.

- Rather than trucking in water, make improvements to the WTP to pretreat water and remove the organics before the contaminated water can enter the WTP. Another possible alternative would be to consider an interconnect to the Peace River Water Treatment Facility. This alternative was listed as the "most viable and best alternative" by Mr. Peter Hubbell, Executive Director, Southwest Florida Water Management District, in his April 30, 1996, letter to the Mayor of Punta Gorda. These improvements should be in place before the first gallon of fuel is pumped through the pipeline.
Potential Impact to Water Treatment Plant

Introduction

This review focuses on the Punta Gorda Water Treatment Plant operation and the effects of feed water contamination due to a pipeline fuel release. The Punta Gorda Water Treatment Plant recently completed a capacity increase expansion from 6 MGD to 8 MGD. At this time, no further plant expansions are planned.

Procedure

This review will study the minimum amount of typical fuel components (benzene, ethyl benzene, xylene, toluene) in the raw water that would result in the finished water exceeding the MCL for these contaminants. The plant’s consumptive use permit lists 4.2 MGD as the average daily flow. The rated plant design capacity of the Punta Gorda Water Treatment Plant is 8 MGD average daily flow and 12 MGD peak design flow.

To calculate the minimum quantity of contaminant to exceed the MCL, the following assumptions were made:

- 4.2 MGD plant water flow
- the maximum contaminant level in all products
- no changes are made to plant operation
• all chemicals being added are optimized for normal feed water without regard to additional fuel contaminant load; therefore, no fuel contaminant is removed by powdered activated carbon (PAC) process
• tray aerators do not evaporate fuel
• each constituent is calculated independently; therefore, all fuel entering the plant will go out with drinking water

The numbers below represent the amount of Shell Premium gasoline required to exceed the MCLs for the contaminants listed when no water plant operational adjustments are made to counteract the additional organic load.

**Minimum Fuel to Exceed MCL**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>State Maximum Contaminant Level* (PPM)</th>
<th>Volume of Contaminant Per Gallon of Fuel Constituent* (PPD)</th>
<th>Fuel (gal.)</th>
<th>PPD Fuel</th>
<th>GPD Fuel</th>
<th>Solubility in Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>0.001</td>
<td>0.036</td>
<td>.05</td>
<td>0.71</td>
<td>0.1</td>
<td>0.18 gr/100 gr</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>0.7</td>
<td>24.9</td>
<td>.04</td>
<td>1,090</td>
<td>150</td>
<td>Minimal Soluble</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.0</td>
<td>35</td>
<td>.25</td>
<td>140</td>
<td>19.3</td>
<td>Minimal Soluble</td>
</tr>
<tr>
<td>Xylene</td>
<td>10</td>
<td>350</td>
<td>.25</td>
<td>1,420</td>
<td>193</td>
<td>Minimal Soluble</td>
</tr>
</tbody>
</table>

PPM - part per million
PPD - pound per day
GPD - gallons per day

*Source: Primary Drinking Water Standard 62-550 F.A.C.

The numbers presented in the table above were calculated as explained in the following calculation using benzene as an example:
State Drinking Water Standards list .001 parts per million (ppm) benzene as the maximum contaminant level.

To determine the pounds per day (ppd) of benzene contaminant in the water to exceed the 0.001 ppm concentration, the pound formula was used:
4.2 MGD flow \times 0.001 \text{ ppm benzene} \times 8.35 \text{ lb./gal.} = 0.035 \text{ ppd benzene}

To find the amount of fuel equivalent to the 0.035 ppd of benzene, the maximum concentration (5%) of benzene in the pipeline product was used. This concentration was determined by review of the fuel manufacturer's material safety data sheet.

0.035 \text{ ppd benzene} \div 0.05 \text{ lb benzene} = 0.7 \text{ ppd fuel}

\text{lb fuel}

Since the fuel has an average specific gravity of 0.87, the fluid density of the fuel is 7.26 lb/gal. The equivalent volume of fuel is:

0.7 \text{ PPD} \div 7.26 \text{ lb/gal} = 0.1 \text{ gal/day (GPD) fuel or } 7 \times 10^{-5} \text{ gal/min.}

The other fuel constituents are calculated in the same manner.

