A Multi-Faceted Approach to Odor Control for a 28.5-Mile Long Force Main

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ABSTRACT

Upon startup of the 16 km (10-mile) long, 91.4 cm (36 inch) diameter force main between the Alcovy River Pump Station (PS) and the F. Wayne Hill Water Reclamation Facility (FWHWRC), Gwinnett County began receiving odor complaints along the pipeline. A preliminary odor investigation of the system indicated that while sulfide concentrations were increasing through the length of the force main and the existing odor control chemical feed was ineffective, there were indications that significant surges were occurring within the pipeline. The following hydraulic and surge analysis showed that keeping the pipeline full during all operating scenarios could eliminate the foul air discharges at the problem air release valves (ARVs) and alleviate the odor complaints. A motor-operated control valve was installed at the end of the force main to modulate to induce additional head at low flows with the goal of keeping the pipeline full. A surge tank was also installed at the Alcovy River PS to minimize surging along the force main. This solution was extremely effective until the conditions of the system changed.

In 2008 and 2009, Gwinnett County added flow from two additional constant speed pumping stations (Lower Big Haynes PS and Brooks Road PS) and two variable speed booster pumping stations (Brooks Road Booster PS and Alcovy River Booster PS) into the same force main. The entire length of the new system, known as the Eastside Conveyance System, was 45.9 km (28.5 miles) and included 153 possible operating scenarios. Within a few months of startup, odor complaints began to increase again. It was determined that the motor operated valves on the force main discharge were not able to keep up with the complexity of the system and could no longer prevent odor emissions from the air release valves. Several aspects of this study, combined together, were able to finally solve the odor problems on this force main:

- **Hydraulic/Surge Improvements** – No feasible solution was determined through the surge modeling that eliminated odorous air discharges from the ARV locations. However, surge modeling identified one option as the most feasible and cost-effective solution: an elevated loop was installed at the FWHWRC to raise the discharge elevation of the force main by about 11.3 m (37 feet). This elevation minimized the amount of draining within the force main, but allowed the existing pumps to still be used. The elevated loop at the FWHWRC significantly cut down on air release volumes and pressures, but did not eliminate them entirely.

- **Liquid Phase Chemical Feed** – Due to the long retention times in the system, a switch from Bioxide to magnesium hydroxide significantly reduced the H₂S concentrations in the system. Determining the appropriate odor control chemical and chemical feed rates allowed the County to utilize activated carbon adsorption at the remote ARV sites, which would not have been practical at the prior H₂S concentrations.
• **Foul Air Capture and Treatment** - A vapor phase odor control system was provided at each pump station wet well to minimize odor complaints near the stations. Prior to construction being completed, two emergency odor control systems were also required: one at a pump station and one at an ARV along the force main. One emergency odor control system was fabricated by an on-call Contractor, under the Engineer’s direction, on a Friday afternoon, using materials at hand, to provide relief to the homeowners for the weekend.

Vapor phase treatment was not initially feasible at several ARV locations. For instance, at one remote ARV location, the air release volume and pressure was so high, it caused the carbon to be blown out of the vessel on multiple occasions. In addition, the County had to change out the carbon on a weekly basis to prevent breakthrough, which was not sustainable. The surge improvements reduced the airflow and pressure from the ARV locations, while the chemical feed improvements reduced the H_{2}S concentrations. These combined improvements allowed activated carbon to be used for odor treatment at the remote ARV locations.

Effective and sustainable odor control along the Eastside Conveyance System would not have been feasible without the implementation of all facets of this project. Addressing the odor issues in this system required a truly multi-faceted approach.

**KEYWORDS:** Collection system odor control, hydraulic modeling, surge modeling, force main, chemical feed, air release valve, activated carbon adsorption, magnesium hydroxide

**INTRODUCTION**

Gwinnett County, Georgia (located northeast of Atlanta) has experienced explosive population growth over the last 20 years. To meet the increased demand for new wastewater services, a new wastewater treatment plant, the F. Wayne Hill Water Resources Center (FWHWRC), was constructed and placed into service in 2000. Due to space constraints and political concerns, the FHWRC was constructed in the northern part of the County and at one of the highest elevations in the County. Therefore, all flow to the FHWRC must be pumped and some from the far reaches of the County. Because of this and other reasons, the Gwinnett County Department of Water Resources’ (GCDWR) owns and operates more than 250 wastewater pumping stations and 468 km (291 miles) of force mains. Due to the population density, GCDWR has always been sensitive to odors at all their facilities.
The Alcovy River Pump Station (PS) was originally built in 1992 to convey raw wastewater through a 45.7 cm (18 inch) force main to the Ezzard Road PS. The pump station consists of three submersible pumps, each rated at 0.44 m$^3$/s (7,000 gpm) and 71.6 m (235 feet) of total dynamic head. Two of the pumps are original to the pump station and were installed in 1992, while the third pump was installed in within the past five years. All three pumps are constant speed and cycle on and off based on wet well water levels.

