

**ATGAS INVESTIGATION  
INITIAL SITE CHARACTERIZATION  
AND RESPONSE  
April 19, 2011 to May 2, 2011  
ATGAS 2H WELL PAD  
PERMIT NO. 37-015-21237  
LEROY TOWNSHIP, BRADFORD COUNTY, PA**

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**SELECTED ACRONYMS AND ABBREVIATIONS**

Chesapeake Chesapeake Appalachia, LLC  
GES Groundwater & Environmental Services, Inc.  
PADEP Pennsylvania Department of Environmental Protection  
US EPA United States Environmental Protection Agency  
UNT Unnamed Tributary of Towanda Creek  
LEL Lower Explosive Limit  
FID Flame Ionization Detector  
TDS Total Dissolved Solids  
YSI YSI, Inc.  
TA TestAmerica Laboratories, Inc.  
DO Dissolved Oxygen  
GPS Global Positioning System  
WGS World Geodetic System  
E&S Erosion & Sediment  
bgs Below Ground Surface  
VOA Volatile Organic Analysis  
mL Milliliter  
TN Tennessee  
PA Pennsylvania  
SAP Sampling and Analysis Plan  
mg/L Milligram/Liter  
µg/L Microgram/Liter  
µmho/cm Micromhos/Centimeter  
ppm Parts per Million

**EXECUTIVE SUMMARY**

## **REDACTIONS MADE AT REQUEST OF PROPERTY OWNER**

On April 19, 2011 at approximately 11:00 pm, a well control incident occurred at the Chesapeake Appalachia LLC (Chesapeake) ATGAS-2H (ATGAS) well site in Leroy Township, Bradford County, Pennsylvania. Chesapeake staff and its consultants quickly responded to contain the release and control the well. The ensuing report details the initial response actions, site characterizations, and water quality and ecological monitoring efforts undertaken by Chesapeake and its consultants in the first two weeks following the incident (April 20, 2011 through May 2, 2011).

Initially, Chesapeake's actions centered upon two items: controlling the incident at the wellhead itself and preventing the discharge of fluid out of containment. Qualified well control specialists were on site within an hour of first notice of the incident; they formulated and implemented plans to plug the well, succeeding in doing so by the afternoon of April 21, 2011 and bringing the well under permanent control by the morning of April 25, 2011. The plan and subsequent actions were commenced by Chesapeake well control specialists in the hours immediately following the well control event and were carried forward by third-party well control specialists upon their arrival. Environmental response actions were immediately implemented, including the use of vacuum trucks to capture and remove accumulated water on the pad.

Due to the record-setting precipitation experienced during April and resulting soil saturation, a portion of the primary containment failed at approximately 2:30 am on April 20, 2011. Fluid discharge out of containment occurred for a period of four hours until vacuum trucks were successful in stemming fluid flow from the pad surface. Approximately 10,000 gallons of well fluid mixed with rainwater was discharged off site into pasture land, a small farm pond adjacent to the pad, and a drainage swale connected to an unnamed tributary to Towanda Creek. A significant portion of the released fluid was captured in two (2) catchment basins adjacent to the pad and in containment areas as part of the response efforts.

Upon arrival at approximately 2:30 am on April 20, 2011, Chesapeake environmental personnel conducted visual inspection of the pad and surrounding area and took field pH measurements, specific conductivity measurements, and total dissolved solids and salinity measurements. Chesapeake staff designed a comprehensive monitoring plan to assess any potential impacts due to the release, encompassing water quality sampling from surface water and domestic (groundwater) well sources, ecological monitoring activities, air quality monitoring, and soil monitoring. Chesapeake's consultants began implementing this plan within 13 hours of the initiation of the release.

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Water quality sampling included parameters used in Chesapeake's routine pre-drilling sampling program in order to compare samples collected following the event to samples collected previously. An expanded parameter list was implemented to monitor for additional constituents of concern and provide a broad evaluation of surface and water well conditions. Key parameters (constituents that could indicate the presence of contaminants) were alcohols, quaternary ammonium salts, and gluteraldehyde which might indicate the presence of hydraulic stimulation fluid and chloride, barium, strontium, total dissolved solids, and specific conductance which might indicate the presence of produced formation water. Sampling occurred at various locations on the surface waters surrounding the pad, including catchment areas, ponds, the unnamed tributary, Towanda Creek and at background locations. Samples were also collected from nearby and regional domestic water wells and springs. Several hundred samples were collected over the course of the two (2) weeks immediately following the well incident and sampling efforts continued for weeks following the dates covered by this Report. All field and analytical data were subjected to rigorous data validation efforts.

Very little impact was seen in any of the surface water samples, with the exception of short-term impacts to the small pond located north of the well pad, the drainage ditch swale system, and the unnamed tributary, all of which showed results indicative of diluted well fluids. In addition, small increases of chloride, total dissolved solids, and specific conductance were noted in Towanda Creek near the confluence of the un-named tributary, but swiftly abated and returned to baseline conditions not later than April 26, 2011. Additionally, no impacts to biological communities were detected in the drainage ditch swale system or the unnamed tributary of Towanda Creek or in Towanda Creek.

Seven nearby water wells surrounding the well pad were sampled daily throughout the reporting period. All samples and analyses of the seven (7) nearby water wells from the first two (2) weeks after the event indicate no impact as a result of the incident. A separate report was prepared for one residence due to special conditions surrounding this well which were determined to be unrelated to the ATGAS event. Chesapeake's consultants also monitored water wells located within 4,000 feet of the well pad on several locations. None of the key compounds were found in any wells and all parameters are consistent with baseline sampling conducted previously at these locations. None of the wells was impacted by the ATGAS release.

Based on the data collected by Chesapeake and its consultants during the first two weeks following the ATGAS incident, review has lead to several important conclusions. Most important, the discharge of well fluid from the event caused only minimal environmental impact. The impacts that did occur were localized, of short duration, and confined to surface waters surrounding the site. There were no ecological impacts to the nearby un-named tributary or its watershed and the Towanda Creek, and there was no impact noted to nearby or regional water wells.

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### ATGAS INVESTIGATION CHESAPEAKE APPALACHIA, LLC INITIAL SITE CHARACTERIZATION AND RESPONSE ATGAS 2H WELL PAD APRIL 19, 2011 TO MAY 2, 2011 AUGUST 30, 2011

#### 1.0 INCIDENT DESCRIPTION AND INITIAL RESPONSE

This Report provides detailed descriptions of the initial response and site characterization activities that were undertaken by Chesapeake Appalachia LLC (“Chesapeake”) and/or its representatives during and following the ATGAS incident.

#### 1.1 DESCRIPTION OF RELEASE

Information related to the release of well fluids from the ATGAS well pad is discussed in the following section of this Report. This Report has been prepared jointly and in conjunction with GES and SAIC.

##### 1.1.1 Timing of Release

The well control incident began shortly after 11:00 pm on April 19, 2011 following the apparent failure of a wellhead valve flange connection. The well fluids released from the wellhead initially were contained within primary containment structures constructed for the ATGAS well pad. The off-pad release of the well fluids mixed with rainwater ponded on the pad began at approximately 2:30 am on April 20, 2011, when primary containment was exceeded on the north side of the pad due to heavy rain and saturated conditions. The discharge out of primary containment structure was stopped at approximately 6:30 am on April 20, 2011. The location of the ATGAS well pad is shown on **Figure 1**. A site-specific aerial photograph and map of the site is shown on **Figure 2**.

The production fluids mixed with rainwater were released out of primary containment surrounding the well pad flowed overland down the north slope of the pad and overtopped erosion and sediment controls located along the northern limit of disturbance boundary for the well pad and then flowed into pasture land to the north of the pad. A portion of the discharge into the pasture land located north of the pad entered a small farm pond to the north. However, the majority of water flowed across a low area in the field and ultimately into the swale northwest of the pad. A portion of the water from the pad entered a drainage ditch (“Ditch”) located immediately west of the pad. A portion of the water from the pad entered the drainage swale (“Swale”) located northwest from the pad. Flow from this “Swale” entered an un-named tributary (“UNT”) to Towanda Creek approximately 1800 feet northwest from the pad at its confluence with the UNT. A significant amount of the release from the well pad was captured by pumping water from the two catchment basins located immediately north of the pad and with the limit of disturbance boundary and built immediately following the release. Ditches were also constructed with the limit of disturbance to the west and northeast of the pad to route water from the pad into the two catchment basins. In addition, a containment area was established north of the well pad to recover water flowing in the drainage ditch located west of the well pad and water was recovered from the pond located north of the pad. The locations of the containment areas, the drainage “Swale”, the drainage “Ditch”, the “UNT”, and Towanda Creek are shown on **Figure 3**.

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### 1.1.2 Volume of Material Released

Chesapeake estimated the volume of well fluid released from the ATGAS site utilizing two separate methodologies (**Appendix A**). Estimate 1 is an initial approximation based on a volume balance approach, encompassing the total incident duration and calculated in the days immediately following the fluid release to the drainage ditch, swale, and UNT. This initial estimate concluded that approximately 238.1 barrels (10,000 gallons) of well fluid were not captured in the containment systems at the site. The actual calculated estimate determined that the well fluids released were approximately 228 barrels or 9,576 gallons.

Estimate 2 was prepared as a check to the initial calculation. This methodology utilizes a flow-balance approach, utilizing best available information and engineering judgment, to determine the well fluid volume released. Based on this approach, a release outside of containment of 244.7 barrels (10,277 gallons) is estimated, which verifies Estimate 1. A detailed description of Estimates 1 and 2 can be found in **Appendix A**.

### 1.1.3 Characteristics of Material Released

The discharge out of primary containment was comprised of well fluid mixed with rainwater. The well fluid is believed to contain a mixture of the materials utilized in the hydraulic fracturing process and naturally occurring produced formation water, as identified in the summary entitled, "Hydraulic Fracturing Fluid Product Disclosure –

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ATGAS 2H" (**Appendix B**), along with elevated levels of total dissolved solids (TDS), including chloride and sodium.

No sample was taken directly of the well fluid, before it mixed with rainwater, due to safety concerns on the pad. However, samples of the released fluids were collected from nearby release catchment areas within approximately 13 hours after the well fluid had mixed with rainwater. Surface-water quality and air-quality monitoring also began within approximately 13 hours following the release.

### 1.1.4 Area Climatic Conditions During Release

The discharge from the primary containment on the ATGAS pad occurred because the primary containment capacity was exceeded on the north side of the pad due to heavy rain and saturated soil conditions. April 2011 was one of the wettest months on record across many areas of northeastern Pennsylvania and southern New York. In Williamsport, Pennsylvania (PA), the 10.04 inches of rain recorded during April 2011 was 6.55 inches above the normal of 3.49 inches for the period of record, and eclipsed the prior April record from 1909 of 8.22 inches. **Table 1** highlights the major national weather/climate stations in the region of the ATGAS site and comparable statistics for April 2011. The closest weather stations to the ATGAS pad location are continuous recording rain-gage stations operated by the United States Geological Survey (USGS) located in Monroeton, PA (12.01 miles northeast from pad); Troy, PA (9.44 miles northwest from pad); and Gleason, PA (11.35 miles southwest from pad). These three rain gage stations are operated by the USGS and all of these rain gage stations record rainfall or precipitation in 15 minute increments. The location of these three rain-gage stations are shown on **Figure 4**, and the ATGAS pad is approximately equi-distance between these rain gages, which are in a triangular pattern. Rainfall recorded at these 3 USGS rain gages are similar values to the rain recorded at more distant national weather station sites for April 2011. The rainfall amounts from April 11, 2011 to May 2, 2011 from these three stations are shown graphically on **Figure 5**. Rainfall amounts received at these three stations from April 11, 2011 to May 2, 2011 was 7.69 inches (Monroeton), 7.23 inches (Troy), and 10.54 inches (Gleason). On the day of the release (April 19, 2011 at approximately 11:00 pm) rainfall was recorded at the three USGS rain gage stations between 0.34 to 0.40 inches, but all rainfall had stopped by 9:00 pm that evening. No rainfall was recorded on April 20, 2011 at the USGS Monroeton and Troy rain gages, and 0.02 inches was recorded at the Gleason rain gage. No rainfall was recorded on April 21, 2011 at any of the USGS rain-gage stations. Rainfall from April 22, 2011 to May 2,

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2011 at Monroeton rain gage was 4.07 inches; at Troy, it was 4.48 inches; and at Gleason, it was 7.38 inches. Rainfall received at these three USGS rain gages in the nine days (April 11 to April 19, 2011) prior to the release was 3.26 inches (Monroeton), 2.75 inches (Troy) and 2.9 inches (Gleason). Clearly, the release occurred during an extended period of record-setting rainfall. Rainfall records for the three USGS rain-gage stations are provided in **Appendix C**.

The two graphics on **Figure 6** depict the rainfall impact on creek heights near the ATGAS site. The top graphic on **Figure 6** depicts daily and cumulative rainfall for Williamsport, PA against normal for the month of April, while the bottom graphic depicts the river gage height, in feet, for Towanda Creek near Franklindale, PA (approximately 7 miles east-northeast and downstream from the ATGAS location). Each increase in river gage height corresponds to a rain event in the month of April 2011. Peak stream flows occurred due to both heavy single-day rain events (April 16, 2011) as well as moderate rainfall over a number of days (April 22 to 28, 2011).

### 1.1.5 Area Stream Flow Conditions

There are two USGS real-time stream gages located on Towanda Creek downstream from the confluence of the UNT to Towanda Creek. The nearest USGS stream-gage station is the Franklindale gage site (USGS 01531908) located approximately 7.4 stream miles downstream from this confluence, and the USGS stream gage at Monroeton (USGS 01532000) located approximately 13.5 stream miles downstream from this confluence. The Franklindale gage has historical records for approximately 1 year, and the Monroeton station has historical records dating back 97 years to February 1914. The locations of these two USGS stream-gage stations are shown on **Figure 4**. These stream gages record stream stage height and daily flow in cubic feet per second (cfs). In addition, since approximately 2002, water-quality parameters have been collected approximately every 2 to 3 months from the Monroeton gage station.

The mean daily flow at the Franklindale USGS gage station on April 19, 2011 was 676 (cfs) and the mean daily stream flow on April 20, 2011 was 696 cfs. Therefore, the approximate average mean flow rate of Towanda Creek at Franklindale on April 19/20, 2011 was 686 cfs (at the time of the ATGAS incident).

The daily mean flow at the Monroeton gage station on April 19, 2011 was 1230 cfs and on April 20, 2011 it was 1290 cfs (average 1260 cfs). Therefore, the approximate

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mean flow rate of Towanda Creek at the Monroeton gage station was 1260 cfs at the time of the ATGAS incident. Since limited historical data is available at the Franklindale Towanda Creek gage station, no exact quantitative historical comparisons could be made as to the historical median flow rate in Towanda Creek at Franklindale during the ATGAS incident. However, 97 years of historical records exist (since February 1914) for the Monroeton gage station in which a historical comparison of the median daily flow rate for Towanda Creek at Monroeton could be made. The daily median flow in Towanda Creek on April 19 and 20 for the historical period of record (1914-2010) was 328 cfs and 315 cfs (average 321.5 cfs), respectively. The long-term historical median flow of Towanda Creek at Monroeton from 1914 to 2010 was 120 cfs. Since the mean daily flow in Towanda Creek at Monroeton during the time of the ATGAS incident (April 19/20, 2011) was approximately 1260 cfs, this flow is approximately 3.9 times higher than the long-term historical median of the daily mean values on April 19/20, 2011 (average of 321.5 cfs). In addition, flow in Towanda Creek was approximately 10.5 times higher than the long-term daily median flow for the historical time period from 1914 to 2010, which was 120 cfs. Clearly, Towanda Creek at Monroeton was at a high flow during the ATGAS incident, and although no long-term historical records exist for the Franklindale gage station, the flow in Towanda Creek at that gage station would similarly be at high flow. These two USGS stream gage stations are only approximately 6.1 miles apart.

Referring to **Figure 7**, which is the flow in Towanda Creek at the Franklindale gage station between April 11, 2011 to May 2, 2011, the mean daily flow at this gage station on April 19, 2011 was 676 cfs, and on April 20, 2011 it was 696 cfs. In the days following the ATGAS incident, the daily mean flow at Franklindale varied from a low of 260 cfs on May 2, 2011 to a high of 4,780 cfs on April 28, 2011. The high flow rates of Towanda Creek at this USGS stream gage station was in response to high rainfall amounts that fell within that watershed during this time period. **Figure 8** is a graph that shows the flow in Towanda Creek at the Franklindale from August 2010 to August 2011. This graph shows the flow in Towanda Creek at Franklindale compared to all flows during this time period. As noted by this graph, the ATGAS incident occurred during a time period when flow in Towanda Creek at this stream-gage station was extremely high.

**Figure 9** shows the flow in Towanda Creek at Monroeton from April 11, 2011 to May 2, 2011 along with the long-term median flow values for those dates plotted as

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the brown line on **Figure 9**. The long-term historical daily median values of the mean daily discharge varied between 249 cfs to 500 cfs during this time period. The brown line represents the 97 year median values of the mean daily flow for those dates. Referring to **Figure 9**, flow in Towanda Creek at this gage station during this time period was well above the historical median flow for those dates, and was between 1.3 (April 12, 2011) to 27.4 (April 28, 2011) times higher than the historical median flow for those dates. From April 19, 2011 to May 2, 2011 the mean daily flow in Towanda Creek at Monroeton was between 1.8 to 27.4 times higher (average 7.6 times higher) than the long-term historical median flow for those same dates. Again, the stream flows in Towanda Creek just before and just after the ATGAS incident were much higher than the normal for that time period.

**Figure 10** shows the flow in Towanda Creek at Monroeton for the past year (August 2010 to August 2011). Referring to **Figure 10**, flow in Towanda Creek at Monroeton at the time of the ATGAS incident was significantly higher than normal just before and immediately following that incident.

The peaks in the Towanda Creek stream flow correspond with the heavy rainfall amounts that occurred in the area between April 11 to May 2, 2011.

### 1.2 DESCRIPTION OF RESPONSE

#### 1.2.1 Initial Activities

##### 1.2.1.1 Well Control Response

The well control incident began at the ATGAS pad at approximately 11:00 pm on Wednesday, April 19, 2011. Following discovery of the incident, Chesapeake representatives reported the incident to Pennsylvania's Department of Environmental Protection (PADEP) at approximately 12:56 am on April 20, 2011. At approximately 1:13 am on April 20, 2011 Chesapeake's representative received a call from the PADEP and additional details were provided to the PADEP representative. PADEP representatives indicated that their emergency response team members would be dispatched to the site.

Qualified well-control team members arrived on site at approximately 12:30 am on April 20, 2011, which was within 45 minutes of first notification of the incident. The well-control team assessed the incident and formulated a well-control plan. As part of this plan, a formulation of heavy fluid and plugging materials (lost circulation materials) was designed to stem the flow from the well. Equipment required for pumping the lost circulation material was being mobilized in the early hours of the incident on April 20, 2011. During this time, the well-control team began designing the well-control fluid, assembling necessary materials, mobilizing and preparing equipment, and assessing the best approach to the well to accomplish the well-control measures.

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The first of the plugging attempts, implemented at approximately 6:47 am on April 20, 2011, reduced flow only a small amount; the second attempt, implemented at approximately 10:00 am on April 20, 2011, reduced flow by approximately 50 percent; and the third and fourth attempts, at approximately 12:27 pm and 1:00 pm on April 20, 2011, respectively, also reduced flow even further. These early actions by the well-control team were successful at reducing the release from the well by approximately 70 percent.

Prior to the fourth attempt, additional contract well-control personnel (Boots and Coots) arrived on site. This team continued to carry forward the well-control plan being implemented by the first responding control team by making additional plugging attempts.

At approximately 7:00 pm on April 20, 2011 after consultation with the well-control team, and to mitigate further risk to personnel and equipment, plans were finalized to remove the completions crew and all non-essential equipment off location. Equipment was removed, the primary containment was repaired, the location was cleared, and all ignition sources were removed from location. This work continued until 11:15 pm on April 20, 2011, when the Lower Explosive Limit (LEL) monitors registered low methane levels at the wellhead. At this time the location was cleared of personnel and equipment and secured until daylight of the next day (April 21, 2011).

As a part of Emergency Response Preparedness, a general Bradford County Marcellus Plume analysis was created in 2009 for use in early incident safety risk assessments. Due to the fact that the well release was expected to turn primarily to gas on the evening of April 20, 2011, Chesapeake requested Boots and Coots to undertake a site-specific plume analysis for the location in order to assess safety precautions. This analysis accounted for actual well conditions, local weather conditions, and topographic features of the location. The analysis showed no danger to adjoining residents existed.

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At approximately 5:45 am on April 21, 2011, the flow from the well turned primarily to gas. A single pumping unit and associated auxiliary equipment was rigged up on April 21, 2011 to conduct a fifth plugging attempt. This was conducted at approximately 3:50 pm, and was successful in stemming the well flow. Following evaluation of the need for further action, a coil tubing intervention was conducted the morning of April 25, 2011 bringing the well under permanent control.

### 1.2.1.2 Environmental Response

Following the reporting of the incident to the PADEP as previously discussed, environmental response actions were immediately implemented. The emergency response was initiated to control, capture, minimize, or prevent the release of fluids off the well pad site. Chesapeake's well pad design and spill containment measures are designed to control any on-site release of fluids from the pad, including rainwater. The design utilized by Chesapeake includes: Primary containment surrounding all sides of the pad;

- Upslope diversion ditches;
- Sedimentation/runoff capture ponds;
- Siltsox; High density plastic based bermed secondary containments; and
- Two vacuum trucks on location during completion operations.

This design was employed at the ATGAS well pad and substantially reduced the fluid discharge from the well pad during the incident.

At the time the incident vacuum trucks were already operating on site due to heavy rain that day and during previous days. These trucks began collecting well fluid promptly after the incident began at 11:00 am on April 19, 2011.

Support personnel were contacted in order to ensure appropriate equipment was available at the site to alleviate the potential for fluid discharge. Heavy equipment, [REDACTED], soil, and additional vacuum trucks were ordered to respond. As many as 8 vacuum trucks were onsite throughout the remainder of the event, and 6 were operating onsite by approximately 6:30 am on April 20, 2011.

Environmental support personnel were onsite by approximately 2:30 am on April 20, 2011 (within 2 hours and 45 minutes after the initial notification). In coordination with the well-control team, the environmental response team considered options to address the discharge at the point of the release. Concerns for worker safety, however, precluded the movement of construction equipment to the pad to bolster primary containment. In addition, saturated ground conditions (from days of heavy rains preceding the incident) prohibited access to the base of the containment throughout the night. Although the site was extremely wet due to heavy rains in the days prior to the incident, an initial visual inspection of the pad and surrounding areas was made during night-time hours. In addition, Chesapeake initially took field measurements of pH, specific conductivity, total dissolved solids, and salinity.

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By approximately 6:30 am on April 20, 2011, the vacuum trucks were able to sufficiently drain the fluid on the pad and stop the flow out of primary containment. The discharge from the primary containment was limited to the time-frame from approximately between 2:30 am to 6:30 am on April 20, 2011 (a 4-hour period), as vacuum trucks were successful in stemming the fluid flow from the pad surface. Soon after at first daylight on April 20, 2011, Chesapeake was able to identify a potential means of access over neighboring property to prevent further discharge from containment structures. Support personnel secured access from the landowner, laid [REDACTED] to allow access, and moved equipment into place to pump the sedimentation/capture ponds previously constructed at base of the pad. Recovery of fluid by pumping below the pad from the catchment basins or areas began at approximately 10:30 am on April 20, 2011. Additionally, a diversion ditch was installed along the lease road to direct seepage from the pad into the existing sediment catchment ponds.

After well-control operations temporarily ceased onsite overnight on April 20, 2011 support personnel directed the fortification of the primary containment in case of heavy rain or the need to use water for suppression.

### **1.2.2 Remedial Activities Conducted in First Two Weeks**

Chesapeake initiated an investigation of site environmental conditions promptly with the arrival onsite of environmental support personnel at approximately 2:30 am on April 20, 2011. Chesapeake representatives conducted a visual inspection of the pad and the surrounding area and recorded field measurements of pH, specific conductivity, TDS and salinity. The investigation and response proceeded as quickly as site conditions and safety constraints allowed.

Chesapeake initially retained Groundwater & Environmental Services, Inc. (GES) to assist with the site investigation. GES arrived onsite at approximately 9:45 am on the morning of April 20, 2011 and continued the investigation activities already ongoing. GES collected the first surface-water samples and domestic well water samples that day. Science Applications International Corporation (SAIC) was retained to conduct the regional well, spring, and background stream sampling on April 27, 2011.

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Chesapeake also retained URS Corporation (URS) to investigate any potential impact to aquatic ecology in the UNT. URS began its qualitative investigation on the afternoon of April 20, 2011.

The following sections of this Report detail investigation activities conducted during the first two weeks following the ATGAS incident.

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## **2.0 IDENTIFICATION OF POTENTIALLY AFFECTED AREAS**

### **2.1 VISUAL SURVEY**

A visual survey of the approximate location of the overland flow path in the pasture area below the well pad erosion and sediment control catchment basin was completed and recorded with Global Positioning System (GPS) equipment on April 25, 2011. The survey was based on observations made by staff present at the incident the morning of April 20, 2011 during the approximate 4-hour time period when discharge from the well pad occurred. The survey was completed by flagging the perimeter of the overland flow path area and recording the location using GPS equipment. The estimated footprint of the overland flow area is shown on **Figure 11**.

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### 3.0 DATA QUALITY EVALUATION AND VALIDATION EFFORTS

The data presented in this Report represent water-quality sample results from the first two weeks following the well-control incident on the ATGAS 2H well pad (April 19 to May 2, 2011). Partial final validated data are available for the surface water and groundwater analytical parameters monitored in the field or as measured through laboratory analyses.

Data for radionuclide parameters are not included in this report. Radiochemical results will be discussed in the final report for the well-control incident.

### 3.1 DATA ACQUISITION

#### 3.1.1 Analytical Parameter Selection

The groundwater and surface water samples were analyzed for the following list of analytical parameters.

