LESSONS LEARNED DURING A LANDFILL'S 10-YEAR STRUGGLE TO CONTROL LANDFILL GAS MIGRATION

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ABSTRACT

Offsite landfill gas (LFG) migration was first discovered at the Brown Station Road Landfill, Prince George's County Maryland, in the early to mid 1990s. And after a long 10 years, we can now report that the migration is finally under proper control. This paper chronicles our story with the hope that other landfill owners or operators would learn from our lessons and maybe manage their offsite migration problems in a more timely and effective manner.

The impacted boundary measured about 1,000 feet, was only about 40 feet away from the compliance boundary, and was adjacent to several private homes. The paper discusses the immediate safety, regulatory, and legal actions taken to respond to the migration discovery.

There were several preliminary findings that made the analysis fairly complex: higher methane concentrations further away from the waste footprint, a nearby underground natural gas line, and nearby marshlands. Moreover, Prince George's County utilizes methane rich LFG at this facility to fuel an offsite 2.5 MW power plant (one of the first LFG-fueled power plants in the United States, installed in 1985), boilers that serve the heating needs of their onsite maintenance shop and an offsite 1,300 bed correctional facility, and more recently to fuel an additional onsite 4.2 MW plant. Adding further to the complexity, the landfill is affected by the Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills (EG) which prescribes the operating parameters of its LFG collection and control system. All these factors taken together made for a challenging solution.

Nonetheless, a relatively simple and cost effective solution was found only a year ago. It consists of a uniquely designed perimeter trench that contains certain state-of-the-art features to allow for various levels of control. The design details of the trench, explanations of its unique features, and actual performance data are also presented in this paper.

INTRODUCTION

On paper, it may appear as though subsurface LFG migration is a problem that can be easily handled. When faced with the problem, though, you realize that it is a potentially serious issue that can take considerable time, expertise, and other resources to resolve. Offsite LFG migration was first discovered at the Brown Station Road (BSR) Landfill, Prince George's County Maryland, in the early to mid 1990s. This paper chronicles our story with the hope that other landfill owners or operators would learn from our lessons and maybe manage their offsite migration problems in a more timely and effective manner.

Site Profile

The BSR Landfill is located in Maryland, just west of Washington DC. It sits on an 850-acre site and the waste footprint in divided into two primary areas. Area A, approximately 150 acres, is further divided into two sub-areas (A1 and A2) and is closed. See Exhibit 1. Area A operated between 1968 and 1992. Area B, approximately 140 acres, is active and has been in operation since 1992. The subsurface migration area was adjacent to Area A2, alongside Brown Station Road.

Since 1968, about 12 million tons of waste have been landfilled. The site presently consists of about 200 LFG collection devices installed inside waste. The County utilizes their collected LFG to fuel an offsite 2.5 MW power plant (one of the first LFG-fueled power plants in the United States, installed in 1985), boilers that serve the heating needs of their onsite maintenance shop and an

offsite 1,200 bed correctional facility, and more recently to fuel an additional onsite 4.2 MW plant. Excess LFG is controlled with enclosed flares.

The landfill is affected by the Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills (EG) which prescribes various operating parameters of its LFG collection and control system.

Issue

Elevated methane concentrations were found in LFG probes (GP-13 through GP-19) located between Area A2 and Brown Station Road. Refer to Exhibit 1. The area of concern measured about 1,000 feet, and adjacent to this area on the other (south) side of Brown Station Road were several private homes.

This is where our story becomes interesting. The construction of Area A2 predates Subtitle D and is an unlined area. Records of waste depths and site geology were either non-existing or uncertain. Nearby marshlands were located on the south side of Brown Station Road. And temporary probes installed between the marshlands and landfill showed increasing methane concentrations further away from the landfill. To add to the complexity, the LFG distribution pipeline serving the correctional facility boilers and offsite power plant is buried in the shoulder of Brown Station Road.

Various questions needed answers. Were the elevated methane concentrations due to LFG migrating from the landfill? Or was it because of a leaking pipeline? Was it even LFG? Maybe it was swamp gas?

HISTORY

Years 1994 And 1995

Upon finding the elevated concentrations of methane along the compliance boundary, the County took immediate steps to protect the public health and safety. The basements of the neighboring homes were monitored regularly for methane, and a network of soil gas samples were collected and analyzed to delineate the extent of migration. In addition, routine communications with the local regulators was initiated.