It is important to recognize the order of magnitude difference between the maximum attainable benzene concentration and the MCL benzene level for drinking water, as the following numbers demonstrate. The equilibrium solubility of benzene in water at 72°F is 0.18 grams benzene/100 grams of water and could be attainable in confined areas of the reservoir. This is equivalent to the benzene
concentration of 1,800 ppm. If you compare this concentration to the benzene MCL concentration of 0.001 ppm, the MCL concentration is 1.8×10⁶ times smaller; an enormous difference in concentrations. This would require a removal of 99.99994% of the 1,800 ppm of benzene to meet the benzene MCL of 0.001 ppm. The aeration tray process at the Punta Gorda water treatment plant can not begin to approach this removal efficiency. Therefore, there is a possibility of contamination of higher concentration than the MCL entering the drinking water distribution system.

The actual removal efficiency of the tray aerators on the contaminants appears to be overstated in the “Final Report, Analysis of Punta Gorda, Florida, Water Treatment Plant Capability to Treat Petroleum Contaminants” by Robert J. Murphy, Ph.D., P.E. The removal efficiencies calculated are closer to those expected from packed bed air stripping towers. The existing type of aeration trays must be pilot-tested to determine an actual removal efficiency for the contaminants mixed together in a common solution at concentrations similar to those expected during a gasoline spill. In addition, the evaporation rate of the potential aromatic hydrocarbon contaminants from the waterways and the tray aerator should be pilot-tested to determine the actual amount of contaminant that can be removed by evaporation.

Toluene and xylene are practically insoluble, but can enter the treatment system by entrainment or vortexing of the fuel layer into the raw water intake pipes. The top of the two 30-inch raw water intake pipes is less than three feet from the reservoir water surface. This depth is not a sufficient submergence depth to eliminate the formation of a vortex into the raw water intake pipe. This allows
surface water and floating fuel will flow into the structure. During dry seasons the lake level will be lower, therefore making the distance from the water surface to the intake pipes even less.

If an increase in organic loading due to a fuel spill were to occur during normal plant operations, the organic removal capacity of the plant's PAC unit operation would be exceeded. Additional PAC material would be required to absorb the suspended organic layer to the acceptable drinking water MCL. Per Robert J. Murphy's "Final Report" the plant is capable of dosing 200 mg/L of PAC, but operational limitations with the upflow clarifier preclude any sustained dosage greater than 20 mg/L. The PAC process with the specified PAC material must be pilot-tested to determine the contaminant removal capability of 20 mg/L of PAC. If the PAC does not have the absorption capacity to decrease the contaminant organic loading below the MCL concentration for all constituents, then the plant will be at risk of producing drinking water that exceeds the MCL requirements.

Conclusions and Recommendations

An oil sheen sensor or a volatile organic compound (VOC) monitoring system could be advantageous to monitor, detect, and report the presence of fuel in the lake water. The detection system would require several monitoring stations located around the lake upstream of the plant intake. A monitor station would consist of an analytical sensor, power supply, radio telemetry unit, or wired communication to a centralized display panel. The flow patterns and estuaries involved in the water supply to the water treatment plant must be studied to
determine the most probable location for these detection systems. A non-
hindering tracing agent should be added to the water to simulate an oil spill. The
path of the agent to the raw water inlet must be determined for the most effective
location for the individual detective devices. This system, with properly placed
monitoring sites, would effectively give early warning of a fuel spill to plant
operations. Therefore, appropriate adjustments could be made to help safeguard
the drinking water from possibly exceeding MCL requirements.

To reduce the amount of the insoluble contaminants of xylene and toluene from
entering the water treatment plant, an insoluble organic separation basin is
suggested to skim the fuel layer before the raw water intake piping. This will
allow for separation and removal of top layer containing the fuel. The basin
should be designed to allow for sufficient submergence and anti-vortex device of
raw water to the intake.

Air stripping towers specifically designed to separate water soluble contaminants
should be provided at the water plant entry point. These towers must be capable
of removing contaminants at 8 MGD flow rates. The water treatment plant tray
aerators must be pilot-tested in a scaled-down model simulator to determine the
actual quantity of VOCs that can be removed by these aerators and the maximum
contaminant composition expected as feed to the PAC process. The pilot unit
must closely simulate the actual tray aerator equipment and process conditions.
The maximum contaminant level expected to reach the aerators must be used.
The aerator operation should be operated at various wind or air flow rates to
determine the composition of contaminants in the water flowing from the tray
aerators to the PAC process.
The effectiveness of PAC to remove the various organic contaminants must also be pilot tested. The PAC process is effective at removing the small quantity of organics in the normal raw water to the water treatment plant. Elevated organic loading due to a fuel spill and the ability of the PAC process to remove them must be pilot tested. The test will simulate the actual process and PAC material used in the treatment plant. Tests must be run over an expected contaminant composition range and with varying dosages of PAC. The product water should be analyzed for remaining contaminant composition. The operational adjustments must be correlated with analytical results to determine the plant process changes required to meet the MCL requirements.