##### • Standard Baseline Analytical Parameters List

- Heavy metals (total and dissolved, as needed): arsenic, barium, cadmium, chromium, iron, lead, manganese, mercury, selenium, and silver;
- Major cations: sodium, potassium, calcium, and magnesium;
- Major anions: chloride, carbonate, bicarbonate, and sulfate;
- Volatile organics: benzene, toluene, ethylbenzene, and total xylenes;
- Light gases: propane, methane, and ethane; and
- General water quality parameters: oil & grease, sulfur, total suspended solids (TSS), total dissolved solids (TDS), pH, specific conductance, turbidity, and Methylene Blue Active Substances (MBAS).

##### • Standard Baseline or Expanded Field Parameter List

- Field pH;
- Field water temperature;
- Field dissolved oxygen (DO);
- Field TDS;
- Field salinity;
- Field specific conductance; and
- Field turbidity.

##### • Expanded List of Analytical Parameters

- USEPA Appendix IX volatile organic compounds (VOCs);
- USEPA Appendix IX semi-volatile organic compounds (SVOCs), including Polycyclic Aromatic Hydrocarbons (PAHs) by SIMS;
- USEPA Appendix IX metals;
- Strontium, bromide, nitrate, nitrite, total phosphorus, and ammonia; ○ Hardness calculation;
- Total Petroleum Hydrocarbons (TPH) Diesel Range Organics (Diesel), TPH as Gasoline Range Organics (GRO), and TPH-Oil Range;
- Chemical Oxygen Demand and Carbonaceous Biochemical Oxygen Demand;
- Gross alpha, gross beta, radium-226 (Ra226), radium-228 (Ra228), thorium, potassium, and uranium;
- Glutaraldehyde;
- Ethylene dibromide (EDB) and 1,2-dibromo-3-chloropropane
- Quaternary ammonium salts; and
- Alcohol scan.

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The alcohols, quaternary ammonium salts, and gluteraldehyde were considered to be organic parameters for the presence of hydraulic stimulation fluid. Chloride, barium, strontium, sodium, TDS, and specific conductance were used as parameters for the presence of produced formation water. The selection of the organic parameters for the stimulation fluid was based on the knowledge of the components of the hydraulic stimulation fluid as discussed in Section 1.1.3. The selection of the parameters for the produced formation water was based on data available in the literature for produced water from the Marcellus Shale Formation (GTI, 2009).

The analytical laboratories that conducted the above-listed analyses are noted below.

- **TestAmerica-Nashville** (all parameters except radionuclides) (TA)

Contact – Gail Lage  
960 Foster Creighton Drive  
Nashville, TN 37204

- **TestAmerica-St. Louis** (Radionuclides)

Contact – Terry Romanko, Technical Director  
13715 Rider Trail North  
Earth City, Mo 63045

### 3.2 DATA-QUALITY EVALUATION

Environmental media data were subjected to data verification and data validation prior to being presented as usable for assessment purposes. The data verification process was conducted in order to determine if the data was complete, correct, and consistent with specified analytical methods and Chesapeake's requirements. The data validation process was conducted on an analyte- and sample-specific basis to evaluate the quality of the specific data set. The reviews were conducted in accordance with Chesapeake's internal environmental data quality assurance and quality control (QA/QC) procedures.

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Preliminary analytical data provided electronically by Chesapeake's third party laboratory, TestAmerica, was reviewed by senior-level environmental scientists to identify potential data outliers, anomalous data, and sample results that required further evaluation. Analytical values that appeared to be unusual compared to others in the data or baseline data, where available, for the individual sample location were noted. The results of these reviews were communicated to Chesapeake and TestAmerica for resolution. In some cases, additional analytes were requested, e.g. dissolved metals when total suspended solids were elevated or laboratory verification of a specific result needed. For the analytical data generated for samples collected from April 20 to May 2, 2011, preliminary analytical data were reviewed as received from TestAmerica.

For the partial final data, individual analytical data packages were reviewed by QA/QC personnel at either GES or SAIC. The results of these reviews were communicated to Chesapeake and TestAmerica, and are described in the Sections below. A summary of QC results, including blanks, matrix spikes, and duplicates, was available with each partial final data package. Data packages considered to be deficient were returned to the laboratory. Only validated data was considered usable for this report. The analytical data discussed in this report has previously been provided to the Pennsylvania Department of Environmental Protection (PADEP) in weekly submittals.

All relevant and reliable data were available through Chesapeake's EQUIS system and delivered from the laboratory via Electronic Data Delivery (EDD) and hardcopy format. Electronic data were verified against the laboratory report. There were no unresolved errors in the databases.

### **3.2.1 Summary of Potential Data Discrepancies from the Laboratory (TestAmerica)**

During the course of the project's sampling phase, certain discrepancies were noted by the laboratory that resulted in reporting delays and potential non-conformances with the analytical results. Each discrepancy is summarized below. The additional documentation provided by TestAmerica is attached in **Appendix D**.

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At the beginning of the project, the scope of investigation and testing parameters were continuing to be developed. The laboratory and consultants were provided pre-printed Chain-of-Custodies (COCs) for the project based on the Sampling and Analysis Plan (SAP). Updated COCs were provided to the laboratory and consultants by email on April 26, 2011.

Chesapeake has had several conversations with the senior management of TestAmerica to address the miscommunication and delivery failures. Chesapeake has been assured by TestAmerica that they are doing every step possible to expedite this analysis and final reports for the missing radiological results based on their ability and available instrument capacity.

On May 19, 2011, the laboratory (TestAmerica) discovered that one or more carts of sample bottles were not kept within the recommended temperature range of 6 degrees Celsius or less as recommended by US EPA/NELAC protocols prior to analysis. This discovery sparked an internal investigation and corrective action report by TestAmerica. TestAmerica followed the recommendation in the corrective action report by conducting a similar study of potential temperature effects for the analysis of TDS, TSS, Alkalinity, and Ammonia (the parameters potentially affected in the discovery). TestAmerica has reported those findings in their letter dated August 12, 2011 in **Appendix D**.

Based on TestAmerica's conclusion of the study, the temperature non-conformance cited on the samples in question did not appear to have any direct effects with the repeatability of the initial tests of TDS, TSS, Alkalinity, and Ammonia. The only variation noted was with the Ammonia results, and it was attributed to other factors mentioned in their corrective action report.

### 3.3 GES DATA QUALITY EVALUATION

GES validated the analytical data for all samples they collected. **Table 2** is a list of all samples validated by GES.

Overall laboratory data quality was found to be of high quality and usability. The quality of the data was evaluated using the following criteria:

- 1) Laboratory quality-control elements: the required elements were found to be present and all recoveries/results were found to be within acceptance limits with few exceptions: and
- 2) Analyte specific results were found to be temporally and spatially accurate and precise.

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When determining if the laboratory control elements were within acceptance limits the validation data and qualifiers were reviewed. With few exceptions, all laboratory data were qualified as usable, with most of the quality control discrepancies resulting in a data flag of estimated value. These data flags were assigned if any of the following items impacted the quality of the data:

- 1) Exceeding analytical holding time;
- 2) Poor response to analytical method, resulting in quality control elements being out of acceptance criteria; and
- 3) Temperature associated with sample transit, as well as at the laboratory.

The overall body of analytical data consists of the determination of presence/absence, as well as the analytical determination of quantity, for approximately 265 analytes. The number of analytes showing high levels of variability in data quality (greater than 40% failure in quality control criteria) is limited to approximately twenty. The reasons for the low data quality of these analytes can be explained as follows:

- 1) Five (5) analytes are known to be analytically poor responders from the water matrix and would not be expected to display high reliability. These are 1,4-Phenylenediamine, a,a-Dimethylphenethylamine, Methapyrilene, 2-Picoline, and Thionazin.
- 2) Many of the remaining analytes showing poor quality were detrimentally impacted by transit times to the laboratory, causing them to be analyzed outside of their analytical holding time. This resulted in flagging the analytical results as estimated. For this project it should be noted that pH, turbidity, DO, TDS, and specific conductance were measured, and recorded, in the field. This is important in that these analytes are known to have less accurate results in analytical testing directly proportional to their hold time. Specifically pH, although determined and reported by the laboratory, has the analytical hold time requirement that it be measured immediately upon sampling. The subsequent laboratory determination, although performed and reported, was requested past hold time and therefore all reported pH data is estimated. The measured field data agreed well with the laboratory data.
- 3) Ammonia was found to have poor reliability due to a storage temperature in the laboratory. The following table details the analytes with poor analytical results, along with the percent failure of the quality control elements.

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Analyte	Percentage of Flagged Results
MBAS	44.38
Nitrate	50.63
Nitrite	53.75
a,a-Dimethylphenethylamine	53.13
Methapyrilene	51.25
Gluteraldehyde	52.50
TSS*	74.25
1,4-Phenylenediamine	85.00
Ammonia	84.38
Quaternary Ammonium Compounds as CTAB	80.00
pH**	100.00
<b>Duplicate Sample Results</b>	<b>Action for Samples</b>
Both original sample and duplicate sample >5x the RL and RPD > 120% of Analytes that had the lowest quality results over the course of the project:	Qualify those results that are $\geq$ RL that are impacted as estimated (J) and

\*TSS is a test of a colloidal mixture which is non-homogenous in nature. It regularly fails precision quality control, which is expected for colloidal mixtures.

\*\*pH is related to holding time exceedences.

### 3.3.1 Verification and Validation Efforts

The project required verified and accurate data from both the field and the laboratory. For each data set, the information must accurately reflect all identifying features (date, location, analytical amounts, etc.). Data verification of all the information with clear rationale for all discrepancies noted.

#### 3.3.1.1 Scope and Methodology

All GES field data and laboratory data generated from field sampling underwent quality assurance/quality control reviews to verify reported data for accuracy and completeness against primary and secondary sources. All laboratory data generated subsequently underwent third party data validation to ensure analytical accuracy and completeness of the reported data, resulting in flagged data to indicate levels of reliability.

#### 3.3.1.2 Approach

The verification and validation of data is described in detail in the following sections. Upon receipt of information, all data was checked to insure that the information was consistent and accurate, as well as verifying against primary sources to insure the reliability of the identifying information.

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3.3.1.3 Data Verification and Data Validation

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### Field Data Verification Methodology

As each chain-of-custody was received by TestAmerica Laboratories, reviews of the chain-of-custody and of the field notes were performed to ensure accuracy. The chain-of-custody information was placed in a spreadsheet to verify accuracy, and to track which chain-of-custodies had been received. If discrepancies were found within a chain-of-custody, revisions were made and the chain-of-custody returned to TestAmerica Laboratories. Revisions were completed by reviewers who would strike a line through the discrepancy, write in the correct information, and initial the edit.

The field notes for every sample collected were reviewed for discrepancies against the taxing authority parcel codes, Geographic Information Systems (GIS) generated maps, and the client sampling information. If any discrepancies were found, the reviewer would strike through the invalid data and replace with valid data. The person verifying the data would initial every revision made. Environmental Systems and Technology, a division of GES, was subsequently notified, and the data was updated within the field data database.

A system was developed to track the quality assurance/quality control review. Upon completion of the review for a sampling event, the sample was marked as verified in the tracking system and subsequently the field data in its entirety was delivered electronically to the client.

### Laboratory Data Verification Methodology

The quality assurance/quality control review of laboratory data was conducted on draft analytical test reports released from TestAmerica Laboratories to GES. The data underwent initial verification to insure that all the identifying information throughout the report was consistent with the chain-of-custody and recorded field data. This consisted of verifying the congruence of the following reported parameters against the chain-of-custody for each specific sample:

- 1) Sample ID,
- 2) Collection date,
- 3) Collection time,
- 4) Date and time of laboratory receipt,
- 5) Laboratory storage temperature, and
- 6) Verification that the laboratory methods match the COC requested methods.

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All discrepancies discovered during validation were rectified by contacting the laboratory directly and requesting a re-issue of the report with the necessary revisions. The re-issued report would undergo a quality assurance/quality control verification which would also include a review of case narrative documentation within the reported data to ensure that any discrepancies in methodology and/or analyses were noted and explained, and to document any report changes and the rationale behind them.

When the quality assurance/quality control review of the laboratory data was completed and any data inconsistencies were noted and rectified, data validation was initiated.

### Laboratory Data Validation Methodology

Guidelines and organization:

GES conducted a Level 2, third party data validation on all reported laboratory data. Data validation for all data collected was conducted under the guidelines outlined in the following:

- 1) *USEPA Laboratory Programs Functional Guidelines for Organic Analytes, and*
- 2) *USEPA Laboratory Programs Functional Guidelines for Inorganic Analytes.*

The GES data validation effort was conducted by a team of validators under the supervision of a Ph.D. chemist supervisor. The data validation was analyte and sample specific and requested to determine the analytical quality (i.e., accuracy, precision, and reliability) of each specific data set.

### Laboratory Data Validation Process

All laboratory data validation efforts were recorded on sample-specific data validation checklists. There was a chemical validation checklist employed for this purpose. The checklist had the following sample specific information contained in the header portion:

- 1) Laboratory work order number,
- 2) Tax parcel number, and
- 3) Project designation and number.

A separate checklist was used for every sample validated. The checklist was used to ensure that each analytical and quality control parameter was checked and verified.

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The checklist included a quality assurance/quality control verification page which included:

1) Sample identification (ID) information

- a) Resident ID,
- b) Client Sample number, and
- c) Sample collection.

2) Sample receipt information

- a) Condition of samples;
- b) Temperature at receipt; and
- c) Method specific requirements;
  - i) Preservation;
  - ii) Lack of headspace.
- 3) Overall analytical quality check

The remainder of the checklist was used exclusively for validation of analytical data. The sections are:

- 1) Qualifier page – a list of all analytical results qualified along with associated validation flags and rationale for qualification.
- 2) Potential qualifier page – a detailed list of samples found outside of analytical acceptance limits and the determination of validation flags.
- 3) Holding time page – listing all the analytical and preparatory holding times for the analyses requested. This page was used to determine if each test was initiated and analyzed within the prescribed time period.
- 4) Quality Control analyses pages - Checklist for every analysis run by the laboratory. This checklist ensures that the following parameters are checked and found sufficient:
  - a) All blanks are present and show no positive detections,
  - b) All laboratory control samples (blank spike), matrix spike and surrogate recoveries are present and fall within acceptance ranges, indicating a reliably accurate result, and
  - c) All duplicates required are present and have results that indicate a reliably precise result.

If any of the above criteria fell outside of the prescribed ranges, the quality control sample was then analyzed to determine if the discrepancy influenced the usability of the sample's analytical result for that analyte.

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The criteria used in this project are as follows:

### Analytical Blank Shows Positive Result

Analytical blanks indicate if positive detection has occurred, either during transport or analysis of the sample. A positive blank result is assessed depending on the result of the client sample as follows:

- 1) If the client result for that analyte is a non-detect, there is no direct evidence of a positive detection in the sample and the analyte would not be qualified as unusable. However, due to the presence of a detection in the quality control sample or trip blank, the integrity of the sample cannot be positively affirmed - the analyte would be qualified as an estimated non-detect.
- 2) If the client result has a detection for that analyte, but the level is less than five times the blank result or Normalized Absolute Difference (NAD) < 1.96, there is no way to distinguish between the positive detection or a true reading - the analyte would be qualified as unusable, R.
- 3) If the client result for that analyte is greater than five times the blank result, NAD greater than 2.58, the result is large enough so that the possible positive detection would be relatively insignificant – the analyte would not be qualified.

Note:

Where S = sample and B = blank

### Surrogate Recoveries Fall Outside of Acceptance Limits

Surrogate recoveries are used in organic analytical testing to reflect the analytical efficiency of recovery for the analytes being tested. Recoveries that fall outside of the acceptance limits indicate problems with the analytical test and are assessed in the following manner:

- 1) If the recovery is low out-of-acceptance limits.

$$NAD = \frac{|S - B|}{\sqrt{\text{uncertainty} \frac{2}{S} + \text{uncertainty} \frac{2}{B}}}$$

- a) The analytical efficiency of the test is in question, all results may be biased low, resulting in all the results from the analytical test being qualified as estimates.
  - b) If there are multiple surrogates to represent different classes of analytes being screened in the analytical test and only one surrogate is low, then only results from that analyte class are qualified estimate; the other classes are considered usable data.
  - c) If there are multiple surrogates, and two or more fail, the efficiency of the entire test is in question and all results from the analytical test are qualified as estimates.
  - d) If one surrogate exhibits greater than 10% recovery, all not-detected results for the analytes of the corresponding compound class are considered unreliable and are therefore qualified R. Positive results for the analytes of the corresponding compound class are qualified as estimates.
- 2) If the recovery is high out-of-acceptance limits
    - a) The analytical efficiency of the test is biased high. All non-detects are usable, all positive detects are qualified as estimated.
    - b) If there are multiple surrogates to represent different classes of analytes being screened in the analytical test and only one surrogate is high, then only results from that analyte class are impacted, the other classes are considered usable data.

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### Laboratory Spike Recoveries Fall Outside of Acceptance Limits (Analyte Specific)

Laboratory blank spikes are used to show consistency of both analytical efficiencies and reported results across an analytical batch. Any spike recovery that falls outside of acceptance limits indicates inconsistency across a batch and calls into question the reported results for that test.

1) The analyte spike recovery is low out-of-acceptance limits

a) The analytical efficiency for the analyte is in question, all results (detect and non-detect) are qualified as estimates.

2) The analyte spike recovery is high out-of-acceptance limits

a) The analytical efficiency of the test is biased high for this analyte. Non-detects are usable, all positive detects are qualified as estimated.

### Matrix Spike Recoveries Fall Outside of Acceptance Limits

For the laboratory control matrix spike samples the recoveries only impact the quality assessment of the data under very special circumstances:

1) The sample used in the matrix spike is the same as the analytical sample being reported.

a) The analyte spike recovery is low out-of-acceptance limits i) The analytical efficiency for the analyte is in question, all results (detect and non-detect) are qualified as estimates.

b) The analyte spike recovery is high out-of-acceptance limits i) The analytical efficiency of the test is biased high for this analyte. Non-detects are usable, all positive detects are qualified as estimated.

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2) The sample used in the matrix spike is a different sample than the analytical sample being reported.

a) Recoveries are not indicative of the analytical sample behavior. The data may not be used to qualify analytical results based on a low or high recovery unless one of the following criteria are met: i) The spikes are run as a matrix spike/matrix spike duplicate pair and the recoveries for the analyte is inconsistent between the two samples (>20% different, with at least one of the recoveries falling outside of acceptance limits), indicating an efficiency problem for that analyte in the test. The analyte is then qualified as an estimate.

ii) Matrix spikes run as pairs (MS1 & MS2, indicative of two different matrices). If they both show consistent, out-of-acceptance limits results for multiple analytes (recoveries within 10% of each other), it is indicative of an efficiency problem and the analytes in question may be qualified as estimates.

### Relative Percent Difference Analysis Falls Outside of Acceptance Criteria

Relative percent difference is used to determine the precision of the analytical results. It is used to measure consistency using historically determined ranges to ascertain if the difference in results between two subsequent analyses of the same sample indicates that the test may not have given a precise result.

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The calculation used to determine the relative percent difference (RPD) number:

$$\text{RPD} = (|S-D|)/(\text{AVG}(S+D)) \times 100$$

Where:

RPD = Relative percent difference

S = Sample results (original)

D = Duplicate results

This calculated number is compared to a historical limit above which the precision is called into question. If the RPD number exceeded the limit, the following actions were taken:

### 3.3.1.4 Limitations

Data verification of field data was limited in scope to the primary and secondary sources

Analyte	Percentage of Flagged Results
MBAS	44.38
Nitrate	50.63
Nitrite	53.75
a,a-Dimethylphenethylamine	53.13
Methapyrilene	51.25
Gluteraldehyde	52.50
TSS*	74.25
1,4-Phenylenediamine	85.00

listed below.

- 1) The taxing authority parcel codes,
- 2) Geographic Information Systems generated maps, and
- 3) Client sampling information.

The scope of the data validation was limited to the reported results. The following reported parameters were evaluated, and the analytical results were determined to be usable as reported, estimated as reported, or unusable as reported.

- 1) Preparation and analytical holding times,
- 2) Temperature of the samples as received,
- 3) Storage temperature of the samples while in the laboratory, and
- 4) Quality control samples including:
  - a) Trip blank sample,
  - b) Laboratory blank samples,
  - c) Laboratory spike and laboratory spike duplicates,
  - d) Matrix spikes and matrix spike duplicates (where applicable),and

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Analyte	Percentage of Flagged Results	
MBAS	44.38	
Nitrate	50.63	
Nitrite	53.75	
a,a-Dimethylphenethylamine	53.13	e)
Methapyrilene	51.25	
Gluteraldehyde	52.50	
TSS*	74.25	
1,4-Phenylenediamine	85.00	
Ammonia	84.38	

Duplicate analyses including relative percent difference statistical analysis.

### 3.3.2 Parameters for Data Qualification

#### 3.3.2.1 Estimated Results

The following criteria were employed to determine whether the analytical result was qualified as estimated:

- 1) Holding time: The USEPA established preparation and analytical holding time for the method employed to analyze the water sample.
- 2) Temperature: The temperature of the sample must be maintained at USEPA prescribed levels to insure that no degradation of analytes have occurred. Temperatures in excess of this level result in estimated values on the analytical result.

#### 3.3.2.2 Quality Control Elements

An evaluation of the laboratory quality control spikes and surrogates run with the analytical batch, which included the water sample, was done if these controls fall outside of acceptance range, and it results in estimated values on the analytical result.

#### 3.3.2.3 Unusable Results

The following criteria were evaluated to determine the usability of the data:

##### 1) Trip Blanks and Laboratory Control Blanks

The evaluation of the blank control samples was used to ensure no impact to the water sample during both transportation and analytical work-up. When an analytical detect for an analyte has a corresponding blank positive detection, the analytical detect is unusable.

##### 2) Degradation and Sample Hold Time.

If the sample hold time exceeds 2x the prescribed amount, the corresponding reported results are unusable. This is due to analyte degradation over time that has been scientifically determined by storage stability testing.

Analyte specific data was determined to be estimated or unusable in the following situations:

Definitions:

J - Analyte detected result is an estimate

UJ - Analyte non-detected result is an estimate

R - Analyte result is unusable

\*Criteria for qualifying any analytical result as either estimates or unusable when a control blank is impacted is dependent upon both the magnitude of the impact, as well as the reported analytical detection of the analyte in the sample. Please see validation methodology for a more detailed description.

## 3.4 SAIC DATA QUALITY EVALUATION

### 3.4.1 Data Quality Evaluation

Analytical reports from samples collected during the Site investigation were submitted

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electronically to SAIC for verification and validation at Chesapeake's direction to ensure that the analytical data reflected the true Site conditions as accurately as possible. The 25 water samples collected by SAIC on April 27, 2011 were validated by SAIC (**Table 3**).

All 25 analytical reports from TestAmerica were reviewed by SAIC's QA/QC team and found to be acceptable based on that review. The review included an evaluation of the quality control report for each sample. SAIC's review process included the addition of data flags when necessary to qualify individual data elements. The following table summarizes the analytes that were frequently (>40%) flagged as estimated ("J").

Analyte	Percentage of Flagged I
MBAS	44.38
Nitrate	50.63
Nitrite	53.75
a,a-Dimethylphenethylamine	53.13
Methapyrilene	51.25
Gluteraldehyde	52.50
TSS*	74.25
1,4-Phenylenediamine	85.00
Ammonia	81.25

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### **3.4.2 Validation Efforts**

#### **3.4.2.1 Project Requirements**

This project required that all analytical data be reviewed to evaluate the quality of the data and to ensure that any unreliable or questionable data were appropriately flagged.

#### **3.4.2.2 Scope and Methodology**

The data quality was verified to ensure that the data presented in the analytical results provided by TestAmerica accurately reflected the concentrations of evaluated analytes present in the sample collected during the Site investigation. Review of analytical data was based on USEPA Laboratory Programs Functional Guidelines for Organic Analytes and the corresponding document covering Inorganic analytes.

#### **3.4.2.3 Approach**

It is integral to data quality that analytical reports be traceable uniquely back to the collection of the individual sample. To this end, sample teams collected the samples and recorded information related to that collection in bound field books. Ultimately, samples were assigned a unique identifier which was recorded in the field book and on the chain-of-custody initiated at the time of collection. This information is transferred to the Laboratory Information Management System (LIMS) upon receipt at the laboratory and is reported with the analytical results so they can be tied to the sample collection location.

Both field data and the associated analytical data were reviewed to ensure accurate representation of site conditions.

#### **3.4.2.4 Data Verification and Data Validation**

The data verification process is initiated by the consultant when completed field notes and COC records are submitted to the laboratory validation team. The team reviews the COC record for completeness and accuracy with the field notes. These records are also compared to the sample receipt information provided by TestAmerica after the samples are logged for processing at the laboratory. Any discrepancies noted during these reviews are confirmed with the initiating party, revised and transmitted to the laboratory. All revisions are completed in a manner that does not obscure the original information and the party making the correction is identified along with the date of that correction.

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Concurrently, the field electronic data deliverable (EDD) processing team initiates a review of the field notes for accuracy and completeness as the field EDD is prepared. Similar to the above process, discrepancies noted are corrected and communicated to the appropriate parties. Completed field EDD were transmitted to Chesapeake via the file transfer protocol (FTP) site.

Upon receipt of the laboratory report, the laboratory validation team conducted a thorough review to identify areas of concern with regard to data accuracy. This review included the following steps:

- COC review and comparison to sample identification in the report
  - COC properly executed,
  - Requested parameters and methods match report,
  - Sample ID accuracy,
  - Sample matrix identification, and
  - Sample data and time of collection accuracy.
  
- Cooler receipt log review
  - Sample tracking information,
  - Temperature of sample upon arrival, and
  - Issues noted during log-in.
  
- Report narrative review
- Data review
  - Review flags and any hits,
  - Evaluate holding time requirements,
  - Data consistency (specific conductance vs TDS; TSS vs turbidity; cation/anion balance; total metals vs dissolved metals; etc.),
  - Data reasonable (pH, temperature, specific conductance, etc.),
  - Surrogate recoveries within laboratory defined limits,
  - Trip blank sample results,
  - Consistency with field data (only evaluated when reported data appears suspect), and
  - Quality Control Report review
    - Method blanks,
    - Laboratory control spike/spike duplicate (LCS/LCSD) recoveries and relative percent differences (RPDs),
    - Matrix spike/spike duplicates (MS/MSDs) recoveries and RPDs, and
    - Surrogate recoveries.