At the time, the County owned the majority of property south of Brown Station Road, but there were a few homeowners neighboring the affected boundary. Trace methane concentrations were found in the basement of one newly constructed home, and as a result, the County purchased it, in addition to at least one other nearby home. By taking these actions, the migration issue strictly became a regulatory compliance matter rather than a public health and safety hazard.

Years 1996 Through 2002

A passive perimeter trench was installed in 1996 between the edge of waste and the monitoring wells parallel to Brown Station Road. This trench was found to be only partially effective in controlling migration. Subsequent efforts included the installation of an additional five LFG extraction wells (C52-C56) on the southern slope of Area A-2. See Exhibit 2. These wells, placed in service on July 7, 2000, significantly reduced methane concentrations detected at five of the seven impacted monitoring wells.

In May and June 2001, the extraction system was adjusted to increase the vacuum and extraction rates from the recently installed five extraction wells. Success was achieved in reducing methane concentrations below the regulatory limit of 5 percent in all but two monitoring wells (GP-13 and GP-16). Although a clear downward trend in methane concentrations was observed at these two wells, vacuum was decreased before compliance was achieved in order to counteract the adverse effects on the electric generating facility from declining gas quality.

Methane concentrations eventually returned to levels similar to those occurring prior to the gas control activities in the spring of 2001. By early 2002, methane concentrations above 5 percent were detected in GP-13, 14, 15, 16, 17, and 19. However, it is important to note that the County was achieving regulatory compliance for surface emissions and well head operational parameters as well as fueling the existing LFG-fired power plant and boilers for energy recovery. Moreover, a second power plant rated at 4.2 MW was beginning construction onsite along with modifications to the existing onsite compressor station.

Years 2002 And 2003

In 2002, Prince George's County contracted with SCS Engineers to assist with solving their migration problem. SCS reviewed the migration history and found it to be a classical case of LFG migrating from an unlined landfill. Swamp gas migration and a pipeline leak were eliminated as causes based on a review of prior troubleshooting activities that showed a direct correlation between more aggressive control at the landfill and a decrease in methane concentrations in the monitoring wells. Note that the suspect leaking pipeline and swamp is located south of the monitoring wells; the landfill is located on the north side. See Exhibit 1. If the methane source(s) was south of the monitoring wells, the concentrations in the monitoring wells would have shown a different response.

The activities that transpired thereafter are given below:

- In April 2002, the overall wellfield vacuum and flowrate were increased to improve control of LFG migration. By June 2002, only GP-14 and

15 had methane concentrations in excess of 5 percent. Refer to Exhibit 3. It shows the response of GP-15 to the various operational/troubleshooting activities.

- Design drawings were developed to provide active extraction from the existing perimeter trench via an interconnection to the existing LFG collection system.

- On August 26, 2002, the compressor facility was shut down for modifications, resulting in a corresponding shut down of the correctional facility power plant and boilers. Consequently, all LFG extraction was accomplished through the blower/flare station. This did provide an opportunity for more flexible and aggressive LFG system operations, given relief from gas quality demands of the power plant engines.

- Piping and valves necessary to connect the perimeter trench were installed. Active extraction from the trench was initiated on September 12, 2002.

- On October 2, 2002, the vacuum applied to the trench was increased.

- On October 7, 2002, all of the methane monitoring probes were in compliance.

- A few days later, vacuum to the trench and nearby wells in Area A-2 was reduced because of gas quality concerns. As a result, methane levels in monitoring well (GP-15) increased above the regulatory limit.

- In April 2003, the correctional facility power plant and new compressor facility were energized, and testing of the new power plant began. However, existing methane quality was inadequate to ensure proper operations. As a result, the perimeter trench was isolated from the LFG collection system and connected to a separate but temporary extraction blower.

From the above findings, it was clear that aggressive extraction from both the nearby wells and trench was necessary to provide effective LFG migration control along the impacted perimeter. However, a balance of multiple but sometimes conflicting operating objectives, including aggressive extraction for good migration control, methane rich gas for proper power plant operation, regulatory oxygen and vacuum wellhead requirements, and control of oxygen to reduce the potential for a landfill fire, had been difficult to achieve.

Knowing that the solution meant aggressive extraction from the trench, it was decided to reconstruct a 650 foot portion of the then existing trench in the vicinity of the "hot" wells (GP-14 and 15), in a manner that would minimize air intrusion.