![Image of the Alcovy River Pump Station](image)

**Figure 1**
Alcovy River Pump Station

After the FWHWRC began operation, a new 16 km (10 mile) long, 91.4 cm (36 in) diameter force main was constructed to divert flow from the Alcovy River PS to the FWHWRC. The new force main was placed into service in 2003. Upon startup of the new force main, the County began receiving odor complaints along the new force main. The County initially tried to address the odor complaints through the use of chemical feed. Bioxide and Odophos were both utilized at the PS, but the odor complaints persisted. Hazen and Sawyer was retained by GCDWR to investigate the problem.

**INITIAL ODOR INVESTIGATION – ALCOVY RIVER FM TO FWHWRC**

**Initial Odor Investigation**

The initial odor investigation began with a field survey of the existing pump station, pumps and each air release valve (ARV) location along the force main. At the time of the initial investigation, Odophos was being fed for odor and corrosion control in the force main. Figure 2 shows the new 36” diameter pipeline profile from the Alcovy River PS to the FWHWRC.

The force main has a total length of approximately 16 km (10 miles or 50,000 ft) and includes 38 ARV locations. Figure 2 shows the significant elevation change along the force main’s route to the FWHWRC. The locations circled in red in Figure 2 (Baptist Church and Azalea Road) represent the ARV locations with the most active odor complaints. The ARV circled in green...
Figure 2
Alcovy River FM to FHWRC Pipeline Profile
represents a location at which the County was concerned about getting odor complaints in the future, due to proposed development plans.

The field investigation included a survey of the wet well, each ARV location and PS operational review. Wet chemistry sampling was conducted at all available points and was timed to correspond with pump startup and shutdown cycles. The wet chemistry sampling included the following:

- Total sulfide
- Dissolved sulfide
- ORP
- pH
- Dissolved oxygen

The sampling was conducted both with and without chemical feed (Odophos at the time) to determine the effectiveness of the existing chemical feed and to establish a baseline for treatment. In addition, continuous H₂S measurements were collected at several ARV manholes using an Odalog instrument. Finally, an attempt was made to measure the airflow discharge rates at problem ARV locations.

Preliminary conclusions from the initial odor investigation were as follows:

- The ORP of the wastewater goes from a healthy positive in the first 4.6 km (15,000 feet) of the force main and remains negative for the rest of the pipeline.
- Concentrations of both dissolved and total sulfide increase over the entire length of the force main, both with and without chemical feed.
- There was no appreciable difference in sulfide production with and without the Odophos chemical addition. (GCDWR increased the chemical dosage after the sampling).
There was a substantial decrease in pH over the length of the force main (7.0 down to 6.2), increasing the potential for odor release.

Chemical feed, as currently operated, was not effective

However, the most concerning result of the field investigation was that field personnel observed and recorded large quantities of air being released and drawn in at several air release valves. In particular at the Azalea Road ARV site (see Figure 3), exceptionally high discharge pressure and airflow rates were noted. This airflow and pressure presented significant concerns because typical vapor phase treatment would present extreme difficulties at these conditions. In addition, at least 2 ARVs appeared have a continuous air intake/release cycle during the entire time the pumps were shutdown.

Based upon our observations at the ARVs during the pump station operation, it became apparent that the hydraulics and surging of the force main were playing an important part in the odor problems. Our next step to address the odor problems was to investigate the hydraulic conditions in the force main.

**Hydraulics and Surge Analysis**

The analysis of existing hydraulic conditions in the force main involved preparing a model of the existing system from the Alcovy River PS to the FWHWRC using WaterCAD\textsuperscript{\copyright} software by Haestad Methods. In an effort to prepare a reasonably accurate WaterCAD\textsuperscript{\copyright} model, information was collected from the following sources and incorporated into the model:

- As-Built Force main Drawings
- As-Built Pump Station Drawings
- As-Built FWHWRC Drawings
- Site visits to FWHWRC and the Alcovy River PS
- Pump curves from GCDWR files

A steady-state analysis was performed using one pump online (typical operating scenario according to Operations staff). The Hazen-Williams roughness coefficient, C, was assumed to be 120 based on the design information obtained from GCDWR and age of the pipeline. Model simulations using a C of 140 were also run and similar hydraulic trends were observed. Figure 4 shows the hydraulic analysis results with respect to the force main profile.