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Any issues identified during this review for a particular analyte that brought the data value into question were flagged as estimated or rejected using the qualifiers specified in the document CHK\_EDD-2010ver1.2.doc.

### 3.4.2.5 Limitations

Verification of the data presented in the laboratory reports is based solely on the information provided in the report except in cases where independent comparisons to field data are possible. No information has been provided to facilitate verification of laboratory instrument calibration.

### 3.4.3 Parameters for Data Qualification

#### 3.4.3.1 Estimated Results

As discussed in the previous section, any issue of concern with the data generally resulted in that value being flagged with a "J" to indicate an estimated value. The "E" flags specifically indicate data values that are estimated because the raw data value exceeded the laboratory calibration curve for that analysis.

#### 3.4.3.2 Holding Time

Holding time issues were reflected with an "H" class flag. Any sample exceeding the regulatory holding time was flagged in this manner.

#### 3.4.3.3 Temperature

There were temperature storage issues at the laboratory in some instances where the samples were held above the required 6° C storage temperature prior to analysis. These results were flagged by the laboratory as "N1" and/or a "J" by the consultant. Information was not provided for independent verification of impacted parameters.

#### 3.4.3.4 Quality Control Elements

Any issues noted related to trip blanks and/or method blank analyses were flagged with a "B" qualifier. All other issues related to quality control elements (LCS/LCSD, MS/MSD) resulted in a "J" qualifier.

#### 3.4.3.5 Unusable Results

None of the data reviewed by SAIC for this report were flagged as unusable.

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**3.5 OVERALL ASSESSMENT OF THE DATA**

Duplicate sample results were retained in the data set. Any sample result that was assigned a laboratory or data validation flag of "U" (non-detect) was evaluated by assuming a numeric value equal to ½ the reported detection limit. Since fewer than 20 data points were available for each individual sample location, no statistical analyses were performed.

All data, as qualified, are acceptable for use. The environmental media data generated for this report appear to be acceptable with minor qualifications, and are consistent with the data quality and data use objectives for the *Initial Site Characterization and Response Report*.

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### 4.0 SURFACE WATER SAMPLING EFFORTS (APRIL 19 TO MAY 2, 2011)

#### 4.1 ON-PAD SAMPLING

##### 4.1.1 Initial Monitoring Water, Air and Precipitation Monitoring

On April 20, 2011, GES, on behalf of Chesapeake, monitored standing water on the ATGAS pad for field water-quality parameters (**Map Label #40**). **Figure 12** shows the ATGAS pad sample location.

On April 21, 2011, GES monitored ambient air for methane at three locations along Southside Road, north of the pad, and six locations along LeRoy Mountain Road, east of the pad, **Map Label #s LEL-01 through LEL-09** (see **Figure 4**). Ambient air was monitored at these locations using handheld LEL meters. The LEL meters were calibrated to manufacturer's specifications prior to use. A summary of these LEL data is attached in **Table 4**.

From April 21, 2011 to April 22, 2011, GES monitored ambient air for methane by stationing remote LEL monitors at three locations around the perimeter of the pad. At approximately 3:15 pm on April 21, 2011, GES stationed remote LEL monitor unit LEL-15 (**Figure 4**) at a location south of the barn located northwest of the pad (**Map Label #146**). At approximately 6:31 pm on April 21, 2011, unit LEL-15 was removed from the station for equipment maintenance in response to a pump alarm. At approximately 7:41 pm on April 21, 2011, unit LEL-15 was returned to the monitoring location and continued recording data.

At approximately 3:20 pm on April 21, 2011, GES stationed remote LEL monitor unit LEL-13 at a location north of the entrance to the ATGAS pad access road (**Map Label #147**) (**Figure 4**).

At approximately 5:45 pm, on April 21, 2011, GES stationed remote LEL monitor unit LEL-14 at a location in the rear yard of the parcel east of the pad (██████ Parcel) (**Map Label #148**) (**Figure 4**). At approximately 7:10 pm on April 21, 2011, GES replaced unit LEL-14 with unit LEL-12, after unit LEL-14 experienced technical difficulties. Unit LEL-12 continued to monitor ambient air in the rear yard of the parcel east of the pad for the duration of remote monitoring.

The location of the six ambient air monitoring locations along LeRoy Mountain Road, the three ambient air monitoring locations along Southside Road, and the three remote LEL monitor stations were mapped with a Trimble GPS unit. Geospatial

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information was recorded in latitude/longitude, WGS 1984 datum. The ambient air monitoring locations and remote LEL monitor stations are shown on **Figure 4**.

The remote LEL units monitored ambient air for methane at five minute intervals and were continuously monitored by GES personnel for any methane readings. The LEL remote monitors were calibrated to manufacturer's specifications prior to deployment. A summary of these LEL data are attached in **Table 5 (Appendix E)** for complete data set).

A standard rain gage was installed in an undisturbed location near the entrance gate to the ATGAS 2H lease road (**Map Label #145**). A summary of rain gage data are presented in **Table 6**. The site rain gage is shown on **Figure 4**.

Water quality was monitored with a YSI water quality-meter and a turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

Standing water on the pad was monitored for the following water-quality parameters in the field:

- pH,
- Temperature,
- Salinity,
- Specific conductance,
- DO,
- TDS, and
- Turbidity.

The field screening results of surface-water monitoring conducted by GES are presented in **Table 7**.

### **4.1.2 Initial Water and Drilling Mud Sampling**

On April 20, 2011, GES collected one sample from water on the northeast corner of the well pad for laboratory analysis (**Map Label #40**). Chesapeake personnel directed GES to the location of sample collection. On April 20, 2011, this sampling location was mapped with a Trimble GPS unit. Geospatial information was recorded

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in latitude/longitude using WGS 1984 datum. This sample is shown as **Map Label #40** on **Figure 12** at the pad location.

The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, Tennessee (TN) laboratory.

The on-pad liquids sample was analyzed for the list of parameters shown in **Table 8**, and the quantitative analytical results are also summarized in **Table 8**.

On April 25, 2011, Chesapeake collected a sample of drilling mud used during the well-control response. On this day, Chesapeake relinquished this sample to GES for submission for laboratory analysis. On April 27, 2011, GES submitted this drilling mud sample to the TestAmerica Nashville, TN laboratory for analysis.

### 4.1.3 Analytical Characterization

The April 20, 2011 field measurements for the on-pad water sample (**Table 7**) for salinity and specific conductance agree with the general chemistry analytical results. The analytical results (**Table 8**) for the on-pad liquid sample are consistent with the water sampled at **Map Location #40** are indicative that the water was a mixture of well stimulation fluids as evidenced by the presence of salinity, specific conductance and the detection of specialty compounds, ethanol (2,360 µg/L) and 2-butoxyethanol (475 µg/L), and produced formation water as evidenced by the presence of chloride (13,100 mg/L), sodium (4,380 mg/l), TDS (27,500 mg/l) and specific conductance (37,000 µmho/cm). Pyridine (47.7 µg/L) was the only detected SVOC. The presence of pyridine can be consistent with the presence of produced formation water from the Marcellus (GTI, 2009). Chlorobenzene (0.5 µg/L) was the only VOC detected and was detected at the laboratory reporting limit. No other VOCs were detected.

The drilling mud sample (**Table 9**) was analyzed for SVOCs, VOCs, and metals. As would be expected, detectable concentrations of antimony, arsenic, barium, total chromium, cobalt, copper, lead, nickel, thallium, vanadium, zinc, and inorganic mercury were found. No SVOCs or VOCs were detected; however, the detection limits were likely elevated as a result of matrix interferences in the analysis.

As summarized in **Table 5**, air monitoring data was available for carbon monoxide, volatile organic compounds, LEL, and hydrogen sulfide from the remote monitoring

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units (**Appendix E** contains the raw air monitoring data). There were detections of carbon monoxide at low concentrations on April 21 and 22, 2011 at Unit 12 (1), Unit 14 (8), and Unit 15 (6). There were two low level detections of total VOCs at Unit 12 on April 22, 2011 (0.1 and 0.8 ppm), no total VOC detections at Unit 13, nine total VOC detections at Unit 14 over a two day period from April 21 to 22, 2011; and 434 detections at Unit 15. The greatest concentration of total VOC detected was 72.1 ppm at Unit 14 on April 22, 2011 at 10:20 am. No other location had similar readings. The LEL readings were all zero. Hydrogen sulfide of 0.1 ppm was detected at Unit 15 on April 21, 2011 at 6:11 pm, 6:49 pm, 7:40 pm and 7:41 pm; there were no other detections. Unit 15 is located at a barn northwest of pad; it is probable that the hydrogen sulfide and volatile organic compound detections are not related to the ATGAS Pad but were related to equipment failures (Unit 15 was being serviced for pump alarm at those times).

### 4.2 CATCHMENT BASINS

#### 4.2.1 Initial Field Monitoring

On April 20, 2011, GES monitored the surface-water quality of water in the East and West catchment basins, and that of the water contained in a silt sock fence located at the outflow of the culvert under the access road to the well pad using water quality meters. GES established surface-water monitoring locations at the East catchment basin (**Map Label #52**), West catchment basin (**Map Label #27**), and culvert (**Map Label #41**). The catchment basin sample locations are provided on **Figure 12**.

On April 20, 2011, GES monitored the East and West catchments basins twice. The frequency of monitoring was established at two (2) times per day.

On April 21, 2011, GES monitored the water quality in the East and West catchments basins (**Map Label #52** and **#46**, respectively) (see **Figure 12**). The monitoring location identified as **Map Label #27** was dry on April 30, 2011. The water-quality monitoring was conducted in conjunction with monitoring by the PADEP on this date. Data collected by PADEP has not been shared with Chesapeake at this time and as a result are not included in this report.

On April 21 and 25, 2011, GES established an additional surface water monitoring location at the East catchment basin (**Map Label #53 and 44**). This sample location is located at the point where the drainage swale systems meets the East catchment

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basin and is within the silt sock containment (**Figure 12**). This location is the near **Map Label #52**.

From April 22 through April 24, 2011, water in the East and West catchment basins (**Map Label #52** and **#46**, respectively) and culvert (**Map Label #41**) were monitored twice a day for water-quality parameters.

From April 25 through May 2, 2011, the East and West catchment basins (**Map Label #52** and **#27**, respectively), culvert (**Map Label #41**), and associated drainage ditches were monitored for water-quality parameters and screened for methane once daily, as well as prior to any sample collection (in accordance with the April 29, 2011 SAP Section 2.2.1 Overland Flow Pathway Field Screening).

On April 27, 2011, GES established an additional surface-water monitoring location at the West E&S catchment (**Map Label #46**) and a surface-water monitoring location at the drainage ditch to the West E&S catchment on the West side of the pad (**Map Label #45**). These locations are shown on **Figure 12**.

Water quality was monitored with a YSI water-quality meter and a turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All surface-water monitoring locations were mapped with a Trimble GPS unit. Geospatial information on the location was recorded in latitude/longitude, WGS 1984 datum.

All surface-water monitoring of catchment basins and related features were monitored for water-quality parameters:

- pH,
- Temperature,
- Salinity,
- Specific conductance,
- DO,
- TDS, and
- Turbidity,

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with the exception of the initial monitoring of the East & West catchments, which were monitored for pH, temperature, salinity, and specific conductance.

The surface water quality field-screening data for the catchment areas are summarized in **Table 7, as recorded by GES.**

### 4.2.2 Air Monitoring

On April 24, 2011, Chesapeake requested GES begin screening ambient air at all surface-water monitoring locations for methane. GES monitored for methane using an LEL and a Flame Ionization Detector (FID). Air monitors were calibrated to manufacturer's specifications prior to use.

**Table 7 provides a summary of the** ambient air screening data for the catchment areas, recorded by GES.

### 4.2.3 Initial Sampling

On April 20, 2011, GES collected one sample from water flowing from the well pad into the West catchment basin for laboratory analysis (**Map Label #27**) (**Figure 12**). The PADEP collected one sample from this location on April 20, 2011, prior to GES sampling.

On April 21, 25, and 28, 2011, GES collected one water sample on each of these days from the East catchment basin (**Map Label #52 and #44**) for laboratory analysis (**Figure 12**). These samples were split with the PADEP and results have not been shared with Chesapeake and as result are not included in this report.

The samples were collected by GES in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

The samples were analyzed for the list of parameters shown in **Table 8**, and the quantitative analytical results are also summarized in **Table 8**.

### 4.2.4 Analytical Characterization

Field surface-water quality measurements in both catchment basins (**Map Labels #27, 44, 46, 52, and 53/28**) indicated the presence of fluids which were consistent with diluted produced formation water. Field specific conductance ranged from

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106  $\mu\text{mhos/cm}$  in the east basin on April 22, 2011 (**Map Label #53, formerly #28**) to 83,780  $\mu\text{mhos/cm}$  on April 20, 2011 in the west basin (**Map Label #27**). In general, the specific conductance declined at **Map Labels #27** and **#52** from April 20 to May 2, 2011. Field measurements in the drainage ditch to the west of the West E&S catchment basin had specific conductance measurements from April 20 and 21, 2011 which exceeded the typical background surface-water quality specific conductance data available from the USGS for Towanda Creek at Monroeton (61 to 142  $\mu\text{mhos/cm}$ ) (USGS NWIS online database, 2002-2011). The field specific conductance at **Map Label #53/28** was variable during the period from April 20 to May 2, 2011.

The surface-water quality as measured in the West catchment basin as sampled on April 20, 2011 and the East catchment basin on April 21, 2011 are indicative of fluids which originated from the well pad. The specialty compounds, 2-Butoxyethanol and ethanol were detected, as were chloride, specific conductance, sodium, TDS, and metals typically associated with produced formation waters in catchment basin samples collected on April 20 or 21, 2011. Pyridine was also detected in samples from both basins on those same dates. Diesel range organics (DRO) were detected in the April 25, 2011 water sample of the West catchment basin. The April 25, 2011 sample for the West catchment basin did not have a detected result for pyridine. Pyridine has been associated with produced formation water from the Marcellus (GTI, 2009). Concentrations in the West catchment basin (**Map Label #27**) generally decreased from the April 21 to April 25, 2011 samples. The acetone detections are only slightly above the detection limit. Acetone is a common laboratory contaminant, and is believed to be a laboratory contaminant in this instance.

The April 28, 2011 water sample collected from the monitoring point at **Map Label #44** which is within the silt sock containment collected on April 28, 2011 contained gluteraldehyde (57.5 mg/L – qualified result) which is slightly above the detection limit of 50 mg/L; however none of the other key indicator organic compounds were detected. The chloride, specific conductance, barium, sodium, strontium, and TDS were consistent with the water quality observed in the samples collected from the catchment basins.

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### 4.3 PONDS

#### 4.3.1 Initial Monitoring

On April 20, 2011, GES monitored the water quality in the pond located in the cattle pasture approximately 300 feet north of the pad, and established a surface-water monitoring location at this pond (**Map Label #32**). Water quality of an agricultural field drainage tile (**Map Label #54**) that discharged into the pond via an open pipe was also monitored from the pond's south side beginning on April 23, 2011. The pond was monitored twice on April 20, 2011. Monitoring of the pond at this location continued throughout the incident response, and additional parameters were added over time. **Figure 13** shows the pond and drainage tile sample locations.

On April 22, 2011, GES began monitoring the water quality of a second pond located approximately 800 feet to the northwest of the pad. (**Map Labels #29**). This pond is also referred to as the [REDACTED] Pond (after the current owner). Additional water quality monitoring was established from two other locations (**Map Labels #30 and #31**) within the pond. Monitoring of field screening parameters at **Map Label #29** and **#30** began on April 23, 2011.

From April 22 through April 24, 2011, the water quality of both ponds was monitored twice per day.

The small pond on the north side of the well pad was also used as a water recovery basin. Thus, water quality was monitored where water was available. On April 23, 2011, GES began monitoring water quality in a plastic barrel placed under the discharge pipe from the tiled drainage area on the south side of the pond, because the pond had effectively been pumped dry. This monitoring point is identified as **Map Label #54 (Figure 13)**.

Beginning on April 23, 2011, the [REDACTED] pond was monitored from three (3) locations around the perimeter. These three (3) monitoring locations (**Figure 13**) included the sampling and monitoring location on the southeast side (**Map Label #29**) and two (2) new monitoring locations, established on the north and west sides of the pond (**Map Labels #30, and #31, respectively**).

From April 25 through May 2, 2011, GES monitored water quality of the pond on the north side of the well pad at the discharge from the drainage tile, and the three (3)

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locations around the perimeter of the [REDACTED] pond on the northwest parcel once per day (Map Labels #32, #54, #29, #30, and #31, respectively) (Figure 13).

Water quality was monitored with a YSI water-quality meter, and a turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All surface-water monitoring locations were mapped with a Trimble GPS unit. Geospatial information on the location was recorded in latitude/longitude, WGS 1984 datum.

All surface-water monitoring of the ponds and at the drainage tile discharge point were monitored for water-quality parameters:

- pH,
- Temperature,
- Salinity,
- Specific conductance,
- DO,
- TDS, and
- Turbidity,

with the exception of the initial monitoring of the pond, which was monitored for pH, temperature, salinity, and specific conductivity.

**Table 7** summarizes the field water-quality screening data recorded by GES at the pond sample locations.

### 4.3.2 Air Monitoring

On April 24, 2011, GES began screening ambient air at all surface water monitoring locations for methane. GES monitored for methane using an LEL and an FID. Air monitors were calibrated to manufacturer's specifications prior to use.

**Table 7** summarizes the ambient air screening data at the pond sample locations, recorded by GES.

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### 4.3.3 Initial Sampling

On April 20, 2011, GES collected one sample from water in the small pond located in the pasture north of the well pad for laboratory analysis (**Figure 13**). The sample was split with the PADEP from a location on the north side of the pond. The sample was collected prior to the pond used as a surface water recovery basin, as part of the incident response (**Map Label #32**)

On April 22, 2011, GES collected one sample from water in the [REDACTED] pond located on the parcel northwest of the well pad. The sample was collected from a location on the southeast side of the pond (**Map Label #29**) (**Figure 13**).

The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

Samples were analyzed for the list of parameters shown in **Table 10**, and quantitative analytical results are also summarized in **Table 10**.

### 4.3.4 Discussion

#### 4.3.4.1 Pond (300 Feet North of Well Pad, Map Label #32)

Analytical characterization of the April 20, 2011 water sampled from the pond located on the north of the well pad (**Map Label #32**) detected two of the key organic compounds, 2-butoxyethanol and ethanol, were detected at concentrations of 101 µg/L and 2,460 µg/L, respectively. Neither gluteraldehyde nor methanol were detected. Analysis for quaternary ammonium compounds was not conducted. The concentrations of chloride, specific conductance, sodium, TDS, barium, and strontium were lower than the concentrations of these parameters detected in samples collected on the well pad (**Map Label #40**) and in one of the catchment basins (**Map Label #27**) on the same day. The sodium-to-chloride ratio (Na/Cl) ratio of 0.35 for the sample is indicative of produced water and is consistent with the Na/Cl for the on-pad sample (**Map Label #40**) of 0.33. The results are consistent with diluted produced fluids from the ATGAS well pad. The surface water in the small pond was recovered as part of the incident response, which included placing fencing around the pond to prevent livestock or wildlife from accessing the pond.

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### 4.3.4.2 [REDACTED] Pond (Map Label #29)

A surface-water sample for analytical characterization was collected from the [REDACTED] pond on April 22, 2011. None of the key organic compounds, light gases, VOCs, or SVOCs were detected in the sample. The chloride, specific conductance, TDS, sodium, and metals concentrations detected are generally consistent with other surface waters in the immediate area. There was a detection of oil and grease in the pond (13 mg/L) located 800 feet to the northwest from the ATGAS pad, but this detection was not considered valid due to possible laboratory QA/QC issues with this analysis. Field measurements at **Map Labels #30 and #31** are consistent with the data from **Map Label #29**. The natural water quality in this pond is slightly different than the area streams due to the fact that it is a pond rather than an intermittent or perennial stream or creek, and as such is more responsive to precipitation events and periods of evaporation, which will change slightly the water quality in the pond. Review of the water-quality data from this pond shows no measurable change in water quality to this pond do to the ATGAS incident.

### 4.3.4.3 Route Pond (Map Label #82)

A sample was collected at the Route Pond (**Map Label #82**) on April 27, 2011; a baseline sample had been collected from this pond on July 13, 2010. This pond located approximately 1100 feet southeast and upslope of the ATGAS pad, and at an elevation approximately 150 feet higher than the ATGAS pad. None of the key organic compounds, light gases, VOCs and SVOCs were detected in the April 27, 2011 sample. Total Petroleum Hydrocarbons-Oil Range (TPH-ORO) was detected at a concentration of 115 µg/L in the April 27, 2011 sample; TPH-DRO and TPH-GRO (as gasoline) were not detected. The detection of the TPH-ORO is not related to the ATGAS incident. The key inorganic parameters, chloride, specific conductance, TDS, and barium, were consistent with the baseline sample for this pond. Based on the available data, there was no impact to this pond from the fluids released from the ATGAS well pad.

### 4.3.4.4 Pond Water Quality Summary

Three (3) ponds are in the vicinity of the well pad and are shown on **Figure 13**. Immediately following the ATGAS incident, Chesapeake established five monitoring sites on these three ponds. These five water-quality monitoring sites are shown on **Figure 13**. The pond located (**Map Label #82**) approximately 1100 feet southeast and upslope of the ATGAS pad, and at an elevation approximately 150 feet higher than the ATGAS pad, was sampled on April 27, 2011. The pond located (**Map**

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**Label #32)** approximately 300 feet north of the ATGAS pad was sampled on April 20, 2011. At this site, there is also an opening to an agricultural field drainage tile that was monitored, and this is **Map Label #54**. The pond located east of the UNT and approximately 800 feet northwest of the ATGAS pad is monitored by **Map Labels #29, #30, and #31, and was sampled on April 22, 2011**. Water-quality monitoring **Map Labels #30, #31, and #54** are water quality field-screening sites. Pond samples from locations at **Map Labels #29, #32, and #82** are both water-quality field-screening sites, and locations where samples were collected for analytical testing. A summary of the surface-water monitoring sites established for area ponds and drainage tiles are provided below:

<b>Analyte</b>	<b>Percentage of Flagged Results</b>
MBAS	44.38
Nitrate	50.63
Nitrite	53.75
a,a-Dimethylphenethylamine	53.13
Methapyrilene	51.25
Gluteraldehyde	52.50
TSS*	74.25
1,4-Phenylenediamine	85.00
Ammonia	84.38
Quaternary Ammonium Compounds as CTAB	80.00
pH**	100.00
<b>Duplicate Sample Results</b>	<b>Action for Samples</b>
Both original sample and duplicate sample >5x the RL and RPD > 120% of the RPD limit.	Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)
Original sample or duplicate sample ≤ 5x the RL (including non-detects) and absolute difference between sample and duplicate > RL	Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)
<b>Analytical Result</b>	<b>Analytical Criteria for Sample Validation</b>
<b>Outside of</b>	<b>LCS Low</b>
<b>LCS High</b>	<b>Matrix spike</b>
<b>Matrix spike</b>	<b>Matrix spike</b>
<b>RPD outside</b>	<b>2x out of</b>
<b>Positive Blank</b>	

For the five pond sites in the ATGAS pad area, there were 58 screening samples and 3

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analytical samples collected between April 20, 2011 and May 2, 2011. From the drainage tile outfall located in the pond north of the well pad was monitored via 12 screening samples collected between April 20, 2011 and May 2, 2011.

Referring to the pond field screening data provided in **Table 7**, there is no apparent affect indicated on the pond located approximately 800 feet northwest of the ATGAS pad or the pond located approximately 1100 feet southeast and upslope of the ATGAS pad. All screening values appear to be within expected normal and background ranges for the area. Screening data indicates an effect on the pond

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(**Map Label #32**) located approximately 300 feet north from the ATGAS pad and the nearby agricultural drainage tile area as monitored at the drainage tile outfall (**Map Label #54**). Screening data indicates elevated specific conductance values and TDS values. The pond 300 feet north of the well pad was affected by the incident, however, this pond was used to recover water and was ultimately pumped dry.

The pond analytical data provided in **Table 10** shows that there is no affect indicated on the pond located approximately 800 feet northwest from the ATGAS pad and the pond located upslope to the ATGAS pad and approximately 1100 feet to the southeast (**Map Labels #29 and #82**, respectively). The chloride and sodium levels in both the [REDACTED] and Route ponds were less than 10 mg/l. There was a detection of oil and grease in the pond located 800 feet to the northwest from the ATGAS pad, but this detection was not considered valid due to possible laboratory QA/QC issues with this analysis. The laboratory data for the pond (**Map Label #32**) located 300 feet north of the well pad shows that this pond was affected by the incident, with elevated levels of chloride, TDS, specific conductance, barium, and strontium present in the sample collected on April 20, 2011.

No specialty hydraulic stimulation compounds (methanol, propargyl alcohol, quaternary ammonium compounds, and glutaraldehyde) were detected in any pond sample analyzed for these specialty compounds. No polycyclic aromatic hydrocarbons (PAHs) and no light gases (methane, propane, and ethane) were detected in any pond sample. Oil-range TPH was detected in the pond (**Map Label #82**) located approximately 1100 feet southeast and upslope of the well pad. This detection cannot be related to the release as this pond is approximately 150 feet higher in elevation than the well pad. Aluminum, iron, and manganese occur naturally in the area surface waters and none of these values appear to be elevated due to the incident in ponds at **Map Labels #29 and #82**. The analytical data for the ponds also show that no VOCs or SVOCs were detected in any of the pond samples, with the exception of 2-butoxyethanol and ethanol found in the pond (**Map Label #32**) located 300 feet to the north of the well pad.

In summary, one of three ponds in the area of the well pad was affected by the incident. This pond (**Map Label #32**) is located approximately 300 feet north of the well pad, and fluids released from the well pad temporarily flowed into this pond, but were later recovered. An agricultural drainage tile that discharged into this pond also was affected by the incident.