The presence of benzene and/or toluene in extremely small quantities can exceed the maximum contaminant levels for drinking water. Further investigation such as bench or pilot tests are necessary before drinking water quality impacts can be determined.
Karst Activity

Introduction

The Applicant's response to the Florida Department of Environmental Protection (FDEP) for the proposed Southwest Florida Pipeline (SWFPL) was reviewed to determine if the information presented with regard to karst activity was adequately addressed. Primary emphasis was placed on assessing potential safety issues and related impacts to the City of Punta Gorda water system. In addition to reviewing the Applicant's response, Kimley-Horn also consulted readily available geologic reports and maps and U.S. Geological Survey 1:24,000-scale topographic quadrangles to obtain a better understanding of possible karst occurrences in Charlotte and southern DeSoto Counties. Consultation was also initiated with specific agencies who are familiar with reported sinkhole occurrences in central and southwest Florida.

Karst is a type of topography that is formed over limestone, dolomite, or gypsum by dissolving or solution and is characterized by closed depressions or sinkholes, caves, and underground drainage. The most common natural sources of stress that trigger sinkhole formation are fluctuations of water levels or water pressures resulting from torrential rains and flooding or severe drought with lowered water levels. Man's activities also impose stresses on the environment, which in karst terrain, pose special concerns. Two categories account for most of the man-induced sinkhole formation: pumpage from wells and construction activities.
overlying impermeable strata. The map, however, identifies one localized area that straddles State Road 31 in the vicinity of the Charlotte County/DeSoto County line (see Figure 1). This area is partially elliptical in shape and measures approximately 1.6 miles in length and 0.5 mile in width. In this area, the limestone is thickly covered (>175 feet) by overburden and a shallow aquifer usually exists perched above the limestone. Deep cover-collapse sinkholes have been known to occur in this geologic unit. Jenkins and Beck further state that although recent collapses are rare, they are still possible. This area will be further discussed in later sections of this chapter.

In addition to reviewing available geologic reports and maps, contact was also initiated with individuals from the Southwest Florida Water Management District (SWFWMD) and the Florida Department of Transportation (FDOT) who are knowledgeable of karst activity in Charlotte and DeSoto Counties. Specifically, Tony Gilboy of the SWFWMD, the agency that maintains the Florida Sinkhole Research Institute (FSRI) database, relates that he has no data on reported sinkhole occurrences in Charlotte County. It must be noted, however, that the FSRI database contains reported sinkhole occurrences, not all sinkholes or potential sinkholes.

Since the proposed SWFPL route generally follows the east side of the existing State Road 31 alignment in Charlotte and southern DeSoto Counties, it was deemed appropriate to contact the FDOT District One in Bartow to inquire whether they had any information on sinkhole occurrences along State Road 31. Brian Jory, FDOT District One Geotechnical Section, responded that they have no
data in their files on reported sinkhole occurrences or related karst activity along this segment of roadway.

The review of USGS topographic maps along the proposed SWFPL route in Charlotte and southern DeSoto Counties reveals that the land surface is nearly level. Elevations are generally on the order of 40 feet and the slope has a slight westerly component. Various circular and elliptical-shaped depressions occur on the east side of the State Road 31/SWFPL corridor.

The 1" = 200' scale air photo strip maps of the pipeline corridor were interpreted in conjunction with the review of the topographic maps. Although these strip maps cover a relatively narrow swath (i.e., approximately 550 feet on either side of the pipeline alignment) it was possible to determine that the shallow depressions shown on the topographic maps are primarily palustrine emergent wetlands. These depressions do not appear to be karst-related.