RECONSTRUCTED TRENCH DESIGN

The original trench was constructed under emergency conditions by County forces, and it was made known that quality control during its construction was poor at best. Based on memory, the trench depth was no more than 15 feet, with maybe 1 to 2 feet of cover soil. Prior to the design and construction of the reconstructed trench, a few test pits were dug. The soil was found to be clayey silt. The strata showed a 6-inch to 18-inch thick sandy layer in some locations: this layer was deep, but above the groundwater/saturated soil. Groundwater/saturated soil was found to be between 20 and 25 feet below surface. These findings further confirmed that the original trench should be reconstructed.

The typical cross-section of the new trench is presented in Exhibit 4. The new trench depth was specified to terminate at groundwater or 2 feet into saturated soil, thereby intercepting any sandy layers. The cover soil above the trench was increased and a geomembrane liner was placed above the stone to minimize air infiltration. The design includes a pipe embedded in the upper portion of the stone pack to allow for either passive or active operation.

The trench is also designed with a second perforated pipe, located in the bottom portion of the stone pack. This dual pipe design (lower and upper piping arrangement) is brand new to the industry (i.e., first to be installed at the BSR Landfill) and provides for a unique feature. It allows the trench to purge potentially stagnant gas. The concept is that fresh air is added through one pipe and exhausted through the other, taking with it any intercepted gases. In effect, it allows the stone to be "air washed".

The reconstruction began in early September 2003, and the new trench was activated on September 22, 2003. The trench was connected to the existing LFG collection system at two locations, spaced about 400 feet apart. Valves were set such that the applied vacuum to the trench was between 0.5 and 1 inch of water column. At these settings, the total flowrate from the trench was less than about 100 cubic feet per minute, and its impact on the gas quality to the power plants and boilers was minimal.

Since activation of the new trench, all of the monitoring wells have been in regulatory compliance.

LESSONS LEARNED

Lessons learned may be summarized as follows:

- It takes considerable time.
- Hiring experts with experience relative to your problem can save time and other resources.
- Communicate, particularly with your local regulatory agency. Our experience is that regulators work best with us when they are kept up to date on the issue.
- Be aware of developments near your landfill. The Prince George's County permitting process has since been modified to flag new development within 1,000 feet of the landfill compliance boundary.
- Building structures onsite and adjacent to the landfill property are routinely monitored for methane. LFG controls are considered for all new structures, and permits are required for all confined space entries.