The hydraulic analysis indicated that the pipeline does not remain pressurized under normal operating conditions (one pump in service). Two pumps must be in operation for the force main to remain pressurized while pumps are operating. The hydraulic analysis also correlated with the field observations, which indicated large and continual air releases at the main high points. The hydraulic profile also shows that there will be significant draining of the pipeline when the pumps shut down and significant air intakes. The large amount of air drawn into the pipeline would then lead to significant air releases when the pumps started up again.

For the surge analysis, the existing hydraulic model from WaterCAD created by H&S was converted to KYPIPE SURGE2000 (University of Kentucky, version 2.111). The model was
Figure 4
Alcovy FM to FHWRC Profile Hydraulic Analysis Results
modified for surge analysis by eliminating many of the node junctions. Information for the existing pump curves, based on pump operation, was added to the model. The ARVs and the surge valve installation information were also added to the model and field-verified.

The surge model was prepared, calibrated and run under the steady state conditions to match the existing hydraulic profile. Once the surge model was verified by running the steady state analysis, the surge analysis was performed to see if the model showed similar air releases. The surge model results indicated and confirmed that there was significant air volume released at the Baptist Church and Azalea Road ARVs during each pump operating cycle shown in Figure 5 below. The ARV at Rock Springs Road showed no air volume being released.
Figure 5
Air Release Volume at Baptist Church and Azalea Road ARVs
Alternatives Analysis and Recommendation

Once the surge model was prepared and calibrated, it was used as a tool to assist in answering the following question: Can reducing surges in the pipeline help to and reduce odor releases at the ARVs? Based on the hydraulic and surge analysis results, it was determined that if we can keep the force main full under all operating conditions, odorous air release will be greatly reduced.

Several alternatives were considered and analyzed using the surge model. The basic idea was to maintain a full pipe condition under all pump station operating conditions, thereby preventing the release of foul air. The alternatives evaluated are listed below:

- **Alternative 1** - Increase the hydraulic grade line (HGL) by adding additional head to the end of the force main through a smaller diameter pipe acting as an orifice.
  - The orifice required to accomplish this was too small and the additional head was unacceptable at peak flows. This alternative was removed from consideration.
- **Alternative 2** - Raise the pipeline elevation at the end of the force main to keep the entire force main full.
  - The existing pipe needed to be raised approximately 19.8 m (65 feet); the existing pumps were not capable of meeting the required flow and head conductions. This alternative was removed from consideration.
- **Alternative 3** – Add a throttling valve to the end of the force main and an invert surge bladder tank at the pump station.
  - This option allowed for the HGL to be raised under lower flow conditions, while minimizing the additional pressure loss at high flow conditions.

Alternative 3 was selected since it accomplished the goal of keeping the pipeline full and the surge modeling showed a significant reduction in air volume from the critical air release valves along the force main. The minimum pressure remained above the pipe profile, therefore air was not drawn into the pipe as much through the vacuum valves when the flow stopped and would not be released when the flow began again. During normal pump cycling the model indicated that no volume of air was being released from the Baptist Church and Azalea Drive ARVs, thereby eliminating the odor problem. Figure 6 below shows the estimated air release volumes both before and after improvements.
Figure 6
Air Release Volume at Baptist Church and Azalea Road ARVs (Alternative 3)
Two valves were recommended to be installed near the end of the force main in series at the FWHWRC. Both valves were needed to provide either head loss or backpressure in order to maintain pressure in force main. Each valve was set to operate in a range of 15% to 75% open to avoid cavitation. For ease of the valve controls, one valve remained at a fixed opening while the other valve was modeled to close before the pump came to a stop. An inverted surge bladder tank was selected to provide much needed surge protection for the system at the Alcovy River PS. The bladder tank was sized to attenuate the surge pressure caused by pump operating cycles, which would allow the closing of 9 of the 38 existing ARVs on the force main. The bladder tank was sized to be a nominal volume of 20 m$^3$ (5,300 gallons) tank. Figure 7 shows the proposed plan for the control valve at the FWHWRC, Figure 8 shows the final installation of the control valve and metering station at FWHWRC, and Figure 9 shows the final installation of the surge tank at the Alcovy River PS.
Figure 7
Control Valve Schematic
In addition, the improvements enabled the County to close 18 of the 38 ARVs on the force main, thereby eliminating the potential for odors at those locations. The combination of the hydraulic/mechanical improvements and the optimization of the odor control chemical feed at
Alcovy River PS successfully mitigated the odor complaints at the air release valves for several years. However, the odor complaints resumed once the County made changes to the system.