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### 4.4 DRAINAGE SWALE AND DRAINAGE DITCH MONITORING

#### 4.4.1 Initial Monitoring

On April 20, 2011, GES began monitoring of the water quality at eight locations on the drainage swale and drainage ditch to the UNT, west and northwest of the pad, as well as one location on a small intermittent tributary (called the small east tributary at **Map Label #1**) to the UNT, north of the well pad (**Figure 12**). The location of the drainage swale and the drainage ditch are shown on **Figure 3**. The drainage ditch flows into the drainage swale, and the drainage swale flows into the UNT as shown on **Figure 3**.

The drainage swale and drainage ditch were monitored at locations upstream of drainage from the ATGAS pad, as well as downstream, before the confluence of the drainage swale with the UNT. Water quality was monitored at the following locations on April 20, 2011:

- one location on small east tributary flowing westward through the cow pasture north of the ATGAS pad but on the east side of the UNT, (**Map Label #1**),
- two locations on the drainage ditch flowing north, west and northwest of the pad, and parallel to a farm road (**Map Labels #4 and #5**),
- one location on the swale flowing west through the grass field, northwest of the pad (**Map Label #10**),
- four locations on the swale flowing north through the grass field, northwest of the pad (**Map Labels #6, #7, #9, and #11**), and
- one location on the swale flowing east through the grass field, northwest of the pad (**Map Label #8**).

On April 20, 2011, GES completed field screening prior to sampling for laboratory analyzes at the following locations: **Map Labels #1, #4, #6, #7, and #10**.

On April 21, 2011, GES monitored three locations (**Map Labels #5, #10, and #20**) on the drainage swale and drainage ditch west and northwest of the ATGAS pad, prior to collecting split samples with the PADEP. Water-quality samples were collected for laboratory analyzes at two locations on the drainage ditch flowing north, northwest and west of the pad, parallel to the farm road (**Map Labels #5 and #20, respectively**), and one location on the swale flowing west through the grass field, northwest of the pad (**Map Label #10**). Field screening for water-quality parameters was also conducted at monitoring sites identified at **Map Labels #4, #5, #10, and**

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**#20.** **Figure 12** shows the location of all drainage swale and drainage ditch samples. Laboratory water quality analytical data for the drainage swale, drainage ditch, and miscellaneous surface-water samples (**Map Labels #1, #84, and #85**) are provided in **Table 11**.

Chesapeake has not been provided data from the PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this report.

From April 22 through April 24, 2011, GES conducted water-quality field screening at most surface water locations on the drainage swale and drainage ditch twice daily.

From April 25 through May 2, 2011, GES conducted water-quality field screening and ambient air monitoring for methane at all drainage swale and drainage ditch surface-water monitoring locations in the drainage swale and drainage ditch areas at least once per day, and prior to sampling for laboratory analyses. The only exceptions to this daily water-quality field screening was no screening was conducted at **Map Label #21** on April 27, 2011; no screening was conducted at **Map Labels #26, #48, and #49** on April 25, 2011; and no screening was conducted at **Map Label #49** on April 26, 2011. Samples for analytical testing were collected from monitoring sites at **Map Labels #10, #11, #20, and #48** during this time period.

On April 26, 2011, GES initiated continuous data collection of water quality parameters at one location in the drainage swale (**Map Label #11**). GES stationed one sonde or continuous-recording water-quality monitoring station, at a location on the drainage swale flowing north through the grassy field, northwest of the pad, and immediately upstream of the confluence with the UNT (**Map Label #11**). Water-quality parameters were logged by the sonde every ten (10) minutes. The water-quality screening data recorded by the Sonde located in the drainage swale are provided in **Table 12**. The sonde at **Map Label #11** is shown on **Figure 12**. The TDS and specific conductance data from the continuously recorded data from the sonde at **Map Label #11** indicates that the drainage swale is very responsive to rainfall events, with the heavy rains between April 26 and 28, 2011 indicated by the low TDS and specific conductance values. The field-measured water-quality field screening parameters on the drainage swale at Map Label #11 are also provided in **Table 7**.

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Each of the monitoring locations discussed above were monitored with a YSI water-quality meter and a turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All surface-water monitoring locations were mapped with a Trimble GPS unit. Geospatial information on the location was recorded in latitude/longitude, WGS 1984 datum.

All surface-water monitoring of the drainage swale and drainage ditches, and related features, were monitored for water-quality parameters:

- pH,
- Temperature,
- Salinity,
- Specific conductance,
- DO,
- TDS, and
- Turbidity,

with the exception of the initial monitoring on April 20, 2011, which was monitored for pH, temperature, salinity, and specific conductance. Select locations were also monitored for TDS, DO, and turbidity on April 20, 2011.

**Table 7 provides a summary of the field water-quality screening data recorded by GES.**

### **4.4.2 Air Monitoring**

On April 24, 2011, Chesapeake requested GES screen ambient air at all surface- water monitoring locations for methane. GES monitored for methane using an LEL and an FID. Air monitors were calibrated to manufacturer's specifications prior to use.

**Table 7** provides a summary of the ambient air screening data recorded by GES.

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### 4.4.3 Initial Sampling

On April 20, 2011, GES collected water samples for laboratory analytical testing from four locations in the drainage ditch or drainage swale to the UNT, west and northwest of the ATGAS pad, and from one location on a small intermittent tributary (called the small east tributary at **Map Label #1**) to the UNT, north of the ATGAS pad (**Figure 12**). The location of the drainage swale and the drainage ditch are shown on **Figure 3**. The drainage ditch flows into the drainage swale, and the drainage swale flows into the UNT as shown on **Figure 3**. Water samples were collected at:

- one location on small east tributary flowing westward through the cow pasture north of the ATGAS pad but on the east side of the UNT, (**Map Label #1**),
- one location on the drainage ditch flowing north, west of the pad and parallel to a farm road (**Map Label #4**),
- one location on the swale flowing west through the grassy field, northwest of the pad (**Map Label #10**), and
- two locations on the swale flowing north through the grassy field, northwest of the pad (**Map Labels #6 and #7**).

The sample collected from the location on the swale flowing west through the grassy field, northwest of the pad (**Map Label #10**) was split with the PADEP on April 20, 2011. Each of the samples split with the PADEP were collected after the PADEP completed sampling at these locations. Chesapeake has not been provided data from the PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this Report.

On April 21, 2011, GES conducted split water sampling for laboratory analyses with the PADEP, from three locations on the drainage swale and drainage ditch west and northwest of the pad (**Figure 12**). Water samples were collected for laboratory analysis at:

- two locations on the swale flowing north, northwest and west of the pad, parallel to a farm road (**Map Labels #5 and #20**, respectively), and
- one location on the swale flowing west through the grassy field, northwest of the ATGAS pad (**Map Label #10**).

Chesapeake has not been provided data from the PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this report.

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On April 25, 2011, GES collected split water samples for laboratory analyses with the PADEP, from three locations on the drainage ditch and drainage swale west and northwest of the pad,. Water samples were collected for laboratory analysis at:

- two locations on the drainage ditch flowing north, west of the pad, parallel to a farm road (**Map Labels #5 and #20**), and
- one location on the swale flowing west through the grassy field, northwest of the ATGAS pad (**Map Label #10**).

Chesapeake has not been provided data from the PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this report.

From April 26 through May 2, 2011, GES collected water samples daily from three locations on the drainage ditch and drainage swale west and northwest of the pad for laboratory analysis. Water samples were collected at:

- two locations on the drainage ditch flowing north, northwest and southwest of the pad, parallel to a farm road (**Map Labels #5 and #48**), and
- one location on the swale flowing north through the grassy field, northwest of the pad (**Map Label #11**).

On April 28, 2011, GES collected five additional surface-water samples from the drainage ditch and drainage swale for laboratory analysis. These five samples were split with the PADEP on April 28, 2011. GES split samples with the PADEP at:

- three locations on the drainage ditch flowing north, northwest, west, and southwest of the ATGAS pad, parallel to a farm road (**Map Labels #5, #20, and #48**, respectively, and
- two locations on the swale flowing west through the grassy field, northwest of the pad (**Map Label #10**) and one location flowing north through the grassy field (**Map Label #11**).

Chesapeake has not been provided data from PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this Report.

The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

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Samples were analyzed for the list of parameters shown in **Table 11**, and quantitative analytical results are also summarized in **Table 11**. All drainage swale and drainage ditch sample locations are shown on **Figure 12**.

### 4.4.4 Analytical Characterization

The drainage ditch and drainage swale system flows from the south across the agricultural fields on the west side of the ATGAS pad and ultimately into the UNT. The pasture on the north side of the well pad also drains into this drainage system. **Figure 3** shows the location of the drainage ditch and drainage swale flow system,

Laboratory samples from **Map Labels #20 and #48** serve as upstream samples to the south for the drainage ditch and drainage swale system. The specific conductance ranged from 32.7  $\mu\text{mhos/cm}$  (**Map Label #48**, April 28, 2011) to 68.2  $\mu\text{mhos/cm}$  (**Map Label #20**, April 25, 2011). The concentrations of TDS ranged from 15.9 mg/L (**Map Label #48**, April 26, 2011) to 76 mg/L (**Map Label #20**, April 21, 2011). There were no detections of VOCs and SVOCs, or the key specialty organic chemicals in any of the samples collected at **Map Labels #20 and #48**. A single detection of TPH-oil range was noted at **Map Label #20** on April 25, 2011 (114  $\mu\text{g/L}$ ). The barium concentrations ranged from 0.0153 mg/L (**Map Label #48**, April 28, 2011) to 0.0606 mg/L (**Map Label #48**, May 1, 2011). The iron concentrations and manganese concentrations ranged from 0.288 mg/L (**Map Label #48**, April 28, 2011) to 4.58 mg/L (**Map Label #48**, May 1, 2011), and 0.0209 mg/L (**Map Label #48**, April 28, 2011) to 0.356 mg/L (**Map Label #48**, May 1, 2011), respectively. The chloride and strontium concentrations were all non-detected. The low concentrations of metals occurred in samples collected during significant precipitation events.

The sample at **Map Label #1** is an upstream sample in a small intermittent tributary which drains from the east into the UNT. The laboratory specific conductance (166  $\mu\text{mhos/cm}$ ) and TDS (94 mg/L) are higher than in the upstream samples (**Map Labels #48 and #20**) taken from the drainage ditch southwest and west of the ATGAS well pad. This small tributary and the UNT appears to receive runoff from a nearby manure storage area (**Figure 3**). The barium, iron and manganese concentrations were also higher than those found in the drainage ditch upstream of the ATGAS pad.

The drainage ditch and drainage swale flows to the north away from the ATGAS well pad towards the confluences with the UNT. In terms of distance from the well pad,

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**Map Label #5** is the closest sampling location to pad (approximately 340 feet from pad), and the constructed catchment basins on the north side of pad followed by **Map Label #10** (approximately 460 feet), #6 (approximately 780 feet), #7 (approximately 960 feet) and #11 (approximately 1080 feet).

Detections of two of the key organic compounds, 2-butoxyethanol (14.2 µg/L) and ethanol (69 µg/L), were found in a single sample at **Map Label #6** on April 20, 2011; no propargyl alcohol was detected. Ethanol was detected at **Map Label #10** on April 20, 2011 (65.7 µg/L). There were no other detections of these compounds at any location in the drainage swale in samples collected during the period of April 20 to May 2, 2011. Quaternary ammonium compounds and gluteraldehyde were not detected in any of the samples from the drainage swale or drainage ditch. In the sample collected on April 20, 2011 from **Map Label #6** there was a detection of pyridine (10.7 µg/L). Pyridine has been found to be associated with produced water from the Marcellus (GTI, 2009). There were no other detections of pyridine for any sample locations from the drainage swale or drainage from April 20 to May 2, 2011. Samples collected in the drainage swale and drainage ditch downslope of the ATGAS pad on April 20, 2011 had concentrations of chloride, specific conductance, TDS, barium, sodium, and strontium elevated above the upstream concentrations of these parameters. The concentration of these parameters typically decreased with distance from the ATGAS pad. The highest concentrations were at **Map Label #6**.

The samples collected in the drainage swale and drainage ditch on April 21, 2011 (**Map Label #5** and **#10**) had concentrations of chloride, TDS, specific conductance, barium, sodium, and strontium elevated above the upstream concentrations of these parameters (**Map Label #20**). The concentrations of these parameters were within the same range at both sample locations.

The concentrations of chloride, specific conductance, barium, sodium, and TDS at **Map Labels #5** and **#10** on April 25, 2011 were still elevated above the upstream sample (**Map Label #20**) but declined significantly from the April 20, 2011 sample results.

The concentrations of chloride, specific conductance, barium, sodium, and TDS were slightly higher in the samples collected at **Map Labels #5** and **#10** on April 26, 2011 and continued to be elevated as compared to the upstream sample location, **Map Label #48**. The concentrations at **Map Label #11** had decreased and were similar in

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water quality to the upstream location in Towanda Creek (**Map Label #14**) and background water-quality data available from the USGS.

Analysis of samples collected on April 27, 2011 at **Map Label #5** continued to show elevated chloride, specific conductance, barium, sodium, and strontium analytical results. Samples collected at **Map Label #11** were found to have water quality that was well within background water quality available from the USGS but the specific conductance and barium were elevated as compared to the upstream sample location, **Map Label #48**.

Sample results for samples collected on April 28, 2011 at three locations along the drainage swale and drainage ditch system downstream of the ATGAS well pad (**Map Labels #5, #10 and #11**) revealed that the concentrations of chloride, specific conductance, and strontium were similar to the upstream concentrations of these parameters (**Map Labels #20 and #48**). The data are certainly consistent with water quality expected in a system which drains across agricultural areas. Samples results for April 29, 2011, April 30, 2011, May 1, 2011 and May 2, 2011 continued to show water quality which was consistent with background water quality.

The water-quality parameters TDS and specific conductance recorded at the sonde at **Map Label #11 (Table 12)** between April 26, 2011 and May 2, 2011 have been plotted on **Figure 14**. A graph of these data shows that the specific conductance and TDS results for this time frame are very similar to the ranges of the TDS and specific conductance levels found in Towanda Creek between 2002 and 2011. Referring to **Figure 14**, the TDS values and the specific conductivity values are within historical ranges noted for Towanda Creek between 2002 and 2011. This graph also shows very minor influences of the TDS and specific conductance levels to rainfall events, with the lower specific conductivity and TDS levels noted after April 26, 2011 related to heavy runoff producing rainfall events.

### 4.5 UNNAMED TRIBUTARY (UNT) TO TOWANDA CREEK

#### 4.5.1 Initial Monitoring

On April 20, 2011, GES began monitoring the water quality at five locations on the UNT (**Figure 15**). Water quality was monitored at:

- two locations east of the pad (**Map Labels #16 and #17**),
- one location north of the pad, upstream of the confluence with the drainage swale (**Map Label #18**),
- one location northwest of the pad, downstream of the confluence with the drainage swale (**Map Label #12**), and
- one location north of the culvert under Southside Road (**Map Label #13**).

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On April 20, 2011, GES repeated the water quality monitoring prior to sampling for laboratory analyses at locations **Map Labels #16** and **#13**.

From April 20, 2011 through April 28, 2011, location on **Map Label #18** was routinely monitored during overnight site activities.

On April 21, 2011, GES monitored water quality at one location north of the culvert under Southside Road (**Map Label #13**) on the UNT, prior to collecting split samples with PADEP. Chesapeake has not been provided data from PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this report.

From April 22, 2011 through April 24, 2011, GES monitored the water quality at all surface-water locations on the UNT twice per day, except monitoring stations located at **Map Labels #43, #47, #50, and #51**.

From April 25, 2011 through May 2, 2011, GES monitored the water quality and ambient air for methane at all surface-water monitoring locations once per day and prior to sampling.

On April 26, 2011, GES initiated continuous data collection of water-quality parameters at one location on the UNT (**Map Label #47**). GES stationed this sonde or continuous water-quality recorder at a location on the UNT, upstream of the confluence with the drainage swale (**Map Label #47**). Water-quality parameters were logged every ten (10) minutes for the duration of the reporting period. A summary of the sonde data for the UNT is shown in **Table 13**. The TDS and specific conductance water-quality data from this continuous water-quality recorder was plotted and is shown on **Figure 16**. Screening data from the continuous water-quality recorder at **Map Label #47** was established near the confluence of the UNT to the "drainage swale" but on the UNT, showed mostly normal values for specific conductance and TDS after April 26, 2011. However, during periods of run-off producing rainfall between April 26 and 28, 2011, minor changes in water quality

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were noted in the UNT. A more detailed discussion of these data can be found in Section 4.9.1.

Water quality was monitored with a YSI water-quality meter, and a turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The equipment used to conduct the water-quality monitoring activities was decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All UNT surface-water monitoring locations were mapped with a Trimble GPS unit and are shown on **Figure 15**. Geospatial information on the location was recorded in latitude/longitude, WGS 1984 datum.

All surface-water monitoring of the UNT and related features were monitored for water-quality screening parameters:

- pH,
- Temperature,
- Salinity,
- Specific conductance,
- DO,
- TDS, and
- Turbidity,

with the exception of the initial monitoring on April 20, 2011, which was monitored for pH, temperature, salinity, and specific conductance. Select locations were also monitored for TDS, DO, and turbidity on April 20, 2011.

**Table 7** summarizes the field water-quality screening data recorded by GES.

### 4.5.2 Air Monitoring

On April 24, 2011, Chesapeake requested GES begin screening ambient air at all surface water monitoring locations for methane. GES monitored for methane using an LEL and an FID. Air monitors were calibrated to manufacturer's specifications prior to use.

**Table 7** summarizes the ambient air screening data recorded by GES.

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### 4.5.3 Initial Sampling

On April 20, 2011, GES collected water samples from two locations on the UNT for laboratory analysis. Water samples were collected at:

- one location east of the pad (**Map Label #16**), and
- one location north of the culvert under Southside Road (**Map Label #13**).

The sample locations on the UNT are shown on **Figure 15**.

The sample collected from location **Map Label #13 on April 20, 2011** was split with PADEP. Samples split with PADEP were collected after PADEP completed sampling at these locations. Chesapeake has not been provided with the results of PADEP split samples; therefore, no comparisons of the split data are included in this Report.

The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 21, 2011, GES collected water samples for laboratory analysis, split with PADEP, from one location north of the culvert under Southside Road (**Map Label #13**) on the UNT.

On April 25, 2011, GES collected water samples, split with the PADEP, from two locations on the UNT. Water samples were collected for laboratory analysis at:

- one location north of the culvert under Southside Road (**Map Label #13**), and
- one location southeast of the pad (**Map Label #43**).

Chesapeake has not been provided data from the PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this Report.

From April 26, 2011 through May 2, 2011, GES collected water samples daily from three locations on the UNT for laboratory analysis, except no sample was collected on April 27, 2011 from UNT monitoring site at **Map Label #47**. Water samples were collected at:

- one location north of the culvert under Southside Road (**Map Label #13**),
- one location southeast of the pad (**Map Label #43**), and

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- one location northwest of pad, upstream of the confluence with the drainage swale (**Map Label #47**).

On April 28, 2011, GES split samples with PADEP at two of three samples collected from the UNT. GES split samples from:

- one location north of the culvert under Southside Road (**Map Label #13**), and
- one location southeast of the pad (**Map Label #43**).

Chesapeake has not been provided data from PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this Report.

The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

Samples were analyzed for the list of parameters shown in **Table 14**, and quantitative analytical results are also summarized in **Table 14**. All UNT sample locations are shown on **Figure 15**.

#### 4.5.4 Analytical Characterization

The UNT flows from topographically high areas located south or southwest of the ATGAS pad (**Figures 1 and 2**) northwesterly towards Towanda Creek along the east side of the ATGAS well pad. The drainage swale, which passes on the west side of the well pad and enters the UNT near the pond on the [REDACTED] property. None of the key organic compounds, VOCs, and SVOCs were detected in any of the samples collected in the UNT.

The upstream sampling location for the UNT was **Map Label #43**. The water quality at this location had chloride concentrations ranging from <1 to 1.17 mg/L during the sampling duration and specific conductance concentration ranged from 32.3 to 48.6  $\mu\text{mhos/cm}$ . The barium concentrations ranged from 0.0115 to 0.0362 mg/L. There were no detections of any VOCs or SVOCs analytes or the key organic chemicals. **Map Labels #16 and #17** are located on the south side of the lease road to the ATGAS well pad. The analytical data for **Map Label #16** as sampled on April 20, 2011 is similar in character to sample results for **Map Label #43** (chloride: 1.37 mg/L; specific conductance: 58.9  $\mu\text{mhos/cm}$ ; barium: 0.0332 mg/L).

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The sample locations in the UNT for which analytical data is available with increasing distance from the ATGAS well pad are **Map Label #47** located just before the confluence with the drainage swale and **Map Label #13** on the north side of Southside Road. The most distant sample location is **Map Label #15**, which is located at the confluence of the UNT with Towanda Creek. The data for this location will be discussed with the data for Towanda Creek.

The analytical data available for **Map Label #47** shows water quality which is of good quality and slightly differs from that at the upstream sample location. This sample location is downstream of a manure storage area shown on **Figure 3**. The chloride concentration ranges from 2.46 mg/L to 4.75 mg/L and specific conductance ranges from 56.5 to 87.2  $\mu\text{mhos/cm}$  over the sampling period. Barium results were generally less than 1 mg/L and strontium was not detected.

**Map Label #13** represents the mixing of waters from the drainage swale and the UNT. The chloride (185 mg/L) and specific conductance (745  $\mu\text{mhos/cm}$ ) at this sample location were elevated above background in samples collected on April 20, 2011. The levels had decreased to 25.8 mg/L and 170  $\mu\text{mhos/cm}$ , respectively, on April 21, 2011. The levels continued to decrease to 7.02 mg/L chloride and 108  $\mu\text{mhos/cm}$  on April 25, 2011. The concentrations of chloride and specific conductance stabilized at less than 4 mg/L chloride and less than 70  $\mu\text{mhos/cm}$  for April 26, 2011 and on subsequent sampling events. Strontium was detected at 0.21 mg/L in the sample collected on April 20, 2011; strontium concentration decreased to 0.0588 mg/l which is slightly above the detection limit of 0.05 mg/L. All other results for strontium were non-detected values (<0.05 mg/L). Barium concentrations showed a similar pattern of a higher than background value on April 20, 2011 (6.24 mg/L) and steadily decreasing until the April 28, 2011 sampling event and stabilizing at 0.2 mg/L or lower.

### 4.6 TOWANDA CREEK

#### 4.6.1 Initial Monitoring

On April 20, 2011, GES began monitoring water-quality screening parameters on Towanda Creek at a location in Towanda, PA, upstream of the confluence with the Susquehanna River (**Map Label #19**), and one location at the confluence of the UNT with the Towanda Creek (**Map Label #15**). The locations of the Towanda Creek surface-water sampling locations are shown on **Figure 17**.

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On April 21, 2011, GES monitored four locations for screening parameters prior to collecting samples on the Towanda Creek at these 4 locations for water quality analyses. Water quality was monitored at:

- one location upstream of the confluence with the UNT (**Map Label #14**),
- one location at the confluence of the UNT with the Towanda Creek (**Map Label #15**),
- one location downstream of the confluence with the UNT, at the Mill Street bridge (**Map Label #22**), and
- one location in Towanda, PA, upstream of the confluence with the Susquehanna River (**Map Label #19**).

The Towanda Creek sample locations are shown on **Figure 17**. Towanda Creek sample locations, **Map Labels #14 and #15**, are also shown on **Figure 15**.

From April 22, 2011 through April 24, 2011, GES monitored the water quality at all surface-water locations on the Towanda Creek twice per day, with the exception of the monitoring site at **Map Label #55**, and only one reading was taken at the monitoring site at **Map Label #19** on April 23, 2011 and April 24, 2011.

From April 25, 2011 through May 2, 2011, GES monitored the water quality and ambient air for methane at all surface water monitoring locations once per day and prior to any sampling.

On April 28, 2011, GES monitored water quality prior to collecting a sample from Towanda Creek at a location in Monroeton, PA, upstream of the confluence with the Susquehanna River (**Map Label #55**). This location was monitored as a replacement for the location in Towanda, PA (**Map Label #19**) because the location in Towanda, PA was inaccessible on April 28, 2011, due to flooding. The location in Monroeton, PA was monitored once daily through May 2, 2011.

Water quality was monitored with a YSI water-quality meter, and a turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

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All surface water monitoring locations were mapped with a Trimble GPS unit. Geospatial information on the location was recorded in latitude/longitude, WGS 1984 datum.

All surface-water monitoring of Towanda Creek and related features were monitored for water-quality parameters:

- pH,
- Temperature,
- Salinity,
- Specific conductance,
- DO,
- TDS, and
- Turbidity,

with the exception of the initial monitoring on April 20, 2011, which was monitored for pH, temperature, salinity, and specific conductance. Select locations were also monitored for TDS, DO, and turbidity on April 20, 2011.

**Table 7** summarizes the field water-quality screening data recorded by GES.

### 4.6.2 Air Monitoring

On April 24, 2011, Chesapeake requested GES begin screening ambient air at all surface water monitoring locations for methane. GES monitored for methane using an LEL and an FID. Air monitors were calibrated to manufacturer's specifications prior to use.

**Table 7** summarizes the ambient air screening data recorded by GES.

### 4.6.3 Initial Sampling

On April 20, 2011, GES collected water samples from three locations on the Towanda Creek for laboratory analysis. Water samples were collected at one location upstream of the confluence with the UNT (**Map Label #14**), one location at the confluence of the UNT with Towanda Creek (**Map Label #15**), and one location located in Towanda, PA, upstream of the confluence with the Susquehanna River (**Map Label #19**).

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On April 21, 2011, GES collected water samples from four locations on the Towanda Creek for laboratory analysis. Water samples were collected at:

- one location upstream of the confluence with the UNT (**Map Label #14**),
- one location at the confluence of the UNT with Towanda Creek (**Map Label #15**),
- one location downstream of the confluence with the UNT, at the Mill Street bridge (**Map Label #22**), and
- one location in Towanda, PA, upstream of the confluence with the Susquehanna River (**Map Label #19**).