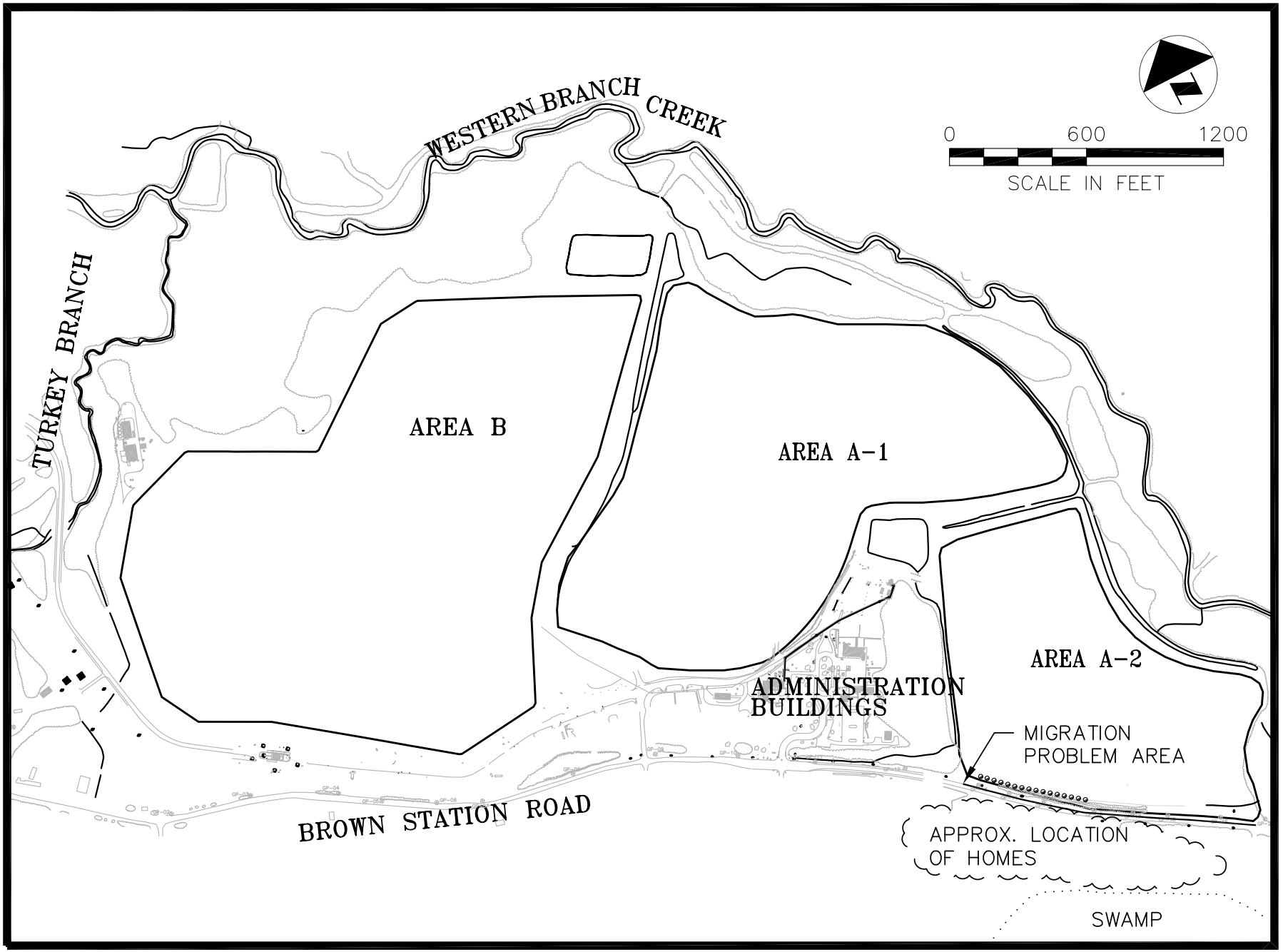


EXHIBIT 1. SITE PLAN