**EASTSIDE CONVEYANCE SYSTEM – LOWER BIG HAYNES PS TO FHWRC**

**Background**

Due to the continual population growth realized in Gwinnett County and a desire to send wastewater flows to the FHWRC to decommission some smaller, less efficient plants, GCDWR planned to reroute additional flows to the FHWRC from the southern portion of the County via the Alcovy River Force Main. The concept was to send flow to the FHWRC from the Lower Big Haynes PS and the Brooks Road PS by pumping over a 45.9 km (28.5 mile) distance, the final portion of which was the Alcovy River Force Main. In order for the flow to make it all the way to the FHWRC, two intermediate, in-line pumping stations were required to boost head. The 2 booster pumping stations constructed were the Brooks Road Booster PS and the Alcovy River Booster PS. The locations of the pump stations and the 45.9 km (28.5 mile) long force main is shown in Figure 10 below. This system was to become known as the “Eastside Conveyance System”.
These booster stations were designed to re-pump the flow to boost the hydraulic grade to provide enough head to get the flow the entire way to the FWHWRC. The hydraulic profile for the booster pumping concept is shown in Figure 11 below and the flow schematic is shown in Figure 12.
Figure 11
New Eastside Conveyance System Hydraulic Profile
The Eastside Conveyance System included 153 possible operating scenarios. Therefore, the County asked Hazen and Sawyer to evaluate/model the entire system with the following 4 pump stations added to the Alcovy River Force Main: Lower Big Haynes PS, Brooks Road PS, Brooks Road Booster PS and Alcovy River Booster PS. A WaterCAD model was developed to evaluate all the pump stations at different design flows. Once again the WaterCAD model was converted into a KYPIPE Surge. This second model evaluated uncontrolled power loss at maximum flow scenarios at each location, one site at a time. It was assumed that if two stations were located at the same site (which was the case for Brooks Road PS/Brooks Road Booster PS and Alcovy River PS/Alcovy River Booster PS), they would both lose power at the same time. The goal was to determine how to best protect the pump stations and their force mains from surge events.

It was recommended that surge protection be provided at both the Brooks Road Booster and Lower Big Haynes Pump Stations. A bladder tank was recommended for each site to attenuate the surge pressures caused by power losses and protect the pump stations and the force mains. The bladder tank that was previously installed at the Alcovy River PS would be re-piped to the discharge of the proposed Alcovy River Booster PS. Surge relief valves were also installed at Brooks Road Booster PS, Alcovy River Booster PS and Lower Big Haynes PS for additional surge protection.
Startup and New Odor Complaints

In 2008 and 2009 all of the following pump stations began operation and sent their flows through the Alcovy River Force Main:

- Lower Big Haynes PS
- Brooks Road PS
- Brooks Road Booster PS
- Alcovy River Booster PS

Within a few months of startup, odor complaints began to increase again. It was determined that the motor-operated valves on the FM discharge were not able to keep up with the complexity of the system. Each of the new stations added more complexity to the control valve operations than the programming could accommodate. Initially, the motorized valve was set to open and close with the operation of the pumps at the Alcovy River PS. This was achieved by connecting the two pieces of equipment using DWR’s SCADA system. However, using the SCADA system was not possible with the additional pumps stations because each station starts and stops independently. The constant speed pump stations at Lower Big Haynes, Brooks Road and Alcovy River start and stop according to wet well levels and the booster pump stations with their variable speed drives operate according to suction pressure set points. The control of the valves with SCADA was further complicated by the distances they had to communicate between the pump stations and the FWHWRC. A pressure sensor and pressure set point method was also attempted to control the valves. However, it was found that the motor operated valve could not be operated very precisely with the pumping stations and this allowed the force main to drain, causing additional odor and surge problems.

Given the complexity of the new system, it was obvious that a single solution would not be possible any longer to prevent odor emissions. Therefore, multiple options were considered.