Samples collected from **Map Labels #14, #15, and #19** were split with PADEP. Chesapeake has not been provided data from PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this Report.

On April 25, 2011, GES collected water samples from four locations on Towanda Creek for laboratory analysis. Water samples were collected at:

- one location upstream of the confluence with the UNT (**Map Label #14**),
- one location at the confluence of the UNT with the Towanda Creek (**Map Label #15**),
- one location in Towanda, PA, upstream of the confluence with the Susquehanna River (**Map Label #19**), and
- one location downstream of the confluence with the UNT, at the Mill Street bridge (**Map Label #22**),

Samples collected from **Map Labels #14, #15, and #19** were split with the PADEP. Chesapeake has not been provided data from PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this Report.

Between April 26 through May 2, 2011, GES collected water samples from three locations on Towanda Creek (**Map Labels #14, #15, and #22**). Samples for analytical testing were collected on April 28, 2011, April 30, 2011 (except **Map Label #15**), May 1, 2011, and May 2, 2011. In addition, a water sample was collected for analyses at **Map Label #55** on April 28, 2011.

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On April 28, 2011, GES collected water samples from four locations on the Towanda Creek for laboratory analysis. Water samples were collected at:

- one location upstream of the confluence with the UNT (**Map Label #14**),
- one location at the confluence of the UNT with the Towanda Creek (**Map Label #15**),
- one location in Monroeton, PA, upstream of the confluence with the Susquehanna River (**Map Label #55**), and
- one location downstream of the confluence with the UNT, at the Mill Street bridge (**Map Label #22**).

Samples collected from **Map Labels #14, #15, #22, and #55** were split with PADEP. Chesapeake has not been provided data from PADEP split samples for review. Therefore, no comparison of data from the split sampling has been included in this Report.

From April 30, 2011 through May 2, 2011, GES collected water samples daily from the Towanda Creek for laboratory analysis. Water samples were collected at:

- one location upstream of the confluence with the UNT (**Map Label #14**),
- one location at the confluence of the UNT with the Towanda Creek (**Map Label #15**), except no sample was collected on April 30, 2011 and
- one location downstream of the confluence with the UNT, at the Mill Street bridge (**Map Label #22**).

The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

Samples were analyzed for the list of parameters shown on **Table 15**, and quantitative analytical results are also summarized in **Table 15**.

#### 4.6.4 Discussion

Samples were collected for analytical characterization at several locations along Towanda Creek. **Map Label #14** is upstream from the confluence with the UNT and serves as the background water-quality location for the investigation. Additional background data was obtained from USGS water-quality data for Towanda Creek at the Monroeton gage station (USGS, 2011).

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The sample location identified as **Map Label #15** is at the confluence of the UNT with Towanda Creek. Samples identified as **Map Label #22** and **#19** are located approximately 2,200 feet and 16.5 river miles downstream of the confluence with UNT, respectively.

None of the key organic compounds were detected in any of the samples collected in Towanda Creek. Similarly, there were no detections of light gases, petroleum hydrocarbons, VOCs or SVOCs.

The water quality at **Map Label #14** was generally consistent over the period sampled, except for data from samples collected on April 28, 2011. Due to significant precipitation in the area, the sample results from April 28, 2011 have lower chloride, specific conductance, and TDS concentrations than the other sample results related to dilution from the increased water volume in the creek. Sample results for April 28, 2011 have increased concentrations of total suspended solids and metals typically associated with high runoff from high precipitation events causing sediment levels in the creek to rise. Chloride concentration ranged from 3.22 mg/L on April 28, 2011 to 8.12 mg/L on April 21, 2011. However, if the two days with significant precipitation are excluded, the measured concentrations are tightly grouped together at 8.06 mg/L, 8.12 mg/L, 7.55 mg/L, 7.69 mg/L, and 7.89 mg/L. Specific conductance concentrations range between 68.5 µmhos/cm and 125 µmhos/cm and TDS results range between 54.9 mg/L and 92 mg/L.

Chloride, specific conductance, and TDS concentrations were elevated above the background concentrations in samples collected on April 20, 2011 at **Map Label #15**. The concentrations of chloride, specific conductance, and TDS had declined in the samples collected on April 21, 2011 from **Map Label #15** and generally returned to background concentrations in samples collected on April 25, 2011. The barium and strontium concentrations followed a similar pattern. Increased concentrations were noted in aluminum, iron, and manganese in the April 28, 2011 samples and were associated with increases in total suspended solids caused by heavy rains and subsequent sediment containing runoff. These increases were related to the precipitation events on April 27 and 28, 2011.

No key organic compounds, light gases, VOCs or SVOCs detected in any of the samples collected at the downstream Towanda Creek sampling locations (**Map Labels #19, #22 and #55**). The key inorganic compounds, chloride, specific

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conductance, and TDS concentrations were consistent with background concentrations for each sampling event between April 20, 2011 and May 2, 2011. Strontium was not detected in any of the downstream samples. Increases in aluminum, arsenic, iron and manganese concentrations were noted in the April 28, 2011 samples. These samples also had elevated total suspended solids concentrations consistent with the precipitation events which occurred on April 27 and 28, 2011. Dissolved analyses for aluminum, iron and manganese for the April 28, 2011 samples from **Map Label #22** had non-detected results (approximately 2,200 feet downstream).

The sample collected from the location in Monroeton, PA, upstream of the confluence with the Susquehanna River (**Map Label #55**) on April 28, 2011 had elevated total suspended solids, aluminum, arsenic, barium, iron, manganese, vanadium and zinc concentrations. These concentrations are related to the increased water sediment content in the water due to the precipitation events on April 27 and 28, 2011.

Based on the available data collected from April 20, 2011 to May 2, 2011 there was limited impact on Towanda Creek at the confluence with the UNT in the first few days following the ATGAS well-control incident. This impact was mostly limited to increased concentrations of chloride, specific conductance, TDS, barium, and strontium in the immediate vicinity of the confluence with the UNT. No measureable impact was measured in any of the water samples collected approximately 2,200 feet downstream at **Map Label #22**, and Towanda Creek at **Map Label #15** had returned to background levels by approximately April 26, 2011.

### 4.7 REGIONAL BACKGROUND STREAM SURFACE WATER SAMPLING

Two stream surface-water samples were collected on April 27, 2011 by SAIC at **Map Labels #84** and **#85**, which are located on an unnamed intermittent tributary east of the UNT; this tributary flows into Towanda Creek (see **Figure 12**). The sample collected by GES at **Map Label #1** is an upstream sample from a small tributary which drains from the east into the UNT, which also provides background stream surface-water data. Data from these samples was used, in part, to evaluate regional background surface-water quality. Samples were collected following SAIC's Standard Operating Procedures (SOPs).

#### 4.7.1 Field Quality Control and Quality Assurance

Sampling information for **Map Labels #84** and **#85** were documented in SAIC's sampling log book. The information gathered was submitted to SAIC's QA/QC field

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officer upon completion of the sampling activities. The information was reviewed for completeness, accuracy and adherence to SOPs. Following SAIC's QA/QC review the information was submitted for entry into the database system.

### **4.7.2 Calibration of Water-Quality and Methane Screening Meters**

SAIC's calibration of the water-quality meters and the methane screening instruments was conducted prior to the first sample location of the day and in accordance with the manufacturer's instructions for each instrument. Outside ambient air was used for zero calibration of the methane screening meters. Methane concentrations of 100 parts-per-million (ppm) and 10,000 ppm were used as the span gases for calibration of the FID. The LEL meter was calibrated to a methane concentration of 50%LEL (2.5% by volume). The calibration of water-quality meters utilized a three-point calibration for pH (4, 7, and 10 SU) and turbidity (0, 1, and 10 NTU), and a single point calibration for specific conductance (1,413  $\mu$ mhos/cm). The calibration of all instruments was verified through a bump test subsequent to calibration and prior to use at each additional property. The instruments were calibrated such that the calibration and/or verification standards bracket the readings observed in samples. Methane screening instruments were calibrated using a concentration of methane gas greater than the screening values collected during sampling activities.

Calibration results for each instrument were documented in the sampling log book and were reviewed by the SAIC QA/QC field officer prior to shipment of the sample.

### **4.7.3 Surface Water Sample Collection Methods**

Samples from surface water source locations lacking a water containment system or pump were collected directly at the water source location. During the collection of stream samples, efforts were made to not disturb the sampling location or areas upstream prior to, or during, sample collection. Water-quality field measurements were collected for pH, turbidity, specific conductance, and temperature directly at the sampling location prior to sample collection (**Table 7**). Surface-water samples were collected in laboratory-supplied containers at a discrete sampling location by submerging the non-preserved containers directly in the stream or pond or utilizing a laboratory-supplied container to fill preserved containers. The laboratory-supplied containers were labeled, photographed, and placed on ice. A chain-of-custody was prepared and photographed. The completed COC was reviewed by the SAIC Quality Assurance/Quality Control (QA/QC) field officer prior to shipment. Samples were shipped under custody seal by overnight courier to TestAmerica Laboratories,

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Inc., located in Nashville, Tennessee. A laboratory trip blank was submitted with each sample for analysis of volatile organic compounds (VOCs) by EPA Method 80260B (low-level).

### 4.7.4 Methane Screening

Methane screening was conducted at each water source sampling location. All screening results were reviewed by the SAIC QA/QC field officer following sample collection. The results of the methane screening are included in **Table 7**. All screening values were bracketed by the methane standard concentration used in calibration of the screening instruments.

### 4.7.5 Analytical Characterization

#### 4.7.5.1 Corradi (Map Label #85)

A surface water sample was collected from **Map Label #85** on April 27, 2011 by SAIC. A baseline sample had been previously collected at this location on January 19, 2011. The location of this sample is shown on **Figure 12**, and the analytical data provided in **Table 11**. No light gases were found in either sample; neither were benzene, ethylbenzene, toluene, or xylenes. No other VOCs or SVOCs were found in the April 27, 2011 sample. None of the key organic compounds were found in the April 27, 2011 sample. The chloride, specific conductance, and TDS are generally slightly lower in the April 27, 2011 sample than in the baseline sample. The total suspended solids, barium, iron, and manganese are at low concentrations in both samples; however, the April 27, 2011 samples are slightly higher. The differences noted are likely related to changes in stream sediment content due to the precipitation events in the area on April 27 and 28, 2011.

#### 4.7.5.2 Clarke (Map Label #84)

A surface water sample was collected from **Map Label #85** on April 27, 2011 by SAIC. In addition to the April 27, 2011 sample, a baseline sample had been collected at this location on January 3, 2011. The location of this sample is shown on **Figure 12**, and the analytical data provided in **Table 11**. No light gases were found in either sample; neither were benzene, ethylbenzene, toluene or xylenes. No other VOCs or SVOCs were found in the April 27, 2011 sample. None of the key organic compounds were found in the April 27, 2011 sample. The chloride, specific conductance, TDS, total suspended solids, barium, iron and manganese concentrations are consistent between the baseline and April 27, 2011 samples.

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### 4.7.5.3 Small East Tributary to the UNT (Map Label #1)

The sample at **Map Label #1** is an upstream sample in a small intermittent tributary which drains from the east into the UNT. The location of this sample is shown on **Figure 12**, and the analytical data provided in **Table 11**. The laboratory specific conductance (166  $\mu\text{mhos/cm}$ ) and TDS (94 mg/L) are higher than in the upstream samples (**Map Labels #48 and #20**) taken from north of the ATGAS well pad. The barium, iron and manganese concentrations were also higher than those in the south drainage swale system. This small tributary is located next to a large manure pile as noted on **Figure 3**.

## 4.8 SURFACE WATER INITIAL ECOLOGICAL CHARACTERIZATION

URS Corporation (URS) provided aquatic resource investigation and assessment services for Chesapeake at the ATGAS wellpad site in Bradford County, Pennsylvania in April, 2011. The field visits were completed on April 20, 22 and 26, 2011 in response to equipment failure which resulted in the release of brine water outside of containment. The purpose of these site investigations was to collect data to characterize and assess the aquatic community of an unnamed tributary (UNT-30550) down gradient of the ATGAS wellpad. Macroinvertebrate samples were collected using standard PADEP methodology along with field measured water-quality parameters of pH, temperature, conductivity, dissolved oxygen, TDS and oxidizing reduction potential to characterize the aquatic community of the UNT. Reports which provide the details of these investigations have been previously submitted to the PADEP (**Appendix F**).

URS biologists arrived onsite at approximately 3:30 pm on April 20, 2011. URS examined four locations on the unnamed tributary (PADEP 30550) to qualitatively assess macroinvertebrate communities. Three of the four sampling locations examined were located downgradient of the well pad. Aquatic macroinvertebrates, including pollution intolerant species, were found at all locations examined. Field measured water quality indicated that conductivity and TDS were higher on the unnamed tributary at the location furthest downstream (UNT-1/Site A, 575  $\mu\text{mhos/cm}$  and 370 mg/L respectively) compared to the upstream location (UNT-6/Site D, 79  $\mu\text{mhos/cm}$  and 50 mg/l).

On April 22, 2011 URS expanded the biologic and field water quality monitoring efforts by adding an additional three sampling locations to the monitoring plan. This field sampling was scheduled in advance of forecasted heavy precipitation for the region. A total of seven locations were sampled. Quantitative macroinvertebrate samples were collected and analyzed using standard protocols. Field water-quality measurements were made at each

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sample location. Aquatic macroinvertebrates, including pollution intolerant species, were found at all locations examined. One of the monitoring locations added to the sampling plan (UNT-3) was established on an additional drainage course (unnamed tributary 2) to the UNT-30550. This other unnamed tributary receives some drainage from the ATGAS wellpad (referred to as the “swale” and “ditch”) as well as other natural drainage from the west. Water quality measurements at UNT-3 taken in the field indicated higher specific conductance (299  $\mu\text{mhos/cm}$ ) and TDS (190 mg/l) compared to the other locations sampled on that date. The conductivities at the other sampled locations ranged between 74  $\mu\text{mhos/cm}$  at UNT-5 and 152  $\mu\text{mhos/cm}$  at UNT-1, while TDS ranged from 50 mg/L and 100 mg/L at the same sampled locations. The ecological and/or field screening sites on Towanda Creek and in the UNT are shown on **Figure 17**.

An additional field visit was made by URS on April 26, 2011 to further investigate unnamed tributary 2 that receives drainage from the “ditch” and “swale” areas. A total of three additional sampling points were established: D-2 and D-1 upstream and downstream of the “swale” respectively, and UNT-3A located on unnamed tributary 2. Macroinvertebrate samples were collected and analyzed along with field measured water-quality parameters. Although flow was limited, aquatic macroinvertebrates were found at all locations and other species (frogs and aquatic beetles) were documented. Field measured water-quality data indicated normal water-quality conditions. Throughout the aquatic resource investigations conducted during April, 2011, none of the field measured parameters exceeded established water-quality standards at any of the sampling locations. Based on the data collected for this aquatic resource investigation during the month of April, 2011, there does **not** appear to have been any adverse impacts to the biologic communities of any of the drainages investigated.

### 4.9 OVERALL ASSESSMENT OF IMPACTS TO SURFACE WATER RESOURCES

#### 4.9.1 Un-Named Tributary (UNT) to Towanda Creek

Within 14 hours following the ATGAS incident, Chesapeake initiated sampling and monitoring of the UNT to Towanda Creek. This UNT is shown on **Figures 1** and **2**, and begins approximately 1600 feet southeast from the well pad and flows in a northwesterly direction past the east side of the well pad and to Towanda Creek, where it discharges. As noted on the USGS topographic map for the area (**Figure 1**), this UNT is approximately 2600 feet in length and is noted as an intermittent stream on the topographic map. This stream does not become deeply incised until it crosses Southside Road (**Figure 2**).

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Immediately following the ATGAS incident, Chesapeake established 12 surface-water monitoring sites on this UNT. These sites consisted of “screening sites” where frequent field screening of surface water in the UNT was conducted by GES, typically once or twice per day. The screening water-quality values collected on surface waters in the UNT included temperature, specific conductance, TDS, pH, DO, turbidity, and salinity. In addition, FID and LEL readings were also measured. The field screening water-quality data are provided in **Table 7**.

At some monitoring sites, surface-water samples were periodically collected and analyzed for the comprehensive list of analytical parameters noted in **Section 3**. Surface-water samples were collected for laboratory analytical testing at UNT **Map Labels #13, #16, #43 and #47 (Figure 15)**. At one monitoring site (**Map Label #47**), a continuously recording water-quality station was established and water-quality parameter readings were taken at 10 minute intervals for temperature, specific conductance, TDS, salinity, DO, pH, and oxidation-reduction potential. A summary of the UNT field screening readings from this continuous water-quality recorder is provided in **Table 13**. A summary of the surface-water monitoring sites established on the UNT are provided below:

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<b>Analyte</b>	<b>Percentage of Flagged Results</b>
MBAS	44.38
Nitrate	50.63
Nitrite	53.75
a,a-Dimethylphenethylamine	53.13
Methapyrilene	51.25
Gluteraldehyde	52.50
TSS*	74.25
1,4-Phenylenediamine	85.00
Ammonia	84.38
Quaternary Ammonium Compounds as CTAB	80.00
pH**	100.00

### **Duplicate Sample Results**

Both original sample and duplicate sample >5x the RL and RPD > 120% of the RPD limit.  
Original sample or duplicate sample ≤ 5x the RL (including non-detects) and absolute difference between sample and duplicate > RL

### **Action for Samples**

Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)  
Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)

### **Analytical Result**

### **Analytical Criteria for Sample Validation**

<b>Outside of method hold time</b>	<b>LCS Low</b>	<b>LCS High</b>	<b>Matrix spike low</b>	<b>Matrix spike high</b>	<b>RPD outside prescribed criteria</b>	<b>2x out of method hold time</b>	<b>Positive Blank</b>
Detect	J	J	J	J	J	R	R*
Non-Detect	UJ	UJ	No effect	J	No effect	R	UJ*

<b>Chemical Name</b>	<b># of tests</b>	<b>%J</b>
a,a-Dimethylphenethylamine	25	44%
Methapyrilene	25	100%
1,4-Phenylenediamine	25	100%
2-Picoline	25	44%
Phosphorus	25	76%
Total Dissolved Solids	25	60%

<b>Pond Water Sample Site Number</b>	<b>Date Established</b>	<b>Period of Data Evaluated in this Report</b>	<b>Type of Monitoring Station</b>	<b>Number of Samples Collected For Screening or Analyses</b>
29 (pond)	4/22/11 @ 0815 hrs	4/22/11 to 5/2/11	Analytical data collection and screening site.	18 screening 1 analytical
30 (pond)	4/23/11 @ 1742 hrs	4/23/11 to 5/2/11	Analytical data collection and screening site.	11 screening 1 analytical
31 (pond)	4/23/11 @ 1748 hrs	4/23/11 to 5/2/11	Screening site.	11 screening
32 (pond)	4/20/11 @ 1155hrs	4/20/11 to 5/2/11	Screening site.	16 screening 1 analytical
54 (drainage tile)	4/23/11 @0935 hrs	4/23/11 to 5/2/11	Screening site.	12 screening

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Surface water samples were collected for laboratory analytical testing from monitoring **Map Labels #13** (11 separate analyses), **#16** (1 analysis), **#43** (8 separate analyses), and **#47** (6 separate analyses). In total, there were 26 separate samples collected from the UNT between April 20, 2011 and May 2, 2011 for analytical testing of the full comprehensive parameter list. The analytical data for the UNT is provided in **Table 14**. All 12 monitoring sites on the UNT were also water-quality screening sites. Between April 20, 2011 and May 2, 2011 approximately 204 individual water-quality screening measurements were made on surface waters in the UNT.

Review of the screening and analytical data clearly show that the majority of the UNT was not affected by the ATGAS incident. Key parameters that can be used to evaluate impact to surface water from fluids released during the ATGAS incident are: chloride, sodium, TDS, specific conductance, strontium, barium, and bromide. For comparative purposes, the fluid collected from the catchment basin (**Map Label #27**) on April 20, 2011 (**Table 11**) is thought to be most representative of the fluids from the ATGAS incident, and these fluids collected on April 20, 2011 at **Map Label #27** showed chloride at 19,800 mg/L, sodium at 8,320 mg/L, TDS at 50,600 mg/L, specific conductance at 66,700  $\mu$ mhos/cm, strontium at 423 mg/L, bromide at 208 mg/L, and barium at 16,200 mg/L. These parameters are the normal key parameters that are

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used to evaluate affects on waters from produced water releases. Due to the elevated nature of these constituents in produced fluids, any significant affect to surface waters would show a significant elevation in these parameters.

Review of the analytical and screening data from the UNT clearly show that there was no affect to the UNT from the ATGAS incident over the majority of its stream length. Referring to **Figure 11**, the screening and analytical data clearly shows that the affect on the UNT from the ATGAS incident was limited to the lower 500 feet of this 2600-foot long intermittent stream. The screening and analytical data show no affect on the water quality in the UNT from its beginning reaches to a point approximately 900 feet north of the ATGAS pad. Referring to **Tables 7 and 14**, the sodium levels noted in all monitoring sites except **Map Label #12 and #13** show levels less than 5 mg/L, chloride levels less than 5 mg/L, TDS levels less than 105 mg/L, specific conductance levels less than 160 mg/L, bromide levels less than 1 mg/L, and strontium levels less than 0.05 mg/L. At monitoring **Map Label #12** an elevated specific conductance value was noted in screening data on April 20, 2011, but after this date the specific conductance and TDS values appear to be within normal or near-normal ranges noted for the UNT. At monitoring **Map Label #13**, the specific conductance field screening and analytical data is plotted on **Figure 18**, and shows that the lower 500 feet of the UNT was most affected during the first 40 to 60 hours following the ATGAS incident, with water quality returning to normal or near-normal ranges following this time. The analytical data for **Map Label #13** in **Table 14** show the maximum chloride value measured approximately 16.3 hours after the ATGAS incident was 185 mg/L, the TDS level was 469 mg/L, the specific conductance level was 745 µmhos/cm, the sodium level was 67.6 mg/L, the barium level was 79 mg/L, and the strontium level was 1.96 mg/L. Twenty-four hours later on April 21, 2011, the chloride level was 25.8 mg/L, the TDS level was 127 mg/L, the specific conductivity was 170 µmhos/cm, the sodium level was 9.03 mg/L, the barium level was 6.24 mg/L, and the strontium level was 0.21 mg/L. By April 26, 2011 these levels were at or near background and were: chloride:3.28 mg/L, sodium 2.14 mg/l, TDS 38 mg/L, specific conductance 74.7 mg/L, strontium <0.05 mg/L, and barium 0.276 mg/L.

Screening data from the continuous water-quality recorder established at **Map Label #47**, established near the confluence of the UNT to the "drainage swale" but on the UNT, showed mostly normal values for specific conductance and TDS after April 26, 2011. However, during periods of run-off producing rainfall between April 26

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and 28, 2011, minor changes in water quality were noted in the UNT. Referring to **Figure 16**, minor changes in water quality are noted and appear to be related to runoff producing rainfall events, where residual amounts of diluted ATGAS fluids in soils within or near to the drainage swale may be re-mobilized. It is also possible that the large manure pile noted near the northeast corner of the ATGAS pad could also be causing, or contributing, to the small changes noted in the TDS and specific conductance. The changes in TDS and specific conductance noted at **Map Label #47** after April 26, 2011 are still within the normal ranges for these two parameters noted in Towanda Creek at the Monroeton stream gage station, where TDS and specific conductivity data are available from 2002 to 2011.

The range of TDS and specific conductance in Towanda Creek recorded between 2002 and 2011 is shown on **Figure 19**, and for specific conductance it ranges from 61 to 141  $\mu\text{mhos/cm}$ , and for TDS it ranges from  $<2$  mg/L to 142 mg/L. The average TDS level in Towanda Creek based upon these USGS data is 79 mg/l and the average specific conductance value is 101  $\mu\text{mhos/cm}$ . The TDS and specific conductance levels noted on **Figure 16** in the UNT at monitoring **Map Label #47** are much lower than these average values except during the runoff producing rainfall events.

The analytical data for the UNT also show that no volatile or semi-volatile organic compounds were detected in any of the surface-water samples, no polycyclic aromatic hydrocarbons (PAHs) were detected, no petroleum hydrocarbons (diesel, gasoline, or oil range) were detected, no light gasses detected (methane, propane, and ethane), and no oil and grease detected. The following metals were also not detected: antimony, beryllium, boron, cadmium, mercury, selenium, silver, tin, thallium, and zinc. No specialty hydraulic stimulation compounds (methanol, propargyl alcohol, quaternary ammonium compounds, and gluteraldehyde) were detected in any surface water sample. Very low and trace levels of lead, arsenic, cobalt, chromium, copper, tin, and vanadium were detected in a few samples, but at levels far below any applicable regulatory standard. Barium levels were only elevated in the first three water samples collected at **Map Label #13** on April 20, 21, and 25 2011. Aluminum, iron, and manganese occur naturally in the area surface waters and their levels often related to the amount of suspended sediment entrained in the water, and none of these values appear to be elevated due to the ATGAS incident.

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In summary, the affect of the ATGAS incident on the UNT to Towanda Creek was limited to the lower 500 feet of this 2600-foot long intermittent stream. The water quality in this stream returned to normal or near-normal ranges within approximately 40 to 60 hours following the ATGAS incident. Minor changes in the water quality in the lower 500 feet of the UNT may occur periodically for very short periods due to mobilization of small residual amounts of chloride, sodium, and other parameters still present in soils and sediments principally in the drainage swale area. Discharge from a large manure pile may also contribute to the constituent levels during the runoff periods.

### **4.9.2 Drainage Swale, Containment Areas, and Ditch Downslope and Northwest of the ATGAS Pad**

During the ATGAS incident, fluids from the ATGAS pad principally flowed either into catchment areas located on the north and west side of the ATGAS pad, into a small drainage ditch located west of the UNT, into a small farm pond located approximately 300 feet north of the pad, or into a drainage swale area located northwest of the pad. The drainage ditch flows into the drainage swale area, and the drainage swale flows into the UNT near a pond located approximately 800 feet northwest of the ATGAS pad. The locations of the drainage swale, catchment areas, and ditch area are shown on **Figure 3**.