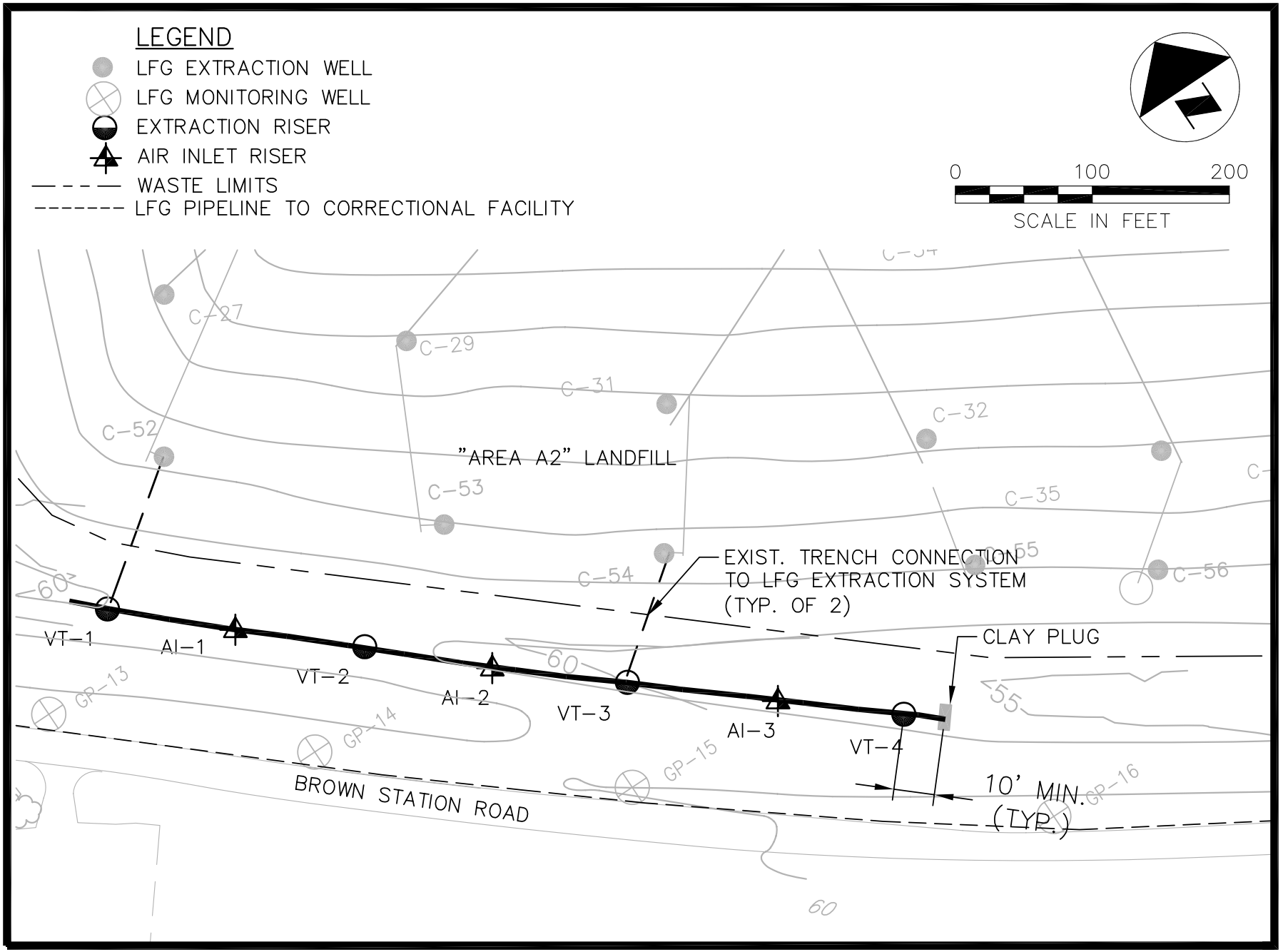
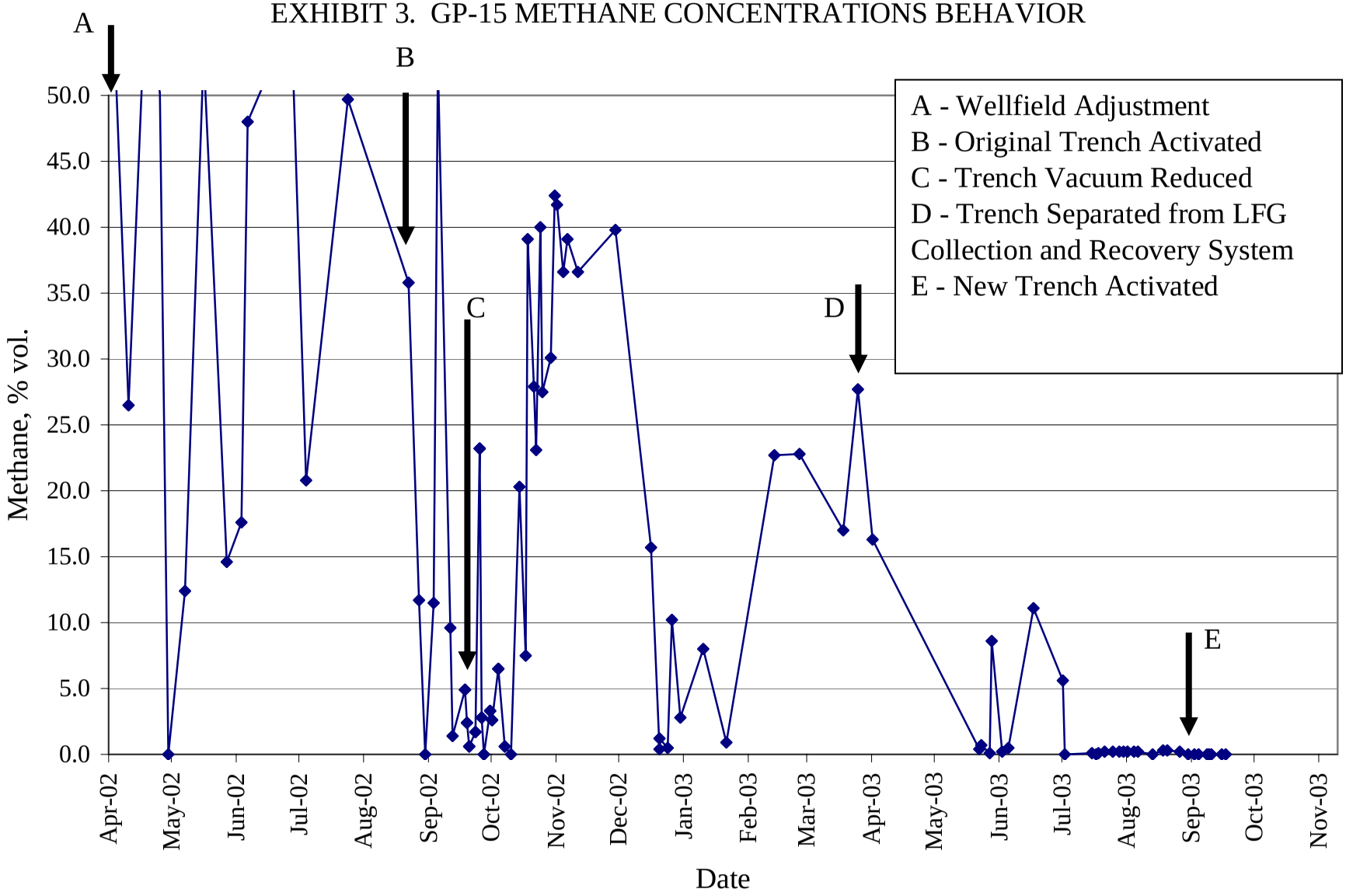