The area along State Road 31 in the vicinity of the Charlotte County/DeSoto County line where the subsurface geology is favorable for sinkhole development (Jenkins and Beck, 1988) was also examined on the photo strip maps to identify potential karst features. The interpretation revealed the presence of several shallow circular depressions, one small lake, and a dug pond within the general area bounded by Myrtle Slough on the south and the Charlotte County/DeSoto County line on the north. The depressions appear to mark the location of palustrine emergent wetlands; the origin of the small lake could not be readily determined.
FIGURE 1

POTENTIAL FOR GROUNDWATER POLLUTION OF THE FLORIDAN AQUIFER

(Based upon surface drainage, karst development overburden characteristics.)
Conclusions and Recommendations

One potential concern that emanated from our data review was uncovered in the map series compiled by Jenkins and Beck, 1988. These maps identify a specific area along State Road 31 in the vicinity of the Charlotte County/DeSoto County line as one where the underlying geology may be suitable to sinkhole collapse. Although the likelihood of karst activity is considered low, there is a possibility that a sinkhole could still develop in this area. Since sinkhole collapse could potentially result in a failure of the pipeline, it is important that this area of concern be fully investigated.

To obtain a better understanding of potential sinkhole concerns, our recommendation is to perform an inventory of closed depressions within a two-mile swath of the proposed pipeline route in Charlotte and southern DeSoto Counties. This inventory will be accomplished by the stereoscopic interpretation of recent aerial photography of the area. The interpretation effort will also include the mapping of photo linear. Photo linear is a natural alignment observed on aerial photos which could be indicative of fractures (jointing, faulting) in the subsurface. Fracture traces are considered primary routes for the movement of water from the surface to the subsurface and provide a potential focal point for the solution of carbonate rocks which typically lead to sinkholes. Primary emphasis will be placed on the identification of photo linear intersections and their relationship to closed depression locations. The objective will be to identify prominent areas where photo linear intersections are proximal to the pipeline route or where photo linear intersect the route in proximity to closed depressions.
These intersections could mark the focal point, or location, where subsurface solution cavities can occur. Suspected karst-prone areas would then be subjected to further investigation by selected test borings or ground penetrating radar, where applicable.

It is essential that the above recommended investigation be used in subsequent project planning and design to provide the City with an additional level of confidence with regard to assessing potential karst activity along the proposed SWFPL route in Charlotte and southern DeSoto Counties.
Florida Department of Environmental Protection Review

Introduction

This review focuses on the current status of the SWFPL application with the Department of Environmental Protection (FDEP) and the outstanding FDEP concerns over the project, specifically as it relates to the impact on the City of Punta Gorda's water system.

Procedure

Kimley-Horn reviewed FDEP files in the Division of Environmental Resource Permitting (ERP), the division responsible for acting on the permit application for the pipeline project. The amount of material related to this project is extensive; it goes back to 1990 when the original permit application was filed and fills more than two file cabinets at the FDEP offices. This review concentrated on material submitted since March 1996 when the application was updated. The permit reviewer, Tom Franklin, was interviewed, along with upper management of the division, including Mike Ashey, Chief of the Bureau of Submerged Lands and Environmental Resources, and Janet Llewellyn, the Deputy Director. FDEP was periodically contacted to check on any change in the status of the SWFPL application. The following is a summary of findings based on the file review and interviews with FDEP staff.
FDEP has declared the application complete, which began a "time clock" under which they must either issue or deny the permit, even though there are outstanding issues associated with the project. SWFPL has submitted waivers of the "time clock". The previous waiver was set to expire on June 1, 1996; however, SWFPL recently submitted another waiver giving FDEP an additional 75 days (August 15, 1996) to act on the application.

Outstanding issues over the application include the lack of a wetlands mitigation plan and concerns over the Punta Gorda watershed crossing. It is believed that SWFPL will provide FDEP with additional information on these issues.

FDEP has authority to look at pipeline safety and potential impact to the Punta Gorda watershed based on "Public Interest" and "Secondary Impact" criteria in Florida Statutes and FDEP regulations. Any ERP permit issued must pass the public interest provisions of Section 373.414, Florida Statutes. This statute lists various factors that must be considered and balanced by FDEP when determining whether a project is in the public's interest. One of the factors to be considered is "whether the activity will adversely affect the public health, safety, welfare, or the property of others."

In addition, FDEP may look at the secondary and cumulative impacts of a project. FDEP not only looks at the direct impacts to wetlands and water resources from the construction of a project, but also the secondary and cumulative impacts that the project might bring about. The classic example is the construction of a bridge to a barrier island where FDEP would not only look at the impacts from construction of the bridge, but also look at impacts from development of the
island. If the FDEP believed, based on substantial scientific evidence, that the pipeline represents a serious threat to Punta Gorda's water supply, it would have the authority and obligation to deny the permit.