Immediately following the ATGAS incident, Chesapeake established or utilized existing catchment areas to contain and capture fluids that had flowed off the ATGAS pad. Three catchment areas were established on the north side of the ATGAS pad near the base of the pad, one catchment area on the west side of the pad, and a ditch catchment area located on the north end of the ditch area. These catchment areas are shown on **Figure 12**.

In the catchment areas, eight monitoring **locations** were established, and are **Map Labels #27, #28/53, #41, #42** (ditch catchment), **#44, #45, #46, and #52**. A sample was collected on the ATGAS pad where fluids had pooled, and is referred to as **Map Label # 40** (On Pad sample). There are five monitoring sites on the drainage ditch located west and northwest from the ATGAS pad and these are referred to as **Map Labels #4, #5, #20, #26, and #48**. In the drainage swale area, there are ten monitoring sites established and these are referred to as **Map Labels #6, #7, #8, #9, #10, #11** (continuous monitoring site), **#21, #24, #25, and #49**. There are two monitoring sites that were established on a drainage located approximately 2600 feet

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(**Map Label #85**) and 3000 feet (**Map Label #84**) northeast of the ATGAS pad. **Map Label #1** was established on a small drainage to the UNT that enters on the east side of the UNT and this monitoring site is located approximately 600 feet north of the ATGAS pad. All of these sample sites are shown on **Figure 12**.

In total, there were 24 monitoring or sampling sites established in the immediate areas where the ATGAS fluids had flowed, were captured, or had pooled in depressions. In addition, three additional sites were established on drainages that could not have been affected by the ATGAS incident. These sites consisted of “screening sites” where frequent field screening of surface water was conducted by GES, typically once or twice per day. The screening water-quality values collected on these surface waters included temperature, specific conductance, TDS, pH, dissolved oxygen, turbidity, and salinity. In addition, FID and LEL readings were also measured. The field screening water-quality data are provided on **Table 7**.

At some monitoring sites, surface-water samples were periodically collected and analyzed for the comprehensive list of analytical parameters noted in **Section 3**. A summary of the surface-water monitoring sites established for the drainage ditch, drainage swale, catchment areas, and miscellaneous locations are provided below:

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<b>Analyte</b>	<b>Percentage of Flagged Results</b>
MBAS	44.38
Nitrate	50.63
Nitrite	53.75
a,a-Dimethylphenethylamine	53.13
Methapyrilene	51.25
Gluteraldehyde	52.50
TSS*	74.25
1,4-Phenylenediamine	85.00
Ammonia	84.38
Quaternary Ammonium Compounds as CTAB	80.00
pH**	100.00

### **Duplicate Sample Results**

Both original sample and duplicate sample >5x the RL and RPD > 120% of the RPD limit.  
Original sample or duplicate sample ≤ 5x the RL (including non-detects) and absolute difference between sample and duplicate > RL

### **Action for Samples**

Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)  
Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)

### **Analytical Result**

### **Analytical Criteria for Sample Validation**

<b>Outside of method hold time</b>	<b>LCS Low</b>	<b>LCS High</b>	<b>Matrix spike low</b>	<b>Matrix spike high</b>	<b>RPD outside prescribed criteria</b>	<b>2x out of method hold time</b>	<b>Positive Blank</b>
Detect	J	J	J	J	J	R	R*
Non-Detect	UJ	UJ	No effect	J	No effect	R	UJ*

<b>Chemical Name</b>	<b># of tests</b>	<b>%J</b>
a,a-Dimethylphenethylamine	25	44%
Methapyrilene	25	100%
1,4-Phenylenediamine	25	100%
2-Picoline	25	44%
Phosphorus	25	76%
Total Dissolved Solids	25	60%

<b>Pond Water Sample Site Number</b>	<b>Date Established</b>	<b>Period of Data Evaluated in this Report</b>	<b>Type of Monitoring Station</b>	<b>Number of Samples Collected For Screening or Analyses</b>
29 (pond)	4/22/11 @ 0815 hrs	4/22/11 to 5/2/11	Analytical data collection and screening site.	18 screening 1 analytical
30 (pond)	4/23/11 @ 1742 hrs	4/23/11 to 5/2/11	Analytical data collection and screening site.	11 screening 1 analytical
31 (pond)	4/23/11 @ 1748 hrs	4/23/11 to 5/2/11	Screening site.	11 screening
32 (pond)	4/20/11 @ 1155hrs	4/20/11 to 5/2/11	Screening site.	16 screening 1 analytical
54 (drainage tile)	4/23/11 @0935 hrs	4/23/11 to 5/2/11	Screening site.	12 screening

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For the ditch monitoring sites there were 106 screening samples collected and 20 analytical samples collected between April 20, 2011 and May 2, 2011. For the swale monitoring sites there were 169 screening samples collected and 13 analytical samples collected between April 20, 2011 and May 2, 2011. For the catchment areas, there were 103 screening samples collected and 13 analytical samples collected between April 20, 2011 and May 2, 2011. The miscellaneous tributary sample sites had 26 samples collected for screening and 5 samples collected for analytical testing. In total, there were 404 samples collected for screening and 43 samples collected for analytical testing.

The screening data for the swale, ditch, catchment, or miscellaneous tributary sites are provided in **Table 7**.

The miscellaneous tributary **Map Labels #1, #84, and #85** located east of the ATGAS pad in different drainages were not affected by the ATGAS incident according to the screening and analytical data.

The five ditch monitoring sites (**Map Labels #4, #5, #20, #26, and #48**) located west, northwest, and southwest from the ATGAS pad were all affected by the release except **Map Labels #20 and #48** according to the screening and analytical data. The **Map Label #20** field specific conductivity value on 4/21/11, at 233  $\mu\text{mhos/cm}$ , does not agree with the laboratory value of 66  $\mu\text{mhos/cm}$ . The chloride value on this sample date was  $<1$  mg/l, the sodium was 1.67 mg/l, and the TDS was 76 mg/l. The lab data clearly indicates that ditch **Map Label #20** was not affected by the ATGAS incident, and the field specific conductivity data is likely in error.

Generally, the screening data shows that the water quality returned to pre-release levels within a few days at **Map Labels #4 and #5**. **Map Label #48** was not affected by the release (upstream from release area) but a data outlier was present on the 4/30/2011 sample, showing a specific conductance of 2112  $\mu\text{mhos/cm}$  and a TDS level of 1386 mg/l. A sample was collected for analyses at this same time and the specific conductance was 60  $\mu\text{mhos/cm}$  and a TDS level of 18.1 mg/l. Clearly, the screening data for the 4/30/11 sample at 8:28 am is likely a transcription or measurement error. Eliminating this point as being an outlier shows that the upstream ditch site (**Map Label #48**) was not affected by the ATGAS incident. Ditch site (**Map Labels #20**) does not appear to be impacted as the chloride levels are all below 5 mg/l, the sodium levels are below 2 mg/l, the TDS levels are less than 76

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mg/l, and the strontium levels are non-detect. Ditch **Map Label #20** also showed a detection of diesel TPH on April 25, 2011, but it is not related to the ATGAS incident.

There were 10 swale sample sites monitored from 4/20/11 and 5/2/11 (**Map Labels #5, #6, #7, #8, #9, #10, #11, #21, #24, #25, and #49**). Review of field and screening data show that water quality at swale **Map Labels #5, #6, #7, #9, #10, #11, #21, #24, and #49** appear to be affected by the ATGAS incident. Swale **Map Labels #8** and **#25** do not appear to be affected based upon screening data. A data outlier exists for **Map Label #25** (specific conductance on April 22, 2011 at 4:50 pm.) where a specific conductance was noted as 900  $\mu\text{mhos/cm}$  with a corresponding TDS value of 58 mg/l. The TDS value of 58 is consistent with all other data, and the specific conductance appears to be in error by a factor of 10.

Screening and/or laboratory analytical data for the eight catchment monitoring locations and the one location from the well pad (**Map Label #40**) was reviewed. This review indicates that all of these catchment or on-pad monitoring sites were affected by the ATGAS incident. During the incident, the released fluids were directed to these catchment basins or flowed onto the pad surface (**Map Label #40**).

The analytical data for the swale and ditch sampling are provided in **Table 11**, and the data for the catchment basin sampling is also provided in **Table 11**.

The analytical data for the swale, ditch, pad, and catchment areas indicate that the only light gas detected was methane at trace levels in the ditch sample at **Map Label #48**, which is the unaffected upstream ditch sample site. This site was not affected by the ATGAS release. None of the specialty organic compounds methanol, propargyl alcohol, and quaternary ammonium compounds were detected in any of the ditch, swale, or catchment monitoring locations. Gluteraldehyde was detected in the catchment basins at **Map Label #27** and at **Map Label #44**. At **Map Labels #52** (catchment) and **#10** (swale) oil and grease was detected. Ethanol was detected at **Map Labels #6** (swale) and **#10** (swale) on 4/20/11. Also on 4/20/11 **Map Label #6** (swale) had detections of pyridine and 2-butoxyethanol. These parameters were expected to be found in these catchment basins since they were used to contain the released fluids, and the catchment basins are located immediately adjacent to the ATGAS pad.

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For the catchment areas, swale area, pad, and ditch there were no detections of arsenic, antimony, thallium, beryllium, boron, cadmium, mercury, selenium, silver, and nickel. Trace levels of lead, vanadium, copper, tin, and cobalt were detected in just a few samples well below any regulatory action level. Iron and manganese occur naturally in the area at elevated levels. Barium was elevated in samples at **Map Labels #5** (ditch), **#6** (ditch), **#10** (ditch), **#27** (catchment), **#40** (pad), **#44** (catchment), and **#52** (catchment).

In the catchment, swale, ditch, and pad area the only VOCs detected were ethanol at monitoring **Map Labels #10** (swale), **#27** (catchment), **#40** (pad), and **#52** (catchment); chlorobenzene at **Map Label #40** (catchment); and acetone at **Map Labels #27** (catchment) and **#52** (catchment). The acetone is likely a laboratory contaminant. The only SVOCs that were detected was pyridine at **Map Labels #27** (catchment), **#40** (pad), and **#52** (catchment); and 2-butoxyethanol at **Map Labels #27** (catchment), **#40** (pad), and **#52** (catchment). At **Map Label #27** (catchment), diesel range petroleum hydrocarbons were detected.

At swale drainage **Map Label #11**, GES installed a continuous water-quality monitoring station at the downstream discharge point of the swale into the UNT. This monitor recorded field screening parameters of specific conductance, TDS, salinity, DO, pH, and oxygen reduction potential. The data was collected from April 26, 2011 to May 2, 2011 and is provided in **Table 12**. A graph of this data is provided on **Figure 14** showing the specific conductance and TDS results compared to the TDS and specific conductance levels found in Towanda Creek between 2002 and 2011. Referring to **Figure 14**, the TDS values and the specific conductivity values are within historical ranges noted for Towanda Creek for TDS and specific conductance. This graph also shows the influences of the TDS and specific conductance levels to rainfall events.

In summary, the catchment areas, drainage ditch, and drainage swale were the principal release pathways of fluids from the ATGAS incident. These are the areas where the most ATGAS fluid components would be expected to be found. The detection of the various VOC, SVOC, and specialty compounds were mostly on the day following the release and subsequent sampling did not show detections of these compounds. The effect of the ATGAS fluid release was very limited to mostly a small area along the drainage swale, areas immediately adjacent to the ATGAS pad where fluids were captured, the small area of overland flow from the pad to the pond located

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approximately 300 feet north of the ATGAS pad, and the lower 500 feet of the UNT to Towanda Creek. A map showing the location of these areas that was affected by the ATGAS incident is provided on **Figure 11** and encompasses an area less than 10 acres.

### 4.9.3 Towanda Creek

The UNT discharges into Towanda Creek approximately 1350 feet northwest from the ATGAS pad as shown on **Figure 15**. During the ATGAS incident Chesapeake initiated water-quality monitoring of Towanda Creek within approximately 16.5 hours of the start of that incident. Stream water-quality monitoring sites were established at three locations (**Map Label #14, #15, and #19**) on Towanda Creek on April 20, 2011, followed by an additional water-quality monitoring location (**Map Label #22**) on April 21, 2011 and another (**Map Label #55**) on April 28, 2011. Towanda water-quality monitoring station **Map Label #14** is the upstream station, and is upstream from the confluence of the UNT to Towanda Creek. Monitoring site, **Map Label #15**, is located at the confluence of Towanda Creek with the UNT. Monitoring site, **Map Label #22**, is located approximately 2200 feet downstream from the UNT confluence. Monitoring site, **Map Label #55**, is located in Monroeton, approximately 13.5 miles downstream of the UNT confluence, and **Map Label #19** is located approximately 1 mile upstream on Towanda Creek from its confluence with the Susquehanna River. A summary of the surface-water monitoring sites established on Towanda Creek are noted below:

<b>Analyte</b>	<b>Percentage of Flagged Results</b>
MBAS	44.38
Nitrate	50.63
Nitrite	53.75
a,a-Dimethylphenethylamine	53.13
Methapyrilene	51.25
Gluteraldehyde	52.50
TSS*	74.25
1,4-Phenylenediamine	85.00
Ammonia	84.38
Quaternary Ammonium Compounds as CTAB	80.00
pH**	100.00
<b>Duplicate Sample Results</b>	<b>Action for Samples</b>
Both original sample and duplicate sample >5x the RL and RPD > 120% of the RPD limit.	Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)
Original sample or duplicate sample ≤ 5x the RL (including non-detects) and absolute difference between sample and duplicate > RL	Qualify those results that are ≥ RL that are impacted as estimated (J) and non-detects as estimated (UJ)
<b>Analytical Result</b>	<b>Analytical Criteria for Sample Validation</b>
<b>Outside of method</b>	<b>Positive Blank</b>
<b>LCS Low</b>	<b>RPD outside prescrib</b>
<b>LCS High</b>	<b>2x out of method</b>
<b>Matrix spike low</b>	
<b>Matrix spike high</b>	

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The Towanda Creek screening data are provided in **Table 7** and the laboratory analytical data is also provided in **Table 15**. During the period from April 20, 2011 to May 2, 2011 GES took 80 screening measurements on Towanda Creek and collected 23 samples for analytical testing. The field screening parameters included temperature, specific conductance, TDS, pH, dissolved oxygen, turbidity, and salinity. In addition, FID and LEL readings were also measured. The locations of the Towanda Creek monitoring stations are shown on **Figure 17**.

There are two USGS stream gage stations established on Towanda Creek downstream from its confluence with the UNT. The USGS stream gage at Franklindale, Pennsylvania is located approximately 7.4 stream miles downstream from the confluence with the UNT and its location is shown on **Figure 4**. This USGS stream gage only records daily discharge of Towanda Creek and stage height. Another USGS stream gage is located approximately 13.5 stream miles downstream from the confluence with the UNT and its location is shown on **Figure 4**. The stream gage at Monroeton records discharge, stage height, and water-quality parameters (periodic measurements of water-quality parameters). Water-quality parameter measurement for most compounds began at this station in April 2002, but some parameters like chloride and sodium were not routinely analyzed until later dates. Chloride measurements started in January 2009 and sodium measurements started in November 2010. Typically, parameter measurements were taken every 2 or 3 months at this station, with records for specific conductance and TDS starting in January 2002.

The TDS and specific conductivity values for the USGS Monroeton gage station have been plotted on **Figure 19** for data available from 2002 to 2011. The TDS values measured at this gage ranged from <2 mg/L to 142 mg/L and averaged 79 mg/L. The specific conductance varied from 61  $\mu\text{mhos/cm}$  to 141  $\mu\text{mhos/cm}$  and averaged 101  $\mu\text{mhos/cm}$  over this time period. This historical Towanda Creek water-quality data can be used to compare and contrast with the data collected from Towanda Creek during the recent ATGAS incident. In addition to the historical water-quality data, the USGS stream gage discharge readings are shown for both the gages at Franklindale and Monroeton. The Franklindale gage is relatively new and has historical records dating back to August 2010. The Monroeton station has records that date back to 1914 (97 years). Gage discharge readings for Franklindale and Monroeton from August 2010 to July 2010 are shown on **Figures 8 and 10**, respectively. As noted by the Monroeton gage station, discharge at that station was much higher than normal

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during and following the ATGAS incident as previously discussed. **Figures 7 and 9** are detailed discharge records at the Franklindale and Monroeton gage stations from April 11, 2011 to May 2, 2011, respectively. The historical gage discharge readings at the Monroeton station clearly show that Towanda Creek was at much higher than normal discharge before, during, and after the ATGAS incident. Information on these USGS stream gage stations is shown in **Appendix G**.

The TDS and specific conductance values have been plotted for measurements taken by GES immediately after the ATGAS incident through May 2, 2011. Referring to **Figure 20**, which is a plot of the stream monitoring sites both upstream and downstream from the confluence with the UNT. Monitoring site **Map Label #14** is on Towanda Creek and is upstream of the UNT confluence. Monitoring site **Map Label #15** is very near the UNT confluence but on Towanda Creek. **Map Label #22** is approximately 2200 feet downstream from the UNT confluence, monitoring **Map Label #55** is approximately 13.5 miles downstream from the UNT confluence, and **Map Label #19** is approximately 1 mile upstream of Towanda Creek's confluence with the Susquehanna River. These Towanda Creek monitoring stations are shown on **Figure 17**.

**Figure 20** shows the specific conductance values in Towanda Creek at the five monitoring sites noted above. Comparing and contrasting these specific conductance data with the upstream samples from **Map Label #14** indicate that there was a change in specific conductance in Towanda Creek right near the outlet of the UNT; but at **Map Label #22**, which is approximately 2200 feet downstream of the UNT confluence, no change in the specific conductance between the upstream site, **Map Label #14**, and downstream site, **Map Label #22**, is indicated. In fact, the values are almost identical between **Map Labels #14 and #22** for the entire monitoring period. The change in specific conductance at **Map Label #15** occurred for approximately the first 36 to 60 hours following the ATGAS incident, and after this time, all specific conductance values in Towanda Creek at its confluence with the UNT were the same as the upstream background sample. No impact was observable in Towanda Creek at any of the downstream monitoring **Map Labels #22, #55, and #19** based upon these specific conductance values. **Figure 21** is a plot of the laboratory specific conductance values for the Towanda Creek measurement stations and are similar to **Figure 20**.

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The Towanda Creek analytical data for all five sites shows that no detectable levels of VOCs; SVOCs; polycyclic aromatic hydrocarbons; light gasses (ethane, methane, or propane); oil and grease; diesel, gasoline, oil range petroleum hydrocarbons; and specialty organic compounds (gluteraldehyde, propargyl alcohol, quaternary ammonium compounds, and methanol) were detected anywhere in Towanda Creek following the ATGAS incident through May 2, 2011. The chloride, TDS, and sodium monitoring values in Towanda Creek found in upstream background **Map Label #14** and downstream site **Map Label #22** are almost identical to each other and show no significance difference for samples collected between April 20, 2011 and May 2, 2011. The affect noted in Towanda Creek right at the discharge point (**Map Label #15**) at the UNT showed the highest chloride level observed was 171 mg/L, the TDS level was 402 mg/L and the sodium level was 59.1 mg/L on 4/20/11. Barium was also elevated. On 4/21/2011 the chloride, TDS, and sodium levels at **Map Label #15** were 31.1 mg/L, 148 mg/L, and 11.1 mg/L, respectively. Other than barium, the heavy metals were at trace levels at monitoring site **Map Label #15**, on 4/20/11. All heavy metals at the upstream site, **Map Label #14**, and downstream site, **Map Label #22**, were very similar and were at trace levels when detected, and typically were also detected at background site **Map Label #14**.

In order to evaluate the potential impact on the drainage system from the catchment area next to the ATGAS well pad, through the ditch-swale system, into the UNT, and finally into Towanda Creek the specific conductance was graphed with increasing distance from the ATGAS well pad. As can be noted from a review of **Figure 22**, on April 20, 2011 the specific conductance rapidly decreased and returned to background within the 2,200 foot distance to **Map Label #22**. For April 26 and 28, 2011 and May 2, 2011 the specific conductance returned to background by **Map Label #5** (which is in the ditch-swale system).

In summary, no affect was measured in Towanda Creek at the **Map Label #22** located approximately 2,200 feet downstream from the UNT during the period 4/20/11 and 5/2/11. The affect on Towanda Creek from the ATGAS incident was limited and only detectable at the point of discharge of the UNT into Towanda Creek. Within approximately 2,200 feet downstream of the UNT confluence, no measurable change in water quality was noted in Towanda Creek. No compounds commonly associated with fracking have been detected in Towanda Creek.

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## **5.0 WATER WELL AND SPRING SAMPLING EFFORTS (4/20/2011 - 5/2/2011)**

### **5.1 NEAR-BY WATER WELLS**

All of the near-by water-well monitoring and sampling was conducted per the PADEP-approved SAP dated April 29, 2011. Field measurements and sample collection was performed by GES personnel. Key water-quality parameters have been graphed and reviewed for the sample results from April 20, 2011 to May 2, 2011, and compared to baseline values. The key analytical indicator parameters associated with the ATGAS fluid release are chloride, sodium, TDS, barium, bromide, strontium, and specific conductance. Significant and sustained changes in these key analytical parameters could indicate a change in water-quality caused by the ATGAS incident. In addition to these key analytical parameters, a review of the total manganese and total iron data was conducted since these two constituents are routinely found naturally in groundwater from water wells in NE Pennsylvania over secondary regulatory drinking water levels. The presence of total iron or total manganese does **NOT** by themselves indicate an impact from drilling fluids, hydraulic stimulation fluids, or produced water. The key indicator parameters of chloride, sodium, TDS, barium, bromide, strontium, and specific conductance would have to be present in significantly elevated concentrations over baseline to indicate an impact to a groundwater source from the ATGAS incident. Total iron and total manganese changes that do not correlate to changes in the key water-quality-parameters noted above cannot be related to impacts that could be caused by the ATGAS incident. The locations of all nearby water wells are shown on **Figure 23**.

#### **5.1.1 [REDACTED] (Map Label #38)**

##### **5.1.1.1 Physical Description of Property**

Parcels # 22-107.00-126.000 and 22-107.00-126.001 (**Map Label #38**) are owned by [REDACTED]. The parcel is located at 5241 Southside Road, Canton, Leroy Township, Bradford County, PA. This parcel contains two residential homes and a barn. Both houses contain basements and the barn is constructed as a slab on grade. The homes are utilized as residential rental properties.

The historical use of the property was residential/agricultural, while the current use of the property is residential only. There are no known public underground utilities at the site; however, overhead telephone and electric lines were observed. The parcel is serviced by a private water well and septic system.

The [REDACTED] well (**Map Label #38**) serves both parcels and is used for domestic use and is not vented. The well is located north of the house. Through field observations

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and information gathered from the property owner, it was determined that the well is constructed of six inch diameter casing to an unknown depth likely with an open-hole completion below the casing, and was drilled to an approximate depth of 170 feet below ground surface (bgs) according to the homeowner. The complete well construction details are unknown. A treatment system is not associated with this well.

### 5.1.1.2 Initial Monitoring

On April 20, 2011 and April 21, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] potable well (**Map Label #38**). Water- quality field screening was conducted with a YSI water-quality meter. Prior to monitoring, the YSI field screening meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. . The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.1.3 Initial Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] water well (**Map Label #38**). The split sample was collected from the kitchen tap for the home located on Parcel 22-107.00-126.001 after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. The PADEP has not provided Chesapeake with analytical results from

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this split sample. All samples were accompanied by a trip blank. Laboratory analytical data are summarized in **Table 17**.

### 5.1.1.4 Continued Field Screening

From April 25, 2011 through May 2, 2011, GES continued collecting field-measured water-quality data of the groundwater associated with the [REDACTED] water well (**Map Label #38**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

Starting on April 25, 2011, in addition to water-quality field screening measurements, GES monitored the groundwater from the [REDACTED] well (**Map Label #38**) for methane using an FID and LEL meter. On April 25, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitoring instrument:

- Cold headspace,
- Cold tap, and
- Wellhead.

All water-quality field measurements are summarized in **Table 16**.

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### 5.1.1.5 Continued Sampling

From April 25, 2011 through May 2, 2011, GES collected groundwater samples from the [REDACTED] water well (**Map Label #38**). These water samples were collected from an outside spigot located in Parcel # 22-107.00-126.000. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 17**.

### 5.1.1.6 Field Parameter Monitoring

On April 20, 2011 and April 21, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] water well (**Map Label #38**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

From April 25, 2011 through May 2, 2011, GES continued collecting field-measured water-quality data of the groundwater associated with the [REDACTED] well (**Figure 3, Map Label #38**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring,

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water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

Starting on April 25, 2011, in addition to water-quality field measurements, GES monitored the groundwater from the [REDACTED] well (**Map Label #38**) for methane using an FID and LEL meter. From April 25, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitor:

- Cold headspace,
- Cold tap, and
- Wellhead.

GES monitored for methane accumulation in the headspace of a 16-ounce glass mason jar. Approximately 12 ounces of sample was collected in the jar and immediately covered with aluminum foil. The jar was allowed to sit for approximately 15 minutes prior to monitoring. Monitoring was then conducted by piercing the aluminum foil with the probe of the FID and LEL and noting the reading.

### Outlier and Special Circumstances Discussion

A review of the field-measured water-quality parameters collected between April 20, 2011 and May 2, 2011 was completed. Through this review, the specific conductance measurement recorded on April 21, 2011 appears to be an outlier. In

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addition, the dissolved oxygen and turbidity measurements recorded on April 26, 2011, appear to be outliers. These outliers may be attributed to equipment failure, mis-reading of the instrument by field personnel, or transcription errors.

### 5.1.1.7 PADEP Split Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #38**). The split sample was collected from the kitchen tap after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an iced cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 27, 2011, the USEPA and PADEP were onsite to split-sample with GES. The USEPA, PADEP, and GES collected a water sample from the [REDACTED] well (**Map Label #38**) via incremental split sampling techniques. Incremental split sampling was completed by each party filling their bottleware approximately one-quarter full, with the exception of the 40-mL VOA bottleware, which were filled completely by each party. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an iced-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. Neither the USEPA or the PADEP have shared their analytical data for these split samples.

It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 17**.