New Odor Control Options Analysis

Since the force main surge issues had been previously addressed, this analysis focused solely on finding a sustainable, long-term solution to the odor issues, particularly at the Azalea Road ARV where odor complaints were more serious. The first step in determining a solution was to update the surge model. The previous surge model for the Eastside Conveyance System was updated using the actual as-built drawings and field data. Since the new booster stations were in service, SCADA data was available and used to calibrate further. The surge modeling identified three viable options:

1. New Odor Control at Azalea Road – This option would require the installation of a new, permanent odor control facility at the Azalea Road ARV location assuming no additional hydraulic/surge improvements are implemented. However, there were several drawbacks to designing a new odor control system for this location:

   a. Surge modeling (and field surveys) indicated air pressure and flow discharges from this ARV are significant. Therefore, any odor control system designed for
this site would have to be designed for pressures up to 689 kPa (100 psi). This would require the odor control unit to be a pressure vessel and all components to be designed for up to 1,034 kPa (150 psi) pressure.

b. The remote location would present issues such as providing power, water, drains and instrumentation and control, as well as present safety, security and space constraint issues.

c. Due to the intermittent nature of the ARV discharge (and remote location), an activated carbon adsorption system would be the recommended odor control system. However, surge modeling indicated potentially high air volumes and hydrogen sulfide sampling at the existing ARV showed H2S peaks up to 540 ppm. These conditions would make this system unsustainable for the long-run.

2. **Lower pipeline at Azalea Road** – It was determined from the pipeline profile that the Azalea ARV is the high point on the force main where the flow transitions to gravity flow. In the gravity section after the Azalea ARV, flow conditions change that promote air pockets, supercritical flows and hydraulic jumps which all contribute to more severe odor releases. An option to remedy this condition was to lower the pipeline so that the discharge point at FWHWRC is higher than at Azalea Road. Once the relocation is completed the Azalea ARV could be removed and then no foul air would be released at Azalea Road. However, a new ARV would need to be installed about 344 m (1,130 ft) upstream of the existing Azalea ARV. Our modeling showed air releases would occur from this new ARV. There is one other high point of the force main that is higher than the FWHWRC which is near Rock Springs Road. The model also showed that lowering the pipe would significantly increase the amounts of air released at the Rock Springs Road ARV. To adequately control odors, an odor control facility would be required in each of these locations with this option.

3. **Elevated Loop at FWHWRC** – In order to keep the pipeline full, increasing the elevation of the discharge point at FWHWRC was considered. This option provides an elevated loop (gooseneck) at the FWHWRC to raise the force main discharge elevation approximately 11.3 m (37 feet) to elevation 347.8 m (1141.00 ft). The 347.8 m (1141.00 ft) discharge elevation was selected because it would reduce the release of foul air from the Azalea ARV, but still allow the existing Alcovy River PS pumps to pump the FWHWRC. Since this is a “passive” system, it would work under all operating scenarios. The modeling of this option shows the amount of foul air released from the Azalea ARV is substantially reduced, but a small odor treatment facility would still be required at Azalea Road. This option also reduces odors from the Baptist Church and Rock Spring locations.

Each alternative was evaluated in the surge model for air releases at each location under three different scenarios:

- Brooks Scenario: 1 pump at Brooks Road PS and 1 pump at Brooks Road Booster PS in service.
- Alcovy 1 Scenario: 1 pump at Alcovy PS in service.
- Alcovy 2 Scenario: 2 pumps at Alcovy PS in service.

Capital and expected annual operating costs were evaluated for each alternative. Based on the cost analysis, surge modeling results and other factors such as the long-term viability of the selected solution, Alternate 3 was selected – the elevated loop at FHWRC. Figure 13 below shows the expected air release volumes at Azalea Road and the Baptist Church ARV under Alternative 3.

**Figure 13**

Expected Air Release Volumes from Baptist Church and Azalea ARVs
As Figure 13 shows, the air release volumes at the two problem ARV locations were greatly reduced. Given the reduced airflow volume and pressure, an activated carbon adsorber was recommended for the Azalea Road ARV location. The photo shown in Figure 14 below shows the completed elevated loop constructed at the FHWRC for the Alcovy River FM. In addition to the reduction of the air volumes at Azalea Road, the hydraulic improvements also enabled the County to close 23 ARVs, eliminating odor potential in those locations.