On the issue of potential impact to the Punta Gorda watershed, FDEP would prefer a thicker wall pipe throughout the entire crossing of the Punta Gorda watershed. FDEP's position is supported by the letter from the US DOT Office of Pipeline Safety (OPS) to SWFPL, in which the OPS states, "A more effective method of protecting the watershed would be to use a thicker wall pipe than pressure requirements would dictate."

In reviewing FDEP files, an agreement between SWFPL and the Peace River Water Supply Authority that spelled out SWFPL obligations to the Authority was discovered. The agreement included immediate spill notification to the Authority, the submittal of all pipeline inspection, corrosion testing, pressure testing, and leak detection reports to the authority, and other information submittals.

GATX, SWFPL's parent company, operates Central Florida Pipeline. Constructed in 1963, the pipeline carries refined product (fuel) 85 miles from the west coast region of Florida to Orlando. This pipeline has had 14 documented spills since 1984.
Conclusions and Recommendations

FDEP is very concerned over the potential impact of the project on the Punta Gorda watershed. This may be the major issue that will determine whether the application is issued or denied. FDEP has recommended that the pipe wall diameter be increased throughout the watershed. At this point, FDEP does not believe SWFPL has provided reasonable assurance that the project will not adversely impact the Punta Gorda watershed; however, it is likely that SWFPL will provide additional information on this issue.

If SWFPL submits additional information on the project, the City should request the opportunity to review and provide written comments on the additional information prior to FDEP taking action on the application.

SWFPL should provide information on the disposal of water used to hydrostatically test the pipeline. Possible concerns include the source of water (potable water, shallow wells, farm ponds, etc.), the locations and methods of disposal (within or outside the watershed, surface water disposal, uplands disposal), and the management practices or treatment methods for the discharged water (hay bales, filter bags, etc.). No information was found in the FDEP files on this issue.
Summary of Findings

The City of Punta Gorda has only one source of drinking water for its citizens and water customers. The City has an obligation to protect this water resource with vigor and foresight. This is especially important given that the City has no viable alternative water source. Source water protection is preventing the pollution of the lakes, streams, and groundwater that serve as sources of drinking water. The cost to protect source water is minimal compared to the astronomical cost of remediating contaminated water. Once a source water is contaminated the cost and time to restore, if possible, is unknown.

After a brief review of the submittal information the following items are deemed necessary to better understand the potential impact of a pipeline failure and the preemptive planning needed.

Pipeline Design Review

According to a SWFPL representative, the pipeline design has not been finalized. However, based on their plans and submittals to date, we have the following comments:

- Increase the wall thickness at stream crossing to 0.500-inch and to 0.300-inch or greater in the balance of the watershed. This will increase the corrosion tolerance and also allow for higher stress loads.
- "Red Concrete" slabs should be used in locations where the potential for excavation activity is high. The balance of the pipe in the watershed should have "warning tape" laid in the backfill approximately 1.5 feet above the pipe. Concrete coated pipe for stream crossings is also needed. All of these items will help reduce the potential for failure due to external forces.

- Directional drilling for crossing Prairie Creek has been proposed by SWFPL. This presents additional problems if a low volume leak occurs at the increased depth (15 to 20 feet). This potential problem needs to be addressed so that subsurface migration of contaminants is limited.

- The bitumastic pipeline coating system is not the best coating available. The use of fusion bonded epoxy should be considered for use throughout the watershed. Otherwise, the applicant should provide studies and/or research to support the use of bitumastic over other coating systems.

- The placement of remote controlled isolation valves within the watershed need to be identified; these valves are essential in limiting the amount of fuel spills.

- Isolation valve design information should be provided to assure remote actuation without reliance on local public electrical power. The public power is subject to outages. Design criteria for the valve closure time should also be provided.
- A training and drill schedule should be furnished for review. Emergency response personnel and pipeline operator dispatches need to have realistic training to minimize spills.

**Potential Impact to Watershed**

Our conclusions and recommendations are directed toward suggested requirements before proceeding with the project. The following improvements should be in place before the pipeline is operational:

- Perform tracer studies under varying stream flow conditions—wet weather flow (five-year and 100-year return flood conditions) and drought—to better estimate travel times to reach the reservoir and water plant intake pipes. Time of travel is critical to emergency response plan design. Without better information on travel times, the emergency response plan is ineffective.