### 5.1.1.8 Discussion

Analytical characterization data was available for a baseline sample collected on July 15, 2010 and nine samples were collected during the period of April 20 to May 2, 2011.

None of the VOC or SVOC compounds were found in any of the nine samples collected in the first two weeks following the fluids release from the ATGAS well pad. Methane was found in all of the samples, including the baseline sample, except the sample collected on April 29, 2011. The methane concentrations are generally less than 1 mg/L. No ethane or propane was detected in any of the samples. Field

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monitoring for methane conducted on April 20 and 21, 2011, and daily between April 25 and May 2, 2011, found variability in methane concentrations. For example, methane measurements in cold headspace samples varied from 50.04 ppm on May 1, 2011 to 530 ppm on April 25, 2011. Measurements for LEL were all zero.

The analytical data for general quality parameters and total metals are generally consistent between the nine samples and the baseline samples. The data for the key analytical parameters (sodium, chloride, TDS, and specific conductance) are graphically presented in **Figure 24**. Sodium and chloride concentrations appear to be fairly consistent. The specific conductance and TDS data have considerable variability. The divergence of the relationship between specific conductance and TDS starting with the April 27, 2011 points to potential natural density/chemical stratification within the well. There appears to be data outlier or quality issues with the April 30 and May 2, 2011 specific conductance and/or TDS results. Field measurements of specific conductance do not show the same variability that is evident in the laboratory-measured specific conductance; they are similar on all the days monitored (635 to 793  $\mu\text{mhos/cm}$ ), except April 21, 2011. As previously discussed the April 21, 2011 field-measurement value is an outlier due to instrument issues. Similarly, field-measured TDS was similar on all the days monitored (414 to 566 mg/L). As is expected there is some variability in water quality between sampling periods. The dissolved methane, total barium, total manganese, and total iron are plotted for the nearby water wells (except **Map Label #39**, [REDACTED] and are provided graphically on **Figures 25, 26, 27** and **28**, respectively. The total barium results are similar in variability to the specific conductance and TDS variability and are similar to the baseline concentration. The total manganese and total iron are similar to the baseline concentration. The dissolved methane values are very consistent and similar to baseline values except for a non-detected reading on 4/29/2011, which is considered an outlier in the data.

The concentrations of chloride, specific conductance, sulfate, TDS, arsenic, barium, iron, manganese, and sodium fall within the range of concentrations found in the regional baseline data. However, the [REDACTED] well is located approximately 450 feet southwest from the [REDACTED] well (**Map Label #39**), and at an elevation slightly higher than the [REDACTED] well. As noted in the [REDACTED] report provided in **Appendix H**, and previously submitted to the PADEP on July 13, 2011, naturally occurring high TDS water occurs at a depth of approximately 172 feet bgs in the [REDACTED] well, and the [REDACTED] well is approximately 170 feet deep as reported by the landowner. The

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water-quality data in the [REDACTED] well is suggestive that this well is completed in part into this naturally-occurring poor water-quality zone.

Based on the data available through May 2, 2011, the [REDACTED] well (**Map Label #38**) was not affected by fluids released at the surface from the ATGAS well pad.

### 5.1.2 [REDACTED] (**Map Label #36**)

#### 5.1.2.1 Physical Description of Property

Parcel # 22-107.00-125.000 (**Map Label #36**) is owned by [REDACTED] and [REDACTED]. The parcel is located at 7664 Southside Road, Canton, Leroy Township, Bradford County, PA. This parcel is divided by Southside Road. On the south side of Southside Road is a residential home and two garages/sheds. The home contains a basement, while the garages/sheds are constructed as slabs on grade. On the north side of Southside Road is a barn used to house livestock.

The current and historical use of the property is residential/agricultural. There are no known public, underground utilities at the site; however, overhead telephone and electric lines were observed. The parcel is serviced by a private well and septic system.

The [REDACTED] well (**Map Label #36**) is used for domestic and livestock use and is not vented. The well is located near the barn, to the north of Southside Road. Through field observations and information gathered from the property owner, it was determined that the well is constructed of six inch diameter casing to an unknown depth likely with an open-hole completion below the casing, and was installed to an approximate depth of 120 feet bgs according to the homeowner. The complete well construction details are unknown. A treatment system is not associated with this well.

#### 5.1.2.2 Initial Monitoring

On April 20, 2011 and April 21, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] water well (**Map Label #36**). Water-quality monitoring was conducted with a decontaminated 13-quart stainless steel container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

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- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

On April 22, 2011, the above-referenced water-quality parameters were measured in the field; however, turbidity and TDS were added to the list of parameters.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.2.3 Initial Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #36**). The split sample was collected from the kitchen tap after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. PADEP has not provided the results of this split sample to Chesapeake.

It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 18**.

### 5.1.2.4 Continued Monitoring

From April 25, 2011 through May 2, 2011, GES continued with collecting field-measured water-quality data of the groundwater associated with the [REDACTED] well (**Map Label #36**). Water-quality monitoring was conducted with a decontaminated container, a YSI water-quality meter, and turbidity meter. Prior to monitoring, water-

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quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

In addition to water-quality, GES monitored the groundwater from the [REDACTED] water well (**Map Label #36**) for methane using an FID and LEL meter. On April 25, 2011 and April 26, 2011, GES was provide access to the hot and cold water at this well; therefore readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

From April 27, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitor:

- Cold headspace,
- Cold tap, and
- Wellhead.

All water-quality field measurements are summarized in **Table 16**.

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### 5.1.2.5 Continued Sampling

From April 25, 2011 through May 2, 2011, GES collected groundwater samples from the [REDACTED] well (**Map Label #36**). These samples were collected on a daily basis. On April 25, 2011 and April 26, 2011, the water samples were collected from the kitchen tap. From April 27, 2011 through May 2, 2011, the water samples were collected from a hose that was connected to the pressure tank. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 18**.

On April 27, 2011, the USEPA and PADEP were onsite to split a groundwater sample with GES.

### 5.1.2.6 Field Parameters

Field monitoring of water-quality parameters was conducted prior to sample collection. On April 20, 2011 and April 21, 2011, GES monitored the water quality through use of a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

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On April 22, 2011, the above-referenced water-quality parameters were measured in the field; however, turbidity and TDS were added to the list of parameters.

On April 25, 2011 through May 2, 2011, the collection of field-measured water-quality parameters continued; however, the water-quality parameter list was expanded and included the following:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Starting on April 25, 2011, in addition to water-quality field measurements, GES monitored the groundwater samples for methane using an FID and LEL meter. When access was granted, readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

GES also monitored for methane accumulation in the headspace of a 16-ounce glass mason jar. Approximately 12 ounces of sample was collected in the jar and immediately covered with aluminum foil. The jar was allowed to sit for approximately 15 minutes prior to monitoring. Monitoring was then conducted by piercing the aluminum foil with the probe of the FID and LEL and the readings recorded.

### Outlier and Special Circumstances Discussion

A review of the field-measured water-quality parameters collected between April 20, 2011 and May 2, 2011 was completed. Through this review, the turbidity measurement recorded on April 26, 2011 appears to be an outlier. This outlier may be attributed to equipment failure, mis-reading of the instrument by field personnel, or transcription errors.

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### 5.1.2.7 PADEP Split Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] water well (**Map Label #36**). The split sample was collected from the kitchen tap after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 27, 2011, the USEPA and PADEP were onsite to split a groundwater sample with GES. The USEPA, PADEP, and GES collected water samples from the [REDACTED] well (**Map Label #36**) via incremental split sampling techniques. Incremental split sampling was completed by each party filling their bottleware approximately one-quarter full, with the exception of the 40-mL VOA bottleware, which were filled completely by each party. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 18**. Neither USEPA nor PADEP have shared the analytical results from this split sampling with Chesapeake.

### 5.1.2.8 Discussion

Analytical characterization data was available for a baseline sample collected on July 14, 2010 and nine samples collected during the period of April 20 to May 2, 2011.

None of the VOC or SVOC compounds were found in any of the nine samples collected in the first two weeks following the fluid release from the ATGAS well pad. Methane was found in all of the samples, including the baseline sample. No ethane or propane was detected in any of the samples. Methane concentrations were somewhat variable ranging from 0.349 mg/L (baseline) to 0.94 mg/L (April 28, 2011). The higher methane values tended to occur on days with a significant precipitation event. Field monitoring for methane also exhibited considerable variability; for example, at the cold tap, readings ranged from 0.025 ppm on April 30, 2011 to 29.17 ppm on April 29, 2011. LEL readings were all zero.

The analytical data for general water-quality parameters and total metals are generally consistent between the nine samples and the baseline samples. The key

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analytical parameter results (sodium, chloride, TDS, and specific conductance) are presented graphically on **Figures 29**. Review of the **Figure 29** reveals that the data are generally linear over the time period of the sampling and very consistent with baseline sampling results. Specific conductance field measurements ranged from 283  $\mu\text{mhos/cm}$  on April 30 to 489  $\mu\text{mhos/cm}$  on April 22, 2011. These values agree with the specific conductance as measured in the laboratory, except for the April 30, 2011 sample which was 437  $\mu\text{mhos/cm}$  as compared to 283  $\mu\text{mhos/cm}$  in the field. The low field measurement is probably associated with instrument malfunction, mis-readings of instrumentation by field personnel, or transcription error. Field measured TDS are in agreement with the laboratory determined TDS. The TDS concentrations in the nine samples collected after April 20, 2011 were consistent with the baseline sample TDS concentration.

Chloride concentrations in samples collected after April 20, 2011 were the same or lower than the baseline sample's chloride concentration. The dissolved methane, total barium, total manganese, and total iron are plotted for all nearby wells (except **Map Label #39**, [REDACTED] and are presented graphically on **Figures 25, 26, 27, and 28**, respectively. Barium and strontium concentrations were relatively constant; barium concentrations were consistent with the baseline sample. No strontium baseline analysis was available for comparison. The methane, total iron, and total manganese are consistent with baseline data. As is expected with groundwater analytical data, there is some variability in water quality.

The arsenic concentrations are consistent between the baseline sample and over the nine samples collected between April 20 and May 2, 2011. Arsenic concentrations ranged from 0.0235 mg/L (May 2, 2011) to 0.0347 mg/L (April 30, 2011). All of the arsenic concentrations found in the groundwater from this well are above the USEPA Maximum Contaminant Level (MCL) for arsenic of 0.01 mg/L. Arsenic was found above the MCL in the baseline sample collected on July 14, 2010, at 0.0293 mg/L. The arsenic found in this well is naturally occurring and is not related in any way to the ATGAS incident.

The concentrations of chloride, specific conductance, methane, TDS, arsenic, barium, iron, manganese, and sodium fall within the range of concentrations found in the baseline data, and no significant changes are noted over baseline data for these parameters.

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Based on the data available through May 2, 2011, the [REDACTED] well (**Map Label #36**) was not affected by fluids released from the ATGAS well pad.

### 5.1.3 [REDACTED] (**Map Label #39**)

#### 5.1.3.1 Physical Description of Property

Parcel # 22-107.00-126.002 (**Map Label #39**) is owned by [REDACTED]. The parcel is located at 7573 Southside Road, Canton, Leroy Township, Bradford County, PA. This parcel contains a residential home with an attached garage, as well as a detached garage. The house contains a basement while the two garages are constructed as slabs on grade.

The current and historical use of the property is residential. There are no known public, underground utilities at the site; however, overhead telephone and electric lines were observed. The parcel is serviced by a private well and septic system.

The [REDACTED] well (**Map Label #39**) is used for domestic use and is not vented. The well is located near the southeast corner of the house. Through field observations and information gathered from the property owner, it was determined that the well is constructed of six inch diameter casing and was installed to an approximate depth of 175 feet bgs. The complete well construction details are known and show steel surface casing set to 77 feet bls followed by an open hole completion to 175 feet bgs. A treatment system was not associated with this well historically or at the time of the ATGAS incident. The [REDACTED] have repeatedly noted that the water quality in their well has always been high in salts.

#### 5.1.3.2 Initial Monitoring

On April 20, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (**Map Label #39**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

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Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

On April 22, 2011, the above-referenced water-quality parameters were measured in the field; however, turbidity and TDS were added to the list of parameters.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.3.3 Initial Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #39**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 19**.

### 5.1.3.4 Continued Monitoring

From April 25, 2011 through May 2, 2011, GES continued with collecting field-measured water-quality data of the groundwater associated with the [REDACTED] well (**Map Label #39**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

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## REDACTIONS MADE AT REQUEST OF PROPERTY OWNER

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

In addition to water-quality field parameters, GES monitored the groundwater from the [REDACTED] well (**Map Label #39**) for methane using an FID and LEL meter. On April 25, 2011; April 26, 2011; and April 29, 2011, GES was provided access to the hot and cold water at this well; therefore readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

On April 27, 2011; April 28, 2011; and April 30, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitor:

- Cold headspace,
- Cold tap, and
- Wellhead.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.3.5 Continued Sampling

From April 25, 2011 through May 2, 2011, GES collected groundwater samples from the [REDACTED] well (**Map Label #39**). These samples were collected on a daily basis. On April 26, 2011 and April 29, 2011, the water samples were collected from the kitchen tap. On April 25, 2011; April 27, 2011; April 28, 2011; and April 30, 2011 through May 2, 2011, the water samples were collected from an outside spigot. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody

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documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 19**.

On April 27, 2011, the USEPA and PADEP were onsite to split a groundwater sample with GES.

### 5.1.3.6 Field Parameters

Field monitoring of water-quality parameters was conducted prior to sample collection. On April 20, 2011, GES monitored the water-quality through use of a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

On April 22, 2011, the above-referenced water-quality parameters were measured in the field; however, turbidity and TDS were added to the list of parameters.

From April 25, 2011 through May 2, 2011, the collection of field-measured water-quality parameters continued; however, the water-quality parameter list was expanded and included the following parameters:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

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Starting on April 25, 2011, in addition to water-quality field parameters, GES monitored the groundwater samples for methane using an FID and LEL meter. When access was granted, readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

GES also monitored for methane accumulation in the headspace of a 16-ounce glass mason jar. Approximately 12 ounces of sample was collected in the jar and immediately covered with aluminum foil. The jar was allowed to sit for approximately 15 minutes prior to monitoring. Monitoring was then conducted by piercing the aluminum foil with the probe of the FID and LEL and recording the readings.

### Outlier and Special Circumstances Discussion

A review of the field-measured water-quality parameters collected between April 20, 2011 and May 2, 2011 was completed. Through this review, the turbidity measurements recorded on April 25, 2011 and April 26, 2011, appear to be outliers. These outliers may be attributed to equipment failure, equipment mis-readings by field personnel, or transcription errors.

### 5.1.3.7 PADEP Split Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #39**). The split sample was collected from the kitchen tap after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 27, 2011, the USEPA and PADEP were onsite to split a groundwater sample with GES. The USEPA, PADEP, and GES collected a water sample from the [REDACTED] well (**Map Label #39**) via incremental split sampling techniques. Incremental split

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sampling was completed by each party filling their bottleware approximately one-quarter full, with the exception of the 40-mL VOA bottleware, which were filled completely by each party. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 19**.

Results of these split samples have not been shared by the PADEP or USEPA with Chesapeake.

### 5.1.3.8 Discussion

Analytical characterization data was available for a baseline sample collected on July 15, 2010 and nine samples collected during the period of April 20 to May 2, 2011.

None of the VOC or SVOC compounds were found in any of the nine samples collected in the first two weeks following the fluids release from the ATGAS well pad. Methane was found in all of the samples, including the baseline sample. The concentrations were extremely variable ranging from 0.134 mg/L (April 29, 2011) to 8.83 mg/L (April 25, 2011). No ethane or propane was detected in any of the samples. Field FID methane measurements were highly variable. LEL readings were non-detected in the cold and hot tap and wellhead determinations. Cold and hot headspace LEL readings ranged from zero to 21 percent in the cold headspace on April 27, 2011.

The analytical data for general water-quality parameters and total metals were found to be extremely variable between the baseline sample and among the nine samples collected between April 20 and May 2, 2011. An intense special investigation of this well was undertaken by Chesapeake in June and July, 2011. The results of this investigation have been documented in a report submitted to the PADAP on July 13, 2011 (See **Appendix H**). Details of that investigation are provided in that report.

The special investigation determined that the [REDACTED] well (**Map Label #39**) was not affected by fluids released from the ATGAS well pad.

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### 5.1.4 [REDACTED] (1) (Map Label #33)

#### 5.1.4.1 Physical Description of Property

Parcel # 22-107.04-4.000 (Map Label #33) is owned by Ted [REDACTED]. The parcel is located at 7854 Southside Road, Canton, Leroy Township, Bradford County, PA. This parcel is divided by Southside Road. There is a barn located on the north side of Southside Road. The barn was historically used as a dairy barn and is constructed as a slab on grade. On the south side of Southside Road, is a residential home and a detached garage. The residential home contains a basement while the garage is constructed as a slab on grade. It should be noted that a second residential home and well are located on this parcel. The second residential home and well will be discussed in **Section 5.1.5** of this report.

The historical use of the property is residential/agricultural while the current use is residential. There are no known public, underground utilities at the site; however, overhead telephone and electric lines were observed. The parcel is serviced by a private well and septic system.

The [REDACTED] well (Map Label #33) is used for domestic use and is not vented. The well is located west of the house. Through field observations and information gathered from the property owner, it was determined that the well is constructed of six inch diameter casing to an unknown depth likely with an open-hole completion below the casing, and was drilled to an approximate depth of 180 feet bgs according to the landowner. The complete well construction details are unknown. A treatment system is not associated with this well.

#### 5.1.4.2 Initial Monitoring

On April 20, 2011 through April 23, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (Map Label #33). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

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Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

It should be noted that on April 20, 2011, turbidity was also measured in the field. On April 23, 2011, the above-referenced water-quality parameters were measured in the field; however, turbidity and TDS were added to the list of parameters.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.4.3 Initial Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #33**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 20**.

### 5.1.4.4 Continued Monitoring

On April 25, 2011 through May 2, 2011, GES continued with collecting field-measured water-quality data of the groundwater associated with [REDACTED] well (**Map Label #33**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

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Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

On April 28, 2011, the YSI water-quality meter was not accurately reading pH; therefore, on this day, pH was field-measured with pH strips. On April 30, 2011, salinity, DO, and TDS were not measured due to human oversight.

In addition to water-quality field readings, GES monitored the groundwater from the [REDACTED] well (**Map Label #33**) for methane using an FID and LEL meter. On April 25, 2011, GES was provided access to the hot and cold water at this well; therefore readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

From April 26, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitor:

- Cold headspace,
- Cold tap, and
- Wellhead.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.4.5 Continued Sampling

From April 25, 2011 through May 2, 2011, GES collected groundwater samples from the [REDACTED] well (**Map Label #33**). These water samples were collected from an

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outside spigot. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 20**.

On April 28, 2011, the USEPA and PADEP were onsite to split-sample with GES.

### 5.1.4.6 Field Parameters

Field monitoring of water-quality parameters was conducted prior to sample collection. On April 20, 2011 through April 23, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (**Map Label #33**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

It should be noted that on April 20, 2011, turbidity was also measured in the field.

On April 23, 2011, the above-referenced water-quality parameters were measured in the field; however, turbidity and TDS were added to the list of parameters.

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From April 25, 2011 through May 2, 2011, the collection of field-measured water-quality parameters continued; however, the water-quality parameter list was expanded and included the following parameters:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Starting on April 25, 2011, in addition to water-quality field parameters, GES monitored the groundwater samples for methane using an FID and LEL meter. When access was granted, readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

GES monitored for methane accumulation in the headspace of a 16-ounce glass mason jar. Approximately 12 ounces of sample was collected in the jar and immediately covered with aluminum foil. The jar was allowed to sit for approximately 15 minutes prior to monitoring. Monitoring was then conducted by piercing the aluminum foil with the probe of the FID and LEL and recording the readings.

### Outlier and Special Circumstances Discussion

A review of the field-measured water-quality parameters collected between April 20, 2011 and May 2, 2011 was completed. Through this review, the turbidity measurement recorded on April 25, 2011, appears to be an outlier. This outlier may be attributed to equipment failure, mis-reading of the field instruments by field personnel, or transcription error.

### 5.1.4.7 PADEP Split Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #33**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected.

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The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. Results of this split sample has not been provided to Chesapeake by the PADEP.

On April 28, 2011, the USEPA and PADEP were onsite to split samples with GES. The USEPA, PADEP, and GES collected a water sample from the [REDACTED] well (**Map Label #33**) via incremental split sampling techniques. Incremental split sampling was completed by each party filling their bottleware approximately one-quarter full, with the exception of the 40-mL VOA bottleware, which were filled completely by each party. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. Results of this split sample has not been provided to Chesapeake by the PADEP or USEPA.

It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 20**.

### 5.1.4.8 Discussion

Analytical characterization data was available for a baseline sample collected on July 18, 2010 and nine samples collected during the period from April 20 to May 2, 2011.

None of the VOC or SVOC compounds were found in any of the nine samples collected in the first two weeks following the fluids release from the ATGAS well pad. Methane was found in all of the samples, including the baseline sample. No ethane or propane was detected in any of the samples. Methane concentrations were somewhat variable ranging from 0.03 mg/L (May 2, 2011) to 0.0585 mg/L (Baseline); generally, the concentrations were less than 0.05 mg/L. Field measurements of methane were variable from non-detected to 20.14 ppm in the cold headspace sample reading on April 26, 2011. LEL readings were all zero values.

The analytical data for general water-quality parameters and total metals are generally consistent between the nine samples and the baseline sample. The chloride and TDS concentrations were lower in the nine samples than in the baseline

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sample. The key analytical parameter results (sodium, chloride, TDS, and specific conductance) are presented graphically in **Figure 30**. As can be noted from review of **Figure 30**, the results are generally linear and show no significant variability from baseline values. Laboratory-measured specific conductance ranged from 398  $\mu\text{mhos/cm}$  in the baseline sample to 431  $\mu\text{mhos/cm}$  on April 30, 2011. Specific conductance measured in the field were in the same range or lower than the laboratory-measured values for the same day except for April 21, 2011; the 770  $\mu\text{mhos/cm}$  value recorded for April 21, 2011 is an outlier and likely a instrument mis-reading, transcription error, or instrument error.

The dissolved methane, total barium, total manganese, and total iron are plotted for all nearby water wells (except **Map Label #39**, [REDACTED] and are presented graphically on **Figures 25, 26, 27, and 28**, respectively. Barium and strontium concentrations are similar for all nine sampling days following the release from the ATGAS well pad, with barium values similar to baseline levels. The methane, total iron and total manganese are similar to baseline values. No baseline strontium values are available. The other metal concentrations are comparable between the baseline and the nine other samples.

The concentrations of chloride, methane, specific conductance, TDS, arsenic, barium, iron, manganese, and sodium are not significantly different than baseline values.

Based on the data available through May 2, 2011, the [REDACTED] well (**Map Label #33**) was not affected by fluids released from the ATGAS well pad.

### 5.1.5 [REDACTED] (2) (**Map Label #34**)

#### 5.1.5.1 Physical Description of Property

The information provided in this section is related to the second residential home and well located on parcel # 22-107.04-4.000 (**Map Label #34**), which is owned by Ted [REDACTED]. The address associated with the second residence is 7794 Southside Road, Canton, Leroy Township, Bradford County, PA. This residential home (containing a basement) is located on the southern side of Southside Road.

The historical use of the property is residential/agricultural while the current use is residential. There are no known public, underground utilities at the site; however,

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overhead telephone and electric lines were observed. The parcel is serviced by a private well and septic system.

The [REDACTED] well (**Map Label #34**) is used for domestic use and is not vented. The well is located southeast of the house. Through field observations and information gathered from the property owner, it was determined that the well is constructed of six inch diameter casing to an unknown depth likely with an open-hole completion below the casing, and was installed to an approximate depth of 180 feet bgs according to the homeowner. The complete well construction details are unknown. A treatment system is not associated with this well.

### 5.1.5.2 Initial Monitoring

On April 20, 2011 through April 23, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (**Map Label #34**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

It should be noted that on April 20, 2011, turbidity was also measured in the field. On April 23, 2011, the above-referenced water-quality parameters were measured in the field; however, turbidity and TDS were added to the list of parameters.

All water-quality field measurements are summarized in **Table 16**.

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### 5.1.5.3 Initial Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #34**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 21**.

### 5.1.5.4 Continued Monitoring

From April 25, 2011 through May 2, 2011, GES continued collecting field-measured water-quality data of the groundwater associated with [REDACTED] well (**Map Label #34**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring, meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

On April 28, 2011, the YSI water-quality meter was not accurately reading pH; therefore, on this day, pH was field-measured with pH strips. On April 30, 2011, salinity, DO, and TDS were not measured due to human oversight.

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In addition to water-quality field parameters, GES monitored the groundwater from the [REDACTED] potable well (**Map Label #34**) for methane using an FID and LEL meter. On April 25, 2011, GES was provided access to the hot and cold water at this well; therefore readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

From April 26, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitor:

- Cold headspace,
- Cold tap, and
- Wellhead.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.5.5 Continued Sampling

From April 25, 2011 through May 2, 2011, GES collected groundwater samples from the [REDACTED] well (**Map Label #34**). These water samples were collected from an outside spigot. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 21**.

On April 28, 2011, the USEPA and PADEP were onsite to split samples with GES. Please refer to "PADEP Split Sampling" below for details related to this sampling event. The USEPA and PADEP have not provided Chesapeake with analytical data from these split samples.

### 5.1.5.6 Field Parameters

Field monitoring of water-quality parameters was conducted prior to sample collection. From April 20, 2011 through April 23, 2011, GES monitored the water

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quality of groundwater associated with the [REDACTED] well (**Map Label #34**).

Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

From April 25, 2011 through May 2, 2011, the collection of field-measured water-quality parameters continued; however, the water-quality parameter list was expanded and included the following parameters:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Starting on April 25, 2011, in addition to water-quality field parameters, GES monitored the groundwater samples for methane using an FID and LEL meter. When access was granted, readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

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GES monitored for methane accumulation in the headspace of a 16-ounce glass mason jar. Approximately 12 ounces of sample was collected in the jar and immediately covered with aluminum foil. The jar was allowed to sit for approximately 15 minutes prior to monitoring. Monitoring was then conducted by piercing the aluminum foil with the probe of the FID and LEL and recording the readings.