![Figure 14](https://via.placeholder.com/150)

**Figure 14**

**Elevated Loop at FHWRC**

**Liquid Phase Chemical Feed**

Gwinnett County had a long history of Bioxide chemical feed at wastewater pumping stations for odor and corrosion control, however, Bioxide was not effective for this system due to the long retention times. A pilot program was conducted which tested several chemicals in the Eastside Conveyance System. It was determined that magnesium hydroxide provided the best results and was the most cost-effective chemical for this system. Figures 15 and 16 below show Odalog measurements before and after implementation of the magnesium hydroxide feed system.
**Figure 15**
Hydrogen Sulfide Measurements at Azalea Road Before Magnesium Hydroxide Addition

**Figure 16**
Hydrogen Sulfide Measurements at Azalea Road After Magnesium Hydroxide Addition
Magnesium hydroxide also provided additional alkalinity to the system and enabled the FWHWRC to discontinue the lime alkalinity addition. Although the magnesium hydroxide significantly improved the odors at Azalea Road, no chemical feed will eliminate odors entirely, particularly at sensitive locations. However, use of the appropriate chemical feed will allow the proposed activated carbon odor control system to be feasible for the County at the recommended locations.

**Vapor Phase Odor Control**

In addition to the chemical feed, a vapor phase odor control system was provided at each pump station wet well to minimize odor complaints near the stations. Chemical scrubbers were provided at the Lower Big Haynes PS and the Alcovy River PS, while the Brooks Road PS had an activated carbon adsorption system. Prior to the commencement of construction of the Brooks Road Pump Station Upgrade, an emergency odor control system was required to address the odor complaints. Hazen and Sawyer provided GCDWR with construction documents to provide a temporary activated carbon adsorption system, on a month-by-month lease basis.

Vapor phase treatment was especially effective at the pumping stations, but was not initially feasible at several ARV locations, particularly the Azalea Road ARV. The initial hydraulic and surge improvements for the Alcovy River FM lowered air releases at this location to almost nothing. However, when the entire Eastside Conveyance System was placed into service, the odor complaints were frequent and severe, and quickly became political. The situation hit a breaking point prior to a Labor Day holiday weekend. An emergency odor control system was fabricated by an on-call Contractor, under the Engineer’s direction, on a Friday afternoon, using materials at hand, to provide relief to the homeowners for the weekend. Activated carbon was borrowed from another site and the Contractor purchased the other required materials at Home Depot, including a 0.2 m^3 (55 gallon) drum, PVC pipe, screens, etc. The photos in Figure 17 below show the emergency odor control system at the Azalea Road ARV.

![Figure 17](image-url)

**Figure 17**

*Emergency Odor Control System at Azalea Road ARV*
The emergency carbon system at the Azalea Road ARV was immediately effective, however, there were several problems with the system. First, air release volume and pressure were a significant problem. On several occasions, the air release volume and pressure was so high, it caused the carbon to be blown out of the vessel. In addition, the County had to change out the carbon on a weekly basis to prevent breakthrough, which was not sustainable. The proper liquid phase chemical feed chemical and dosages significantly improved the carbon replacement period.

A preliminary design for a permanent activated carbon adsorption system using a high pressure vessel was completed, but surge modeling and hydraulic improvements enabled the County to significantly reduce the pressures and airflow rates at the Azalea Road ARV, thereby allowing the installation of a typical low pressure carbon adsorber. Since this was a combination air/vacuum release valve, the final design included a bypass with a check valve to allow fresh air into the valve for vacuum purposes and the discharge from the ARV was directly piped into the new passive carbon adsorbers. The permanent carbon adsorption system was installed in 2010 and has been extremely successful at providing odor control for the ARV at the high point.

The photos in Figure 18 below show the temporary and final odor control systems at the Azalea Road ARV.
DISCUSSION AND CONCLUSIONS

The Eastside Conveyance System presented particular challenges, all which contributed to the odor problems. These challenges included significant elevation changes, intermittent pumping flows, hundreds of operating scenarios, high H2S concentrations, large surge volumes and high air discharge pressures. This study presented some of the tools available to combat these challenges and the lessons learned from this analysis, which can be applied to other projects in the future.

Different aspects of the modeling, surge analysis, vapor phase treatment, liquid phase chemical addition and mechanical/hydraulic changes discussed above all were implemented for this system. Many of these items were instituted concurrently, but combined, ultimately provided Gwinnett County with an effective, long-term strategy for odor control. Addressing the odor issues in this system required a truly multi-faceted approach.