EXHIBIT 2. MIGRATION PROBLEM AREA NEAR RECONSTRUCTED TRENCH

EXHIBIT 3. GP-15 METHANE CONCENTRATIONS BEHAVIOR



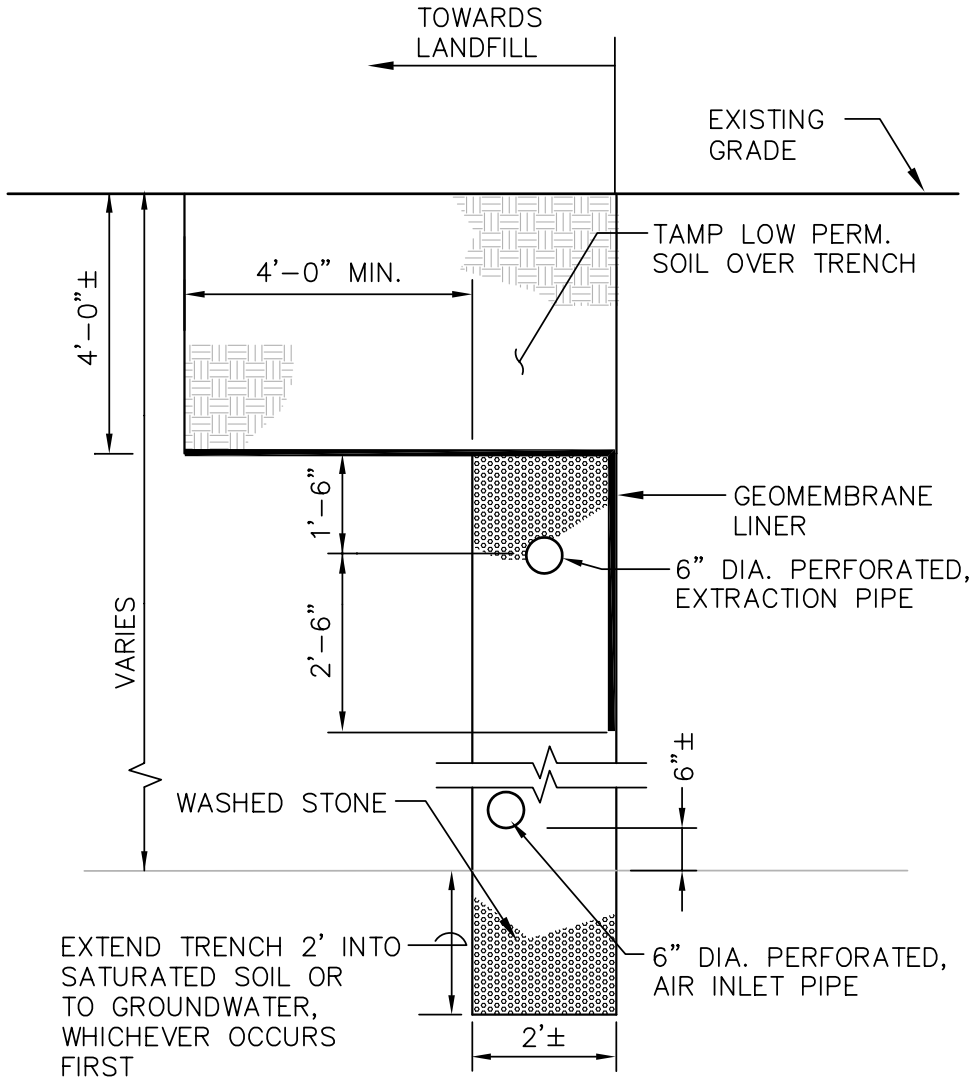


EXHIBIT 4. LFG MIGRATION CONTROL TRENCH