- Provide a model of the reservoir to estimate the length of time the pollutant will remain in and around the reservoir. This needs to be done to better understand containment/cleanup measures, as well determine the length of time the state water standards will be exceeded.

- Obtain easements for spill contractors, SWFPL, and Punta Gorda/Charlotte County emergency response personnel to gain access to the potential containment sites. Without easements access may not be granted in a timely manner, if at all.
- Perform drills for containing spills. The drills should be performed at regular intervals, with at least one dry weather and one storm event condition emergency response drill conducted each year. Use a tracer to simulate the time of travel and compare response to containment effectiveness. The contractors must be aware of all potential obstacles and conditions before a spill occurs.

- Make improvements to the WTP to pretreat water and remove the organics before the contaminated water can enter the WTP. Another possible emergency alternative would be to consider an interconnect to the Peace River Water Treatment Facility. This alternative was listed as the "most viable and best alternative" by Mr. Peter Hubbell, Executive Director, Southwest Florida Water Management Director, in his April 30, 1996, letter to the Mayor of Punta Gorda.

**Potential Impact to Water Treatment Plant**

The Punta Gorda water treatment plant can not tolerate low levels of certain gasoline constituents without process modifications. To determine tolerance levels and necessary modifications, the following are recommended:

- The existing aeration trays of the water treatment plant needs to be pilot-tested to determine an actual removal efficiency for fuel contaminants.
- The evaporation rate of aromatic hydrocarbons from plant waterways and aerator needs to be pilot-tested to determine the actual amount of contaminant that could be expected to evaporate.

- The powdered activated carbon (PAC) material must be pilot-tested to determine the contaminant removal capacity of different doses of PAC.

- Sensors for oil sheens and volatile organic compounds should be placed in the raw water reservoir. These would monitor, detect, and report the presence of fuel so that the appropriate countermeasures could be taken within the water plant operations.

- A separation basin would be needed before the water intake piping. This would allow the removal of insoluble contaminants before they enter the plant operation and is essential given the vortex activity at the intake piping.

- Air stripper towers need to be studied for use at the water plant entry point. These towers would be necessary to remove soluble contaminants before entry into the treatment plant.

**Karst Activity**

Sinkholes and subsidence are concerns to pipeline safety. The following recommendations are needed for final design criteria:
An inventory of closed depressions within a two-mile envelope of the pipeline route throughout the Punta Gorda water shed is needed. There is evidence of geological features that indicate sinkholes are possible in the area. These indications are strongest in the vicinity of the Charlotte and DeSoto County line.

A mapping of photo linears will be needed along the proposed corridor. Photo linears are natural alignments that could be indicative of fractures (jointing, faulting) in the subsurface. The location and alignment of photo linears are needed to further assess the potential for sinkholes. An FDEP internal memorandum by Mr. Jonathan Arthur, Ph.D., P.G. (11/94) states an inventory of closed depressions and a photo linear survey two miles wide would be valuable in evaluation of the project.

**Florida Department of Environmental Protection Review**

Review of FDEP files and interviews with FDEP personnel are the basis of the following recommendations:

- The City of Punta Gorda should enter a binding agreement with SWFPL that specifies obligations to the City during normal operations, spill, and impacts to the water treatment system.
- Punta Gorda should request that FDEP furnish any additional information that SWFPL submits. The City should have the opportunity to review and provide comment prior to FDEP taking action on the application.

- Hydrostatic testing of a newly constructed pipeline is required. Information concerning the discharge of the test water needs to be provided by SWFPL. Depending on the source water and test vessel, the discharge could impact water quality within Punta Gorda’s watershed.
References Cited

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National Transportation Safety Board, Pipeline Special Investigation Report, January 23, 1996.


May 29, 1996

Mr. Robert Rackleff, President
Friends of the Aquifer
816 Cherry Street
Tallahassee, FL 32303

Dear Mr. Rackleff:

Per our conversation from this morning, I am enclosing a copy of "Southwest Florida Pipeline Submittal Review for The City of Punta Gorda, Florida." The report was drafted by Kimley-Horn and Associates, Inc. I apologize for the photocopy, but our office has only one bound copy remaining.

I hope that you find the report informative and I will contact you when a date is scheduled for the GATX public forum.

Sincerely,

[Signature]

Forrest E. Cotten
Assistant to the City Manager

Enclosure