### 5.1.5.7 PADEP Split Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #34**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 28, 2011, the USEPA and PADEP were onsite to collect split samples with GES. The USEPA, PADEP, and GES collected a water sample from the [REDACTED] well (**Map Label #34**) via incremental split sampling techniques. Incremental split sampling was completed by each party filling their bottleware approximately one-quarter full, with the exception of the 40-mL VOA bottleware, which were filled completely by each party. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 21**.

### Outlier and Special Circumstances Discussion

A review of the field-measured water-quality parameters collected between April 20, 2011 and May 2, 2011 was completed. Through this review, the turbidity measurement recorded on April 25, 2011, appears to be an outlier. This outlier may be attributed to equipment failure, mis-reading of field instruments by field personnel, or transcription error.

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### 5.1.5.8 Discussion

Analytical characterization data was available for a baseline sample collected on July 18, 2010 and nine samples collected during the period of April 20 to May 2, 2011.

None of the VOC or SVOC compounds were detected in any of the nine samples collected in the first two weeks following the fluids release from the ATGAS well pad. Methane was found in all of the samples, including the baseline sample. No ethane or propane was detected in any of the samples. Methane concentrations were somewhat variable ranging from 0.0669 mg/L (April 27, 2011) to 7.06 mg/L (April 29, 2011); generally, the concentrations were less than 0.15 mg/L (9 of the 10 samples). The higher methane value of 7.06 mg/L is a data outlier. Dixon's Outlier Test was performed, as available in ProUCL; the 7.06 mg/L value was an outlier at 1 percent significance level. This value is totally inconsistent with the methane values collected the day before and the day after this anomalous result. The result is likely due to laboratory error or sample mis-identification. With the exception of the outlier value, there is no significant change in methane from the baseline value. Field measurements of methane were variable from zero to 63.47 ppm in the hot headspace on April 25, 2011.

The analytical data for general water-quality parameters and total metals are generally consistent between the nine samples and the baseline samples. The key analytical parameter results have been presented graphically in **Figure 31**. The chloride, sodium, specific conductance, and TDS results have a generally linear pattern and are similar to baseline values. Specific conductance measurements were made in the field and ranged from 318  $\mu\text{mhos/cm}$  on April 30, 2011 to 484  $\mu\text{mhos/cm}$  on April 29, 2011. The field-measured concentration of 996  $\mu\text{mhos/cm}$  on April 21, 2011 was considered an outlier due to equipment calibration issues. Laboratory-measured specific conductance values were generally in agreement with the field-measured data, except for the field outlier on April 21, 2011. The previous day's field reading (April 20, 2011) and the field reading on April 23, 2011 were consistent.

As is expected with a groundwater analytical data, there is some variability in water quality. The concentrations of chloride, methane, specific conductance, sulfate, TDS, arsenic, barium, iron, manganese, and sodium are very similar to baseline values. The dissolved methane, total barium, total manganese, and total iron are plotted for all nearby water wells (except **Map Label #39**, [REDACTED] and are presented graphically

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on **Figures 25, 26, 27, and 28**. A methane outlier occurs for the April 29, 2011 sample analyses and is thought to be a laboratory error or sample mis-identification.

Based on the data available through May 2, 2011, the [REDACTED] well (**Map Label #34**) was not affected by fluids released from the ATGAS well pad.

### 5.1.6 [REDACTED] (**Map Label #35**)

#### 5.1.6.1 Physical Description of Property

Parcel # 22-107.00-124.001 (**Map Label #35**) is owned by [REDACTED]. The parcel is located at 382 Leroy Mountain Road, Canton, Leroy Township, Bradford County, PA. This parcel contains a residential home with and a detached garage. The house contains a basement while the garage is constructed as a slab on grade.

The current and historical use of the property is residential. There are no known public, underground utilities at the site; however, overhead telephone and electric lines were observed. The parcel is serviced by a private well and septic system.

The [REDACTED] potable well (**Figure 3, Map Label #35**) is used for domestic use and is not vented. The well is located west of the house. Through field observations and information gathered from the property owner, it was determined that the well is constructed of six inch diameter casing to an unknown depth likely with an open-hole completion below the casing, and was installed to an approximate depth of 185 feet bgs according to the homeowner. The complete well construction details are unknown. A treatment system is not associated with this well.

#### 5.1.6.2 Initial Monitoring

On April 20, 2011 and April 21, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (**Map Label #35**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

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- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. The container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.6.3 Initial Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #35**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 22**.

### 5.1.6.4 Continued Monitoring

From April 25, 2011 through May 2, 2011, GES continued collecting field-measured water-quality data of the groundwater associated with the [REDACTED] well (**Map Label #35**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

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Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

On April 28, 2011, the YSI water-quality meter was not accurately reading pH; therefore, on this day, pH was field-measured with pH strips.

In addition to water quality, GES monitored the groundwater from the [REDACTED] well (**Map Label #35**) for methane using an FID and LEL meter. From April 25, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitor:

- Cold headspace,
- Cold tap, and
- Wellhead.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.6.5 Continued Sampling

From April 25, 2011 through May 2, 2011, GES collected grab groundwater samples from the [REDACTED] well (**Map Label #35**). These grab water samples were collected from an outside spigot. Between April 25, 2011 and April 29, 2011, the samples were collected after a sufficient volume of water was purged and water-quality readings were collected. On April 28, 2011, the [REDACTED] well (**Map Label #35**) was purged for approximately 15 minutes. At the start of sample collection, the water changed from clear to a brownish, rust-like color. Therefore, the water was purged for approximately five (5) additional minutes. After the additional purge time, the water remained a brownish, rust-like color and the sample was collected. Between April 30, 2011 and May 2, 2011, due to the home owners concerns regarding water usage, a full purge was not completed at this well prior to sampling; however, the

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water was utilized by the residents through routine domestic activities; which simulated a purge prior to sampling. All samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 22**.

On April 28, 2011, the USEPA and PADEP were onsite to collect split samples with GES. Neither the USEPA or PADEP have provided their analytical results for these split samples to Chesapeake.

### 5.1.6.6 Field Parameters

Field monitoring of water-quality parameters was conducted prior to sample collection. On April 20, 2011 and April 21, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (**Map Label #35**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

From April 25, 2011 through May 2, 2011, GES continued collecting field-measured water-quality data of the groundwater associated with the [REDACTED] well (**Map Label #35**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring,

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water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Starting on April 25, 2011, in addition to water-quality field parameters, GES monitored the groundwater samples for methane using an FID and LEL meter. Readings were collected at the following locations:

- Cold headspace,
- Cold tap, and
- Wellhead.

GES monitored for methane accumulation in the headspace of a 16-ounce glass mason jar. Approximately 12 ounces of sample was collected in the jar and immediately covered with aluminum foil. The jar was allowed to sit for approximately 15 minutes prior to monitoring. Monitoring was then conducted by piercing the aluminum foil with the probe of the FID and LEL and recording the readings.

### Outlier and Special Circumstances Discussion

A review of the field-measured water-quality parameters collected between April 20, 2011 and May 2, 2011 was completed. Through this review, the specific conductance measurement recorded on April 21, 2011 and the DO measurement recorded on April 25, 2011, appear to be outliers. These outliers may be attributed to equipment failure, instrument mis-reading by field personnel, or human error when transcribing the field measurements.

### 5.1.6.7 PADEP Split Sampling

On April 20, 2011, the PADEP and GES collected a split samples from the [REDACTED] well (**Map Label #35**). The split samples were collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an

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ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 28, 2011, the USEPA and PADEP were onsite to collect split samples with GES. The USEPA, PADEP, and GES collected a water sample from the [REDACTED] well (**Map Label #35**) via incremental split sampling techniques. Incremental split sampling was completed by each party filling their bottleware approximately one-quarter full, with the exception of the 40-mL VOA bottleware, which were filled completely by each party. The sample was collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 22**. Neither the USEPA or PADEP has shared the results of their split samples with Chesapeake.

### 5.1.6.8 Discussion

Analytical characterization data was available for a baseline sample collected on July 13, 2010 and nine samples collected during the period from April 20 to May 2, 2011.

None of the VOCs, SVOCs, or light gasses (ethane, methane, or propane) were found in any of the nine samples collected in the first two weeks following the fluids release from the ATGAS well pad. Field measurements for methane, using the FID, were variable between non-detected to 12.09 ppm in the cold headspace sample on April 26, 2011. There were no detected field LEL readings.

The analytical data for general water-quality parameters and total metals are generally consistent between the nine samples and the baseline samples. An N1 qualified data result for TDS (289 mg/L) in the April 25, 2011 sample appears to be an outlier. The value was tested with Dixon's Outlier Test using ProUCL, and it was determined to be an outlier at the 1 percent significance level (1% critical value: 0.597). The TDS results for April 20, 2011 and April 26, 2011 were 172 and 169 mg/l, respectively; both concentrations are slightly below the baseline concentration of 184 mg/L. The field measured TDS for April 25, 2011 was 206 mg/L. The chloride and specific conductance concentrations in the April 25, 2011 sample are not elevated and are lower than the baseline sample results. The field measurement for specific conductance on April 25, 2011 (317  $\mu$ mhos/cm) was well within the range of

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the other field measured specific conductance values. The TDS outlier is probably attributable to laboratory error.

The key analytical parameters have been summarized in **Figure 32**; review of these data reveals that with the exception of the data outlier for TDS, the data is generally linear and very similar to baseline values

Total suspended solids and turbidity were elevated on April 28, 2011 due to issues with sampling discussed previously in Section 5.1.6.5. As noted, the water was left running for an extended period during sampling and therefore, began to pump sediment from the bottom of the well. As a result, the aluminum, arsenic, barium, iron, manganese, strontium, and other metals results were elevated for the April 28, 2011 sample over baseline. Dissolved metals for aluminum, iron, nickel and vanadium were non-detected in the April 28, 2011 sample. The total metals data are related to the excessive amount of entrained sediment in the sample from the April 28, 2011 sampling and are not reflective of the normal or natural water quality for this well.

The dissolved methane, total barium, total manganese, and total iron are plotted for all nearby water wells (except **Map Label #39**, [REDACTED] and are presented graphically on **Figures 25, 26, 27, and 28**, respectively. The concentrations of chloride, methane, specific conductance, sulfate, TDS, arsenic, barium, iron, manganese, and sodium are very similar to baseline values (except for the iron and manganese data collected on April 28, 2011).

Based on the data available through May 2, 2011, the [REDACTED] well (**Map Label #35**) has not been affected by fluids released from the ATGAS well pad.

### 5.1.7 [REDACTED] (**Map Label #37**)

#### 5.1.7.1 Physical Description of Property

Parcel # 22-107.00-124.002 (**Map Label #37**) is owned by [REDACTED]. The parcel is located at 294 Leroy Mountain Road, Canton, Leroy Township, Bradford County, PA. This parcel contains a residential home with and a detached garage. The house and garage are constructed as slabs on grade.

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The current and historical use of the property is residential. There are no known public, underground utilities at the site; however, overhead telephone and electric lines were observed. The parcel is serviced by a private well and septic system.

The [REDACTED] well (**Map Label #37**) is used for domestic use and is not vented. The well is located south of the house. Through field observations and information gathered from the property owner, it was determined that the well is constructed of six inch diameter casing to an unknown depth likely with an open-hole completion below the casing, and was installed to an approximate depth of 150 feet bgs according to the homeowner. The complete well construction details are unknown. A treatment system is not associated with this well.

### 5.1.7.2 Initial Monitoring

On April 20, 2011 and April 22, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (**Map Label #37**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

It should be noted that on April 22, 2011, turbidity was also measured in the field.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All water-quality field measurements are summarized in **Table 16**.

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### 5.1.7.3 Initial Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #37**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 23**.

### 5.1.7.4 Continued Monitoring

From April 25, 2011 through May 2, 2011, GES continued collecting field-measured water-quality data of the groundwater associated with the [REDACTED] well (**Map Label #37**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

In addition to water-quality field parameters, GES monitored the groundwater from the [REDACTED] well (**Map Label #37**) for methane using an FID and LEL meter. On April 25, 2011, GES was provided access to the hot and cold water at this well; therefore readings were collected at the following locations:

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- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

From April 26, 2011 through May 2, 2011, GES was only given access to the cold water; therefore, the following locations were monitored with the FID and LEL monitor:

- Cold headspace,
- Cold tap, and
- Wellhead.

All water-quality field measurements are summarized in **Table 16**.

### 5.1.7.5 Continued Sampling

From April 25, 2011 through May 2, 2011, GES collected groundwater samples from the [REDACTED] well (**Map Label #37**). These water samples were collected from an outside spigot, with the exception of the sample collected on April 25, 2011. On April 25, 2011, the sample was collected from a bathroom tap located in the garage. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 27, 2011, the USEPA and PADEP were onsite to collect split samples with GES. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 23**.

### 5.1.7.6 Field Parameters

On April 20, 2011 and April 22, 2011, GES monitored the water quality of groundwater associated with the [REDACTED] well (**Map Label #37**). Water-quality monitoring was conducted with a decontaminated 13-quart container and a YSI water-quality meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

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- Temperature,
- pH,
- Salinity,
- Specific conductance, and
- DO.

It should be noted that on April 22, 2011, turbidity was also measured in the field.

Water-quality monitoring was conducted after a sufficient volume of water was purged from the well. A container was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The water being purged from the well continued to flow into the container while conducting water-quality monitoring. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

From April 25, 2011 through May 2, 2011, GES continued collecting field-measured water-quality data of the groundwater associated with the [REDACTED] well (**Map Label #37**). Water-quality monitoring was conducted with a decontaminated container and a YSI water-quality meter and turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. The field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

Starting on April 25, 2011, in addition to water-quality field parameters, GES monitored the groundwater samples for methane using an FID and LEL meter. When access was granted, readings were collected at the following locations:

- Cold headspace,
- Hot headspace,
- Cold tap,
- Hot tap, and
- Wellhead.

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GES monitored for methane accumulation in the headspace of a 16-ounce glass mason jar. Approximately 12 ounces of sample was collected in the jar and immediately covered with aluminum foil. The jar was allowed to sit for approximately 15 minutes prior to monitoring. Monitoring was then conducted by piercing the aluminum foil with the probe of the FID and LEL and recording the readings.

### Outlier and Special Circumstances Discussion

A review of the field-measured water-quality parameters collected between April 20, 2011 and May 2, 2011 was completed. Through this review, the turbidity measurements recorded on April 25, 2011 and April 29, 2011, appear to be outliers. These outliers may be attributed to equipment failure, equipment mis-reading by sampling personnel, or transcription errors.

### 5.1.7.7 PADEP Split Sampling

On April 20, 2011, the PADEP and GES collected a split sample from the [REDACTED] well (**Map Label #37**). The split sample was collected from an outside spigot after a sufficient volume of water was purged and water-quality readings were collected. The sample was collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory.

On April 27, 2011, the USEPA and PADEP were onsite to split-sample with GES. The USEPA, PADEP, and GES collected a water sample from the [REDACTED] well (**Map Label #37**) via incremental split sampling techniques. Incremental split sampling was completed by each party filling their bottleware approximately one-quarter full, with the exception of the 40-mL VOA bottleware, which were filled completely by each party. The samples were collected after a sufficient volume of water was purged and water-quality readings were collected. The samples were collected in clean, laboratory-provided bottleware, placed in an ice-filled cooler, and shipped under proper chain-of-custody documentation to the TestAmerica Nashville, TN laboratory. It should be noted that all samples were accompanied by a trip blank. All laboratory analytical data are summarized in **Table 23**.

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The USEPA and PADEP have not provided Chesapeake with their analytical results from this split sampling event.

### 5.1.7.8 Discussion

Analytical characterization data was available for a baseline sample collected on July 14, 2010 and nine sample collected during the period from April 20 to May 2, 2011.

None of the VOC and SVOC compounds (except carbon disulfide) or light gasses (ethane, methane, or propane) were found in any of the nine samples collected in the first two weeks following the fluids release from the ATGAS well pad. The SVOC compound carbon disulfide, a common laboratory contaminant, was found at a level of 0.6 parts per billion (ppb) in the April 26, 2011 sample. This compound was not detected in any other sample result from this well.

Field measurements with the FID for methane were variable between non-detected to 42.79 ppm in the cold headspace measurement on April 25, 2011. There were no detected LEL readings. There were two outliers in the field turbidity measurements (April 25 and 29, 2011); laboratory measured turbidity was not elevated on either day. There appeared to be instrument or recording error in the field data for turbidity on those days. The field measurement for specific conductance on May 1, 2011 (917  $\mu\text{mhos/cm}$ ) also appears to be an outlier; the laboratory-measured specific conductance was 495  $\mu\text{mhos/cm}$ .

The analytical data for general chemistry parameters and total metals are generally consistent between the nine samples and the baseline sample. The key analytical parameter results have been summarized graphically in **Figure 33**. The data are generally linear and are very similar to baseline values. The dissolved methane, total barium, total manganese, and total iron are plotted for all nearby water wells (except **Map Label #39**, [REDACTED] and are presented graphically on **Figures 25, 26, 27, and 28**. The concentrations of chloride, methane, specific conductance, sulfate, TDS, arsenic, barium, iron, manganese, and sodium are very similar to baseline values.

Based on the data available through May 2, 2011, it does not appear that the [REDACTED] well (**Map Label #37**) was affected by fluids released from the ATGAS well pad.

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### **5.1.8 Summary of Near-by Water Well Water Quality**

The data for six (**Map Label #s 33 through 38**) of the seven near-by water wells were examined collectively in order to discern any trends in the data which reveal potential impacts to nearby groundwater as a result of the release from the ATGAS well pad. The [REDACTED] well (**Map Label #39**) was not included in this data review due to the special nature of the issues with this well, and a detailed separate report was prepared for this well, which is found in **Appendix H**.

Results for several key analytical parameters (chloride, TDS, specific conductance, and sodium) for the six wells were examined graphically and are provided in **Figures 24, 29, 30, 31, 32, and 33**. The sodium, chloride, specific conductance, and TDS values for wells at **Map Labels #33, #34, #35, #36, and #37** are very similar to baseline values and very consistent with time. These same parameters for the well at **Map Label #38** show more variability, and have possible outlier issues for TDS and specific conductance on 4/30/2011 and 5/2/2011, but otherwise are similar to baseline values. **Figure 25** presents the data for dissolved methane for the six wells. There is no trend evident in the methane data for any well. As previously discussed, the elevated methane result for **Map Label #34** on April 29, 2011 and low methane result for **Map Label #38** on 4/29/2011 are data outliers and not reflective of the water quality in these wells.

The data for total iron from the six wells was summarized graphically on **Figure 28** and for barium on **Figure 26**. With the exception of the data outlier for **Map Label #35** on April 28, 2011 the iron data appears to be generally linear with no significant increasing or decreasing trend. The barium follows a similar pattern for all of the wells except **Map Label # 38**. For **Map Label #38**, barium shows some variability, but no dominant trend. The manganese data for the six wells are summarized graphically on **Figure 27**. With the exception of the manganese outlier for **Map Label #35** on the April 28, 2011, the manganese data are stable and generally linear and similar to baseline values.

Based upon this review as of data through May 2, 2011, none of the seven nearby water wells have been impacted by the ATGAS release.

### **5.2 REGIONAL WATER WELLS**

GES initiated field monitoring of the water quality in domestic water wells located with 4,000 feet of the ATGAS well pad on April 21, 2011. Their activities and findings are described in

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Section 5.2.1. SAIC conducted field measurements and collected samples for analytical characterization on April 27, 2011 and their findings are described in Section 5.2.2. All regional water wells located within 4,000 feet of the ATGAS well pad are shown on **Figure 23**.

### 5.2.1 Field Parameters

On April 21, 2011, GES monitored the water quality of groundwater associated with the following regional domestic water wells:

- Henry Chamerlain (**Map Label #80**),
- Robert and Jaye Chilson (**Map Label #92**),
- Dennis Boyd (**Map Label #79**),
- James Jennings (**Map Label #98**),
- Doug Chaapel (**Map Label #81**),
- Joe McCabe (**Map Label #102**),
- Beverly [REDACTED] (**Map Label #95**),
- Richard Nicholls (**Map Label #93**),
- Thomas Carl (**Map Label #91**), and
- Tim Williams (**Map Label #106**).

On April 22, 2011, GES monitored the water quality of groundwater associated with the following regional domestic water wells:

- Richard Nicholls (**Map Label #93**),
- Jack Moore (**Map Label #101**),
- Dale Petty (**Map Label #89**),
- [REDACTED] [REDACTED] (**Map Label #96**),
- Ron Bly (**Map Label #97**),
- Roussos Stamatios (**Map Label #104**),
- Rose Marie Sentyz (**Map Label #100**),
- Jeremy Route (**Map Label #94**), and
- Thomas Ryerson (**Map Label #99**).

On April 22, 2011, GES also monitored water quality of groundwater associated with the a regional livestock water well located at the parcel owned by Roussos Stamatios (**Map Label #105**), as well as the surface water associated with a pond located on a property owned by Jeremy Route (**Map Label #82**).

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On April 23, 2011, GES monitored the water quality of groundwater associated with the following regional domestic water well:

- Joe McCabe (**Map Label #102**).

Water-quality monitoring was conducted with a decontaminated 13-quart bucket, a YSI water-quality meter and a turbidity meter. Prior to monitoring, water-quality meters were calibrated to manufacturer's specifications. In general, field-measured water-quality parameters included:

- Temperature,
- pH,
- Salinity,
- Turbidity,
- TDS,
- Specific conductance, and
- DO.

The bucket was used to collect a sufficient volume of water to submerge the YSI probe in the water sample. The equipment used to conduct the water-quality monitoring activities were decontaminated with a liquinox/distilled water mixture and rinsed with distilled water before and after each use.

All water-quality field measurements are summarized in **Table 24**.

### Outliers and Special Circumstances Discussion

GES has determined that most of the specific conductance field measurements made on April 21, 2011 in the regional water wells were conducted with equipment which was either calibrated incorrectly or not calibrated. Review of the data indicates that the measurements recorded are inconsistent and are not reflective of the water quality for April 21, 2011.

### 5.2.2 Analytical Characterization

A total of 20 groundwater samples were collected on April 27, 2011 by SAIC. Sampling locations are summarized on **Table 25**. Parcels sampled were generally located within a 4,000-foot radius of the ATGAS well pad. Samples were collected following SAIC's SOPs for water sampling. Methane screening was conducted in accordance with SAIC's SOP for methane gas screening.

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### 5.2.2.1 Field Quality Control and Quality Assurance

Sampling information was documented in the sampling log book. The information gathered was submitted to SAIC's QA/QC field officer upon completion of the sampling activities. The information was reviewed for completeness, accuracy and adherence to SOPs. Following SAIC's QA/QC review the information was submitted for entry into the database system.

### 5.2.2.2 Calibration of Water-quality and Methane Screening Meters

Calibration of the water-quality meters and the methane screening instruments was conducted prior to the first sample location of the day and in accordance with the manufacturer's instructions for each instrument. Outside ambient air was used for zero calibration of the methane screening meters. Methane concentrations of 100 ppm and 10,000 ppm were used as the span gases for calibration of the flame ionization detector. The LEL meter was calibrated to a methane concentration of 50%LEL (2.5% by volume). The calibration of water-quality meters utilized a three-point calibration for pH (4, 7, and 10 SU) and turbidity (0, 1, and 10 NTU), and a single point calibration for specific conductance (1,413  $\mu\text{mhos/cm}$ ). The calibration of all instruments was verified through a bump test subsequent to calibration and prior to use at each additional property. The instruments were calibrated such that the calibration and/or verification standards bracket the readings observed in samples. Methane screening instruments were calibrated using a concentration of methane gas greater than the screening values collected during sampling activities.

Calibration results for each instrument were documented in the sampling log book and were reviewed by the SAIC QA/QC field officer prior to shipment of the sample. All calibrations performed during the sampling activities meet the SOP requirements.

### 5.2.2.3 Groundwater Sampling Methods

Following property owner's approval, an attempt was made at each groundwater sampling location to purge a volume of water equal to or greater than twice the volume of the water system pressure tank capacity. In the event that a property owner requested a reduced purge volume the request was documented in the sampling log book and a minimum of five gallons of groundwater was purged to activate and cycle the water-well pump. The purge rate was calculated utilizing a stopwatch and a graduated container. Purge volumes at each groundwater sampling location are included in **Table 25**.

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All purge volumes were reviewed by the SAIC QA/QC field officer following sample collection. In accordance with SOPs a volume of water greater than five gallons was purged at each groundwater sampling location prior to sample collection.

Immediately prior to or following completion of the water source purge, water-quality field measurements were collected for pH, turbidity, specific conductance and temperature. Water-quality measurements were collected at a location prior to any existing water treatment, if such a location was available. Water-quality measurements recorded at each sampling location are included in **Table 24**. Water-quality and methane screening measurements were recorded in the sampling log book and were reviewed by the SAIC QA/QC field officer prior to shipment of the sample.

Following completion of the purge and collection of the water-quality measurements, samples were collected in laboratory-supplied containers from an untreated sampling location, when available. Sample collection locations and treatment information for each sample are indicated in **Table 25**. Following collection of the samples, the laboratory-supplied containers were labeled, photographed, and placed on ice. A COC was prepared and photographed. The completed COC was reviewed by the SAIC QA/QC field officer prior to shipment. Samples were shipped under custody seal by overnight courier to TestAmerica Laboratories, Inc. located in Nashville, Tennessee. A laboratory trip blank was submitted with each sample for analysis of Target Compound List (TCL) volatile organic compounds (VOCs) by EPA Method 80260B (low-level).

Analytical results of these groundwater samples are included as **Table 26**.

### 5.2.2.4 Methane Screening

Methane screening was conducted at each water source sampling location. All screening results were reviewed by the SAIC QA/QC field officer following sample collection. The results of the methane screening are included in **Table 24**. All screening values were bracketed by the methane standard concentration used in calibration of the screening instruments.

### 5.2.2.5 Analytical Results Discussion

The results each individual well sampled by SAIC on April 27, 2011 were compared to the individual baseline sampling result for the well, if available.

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The baseline water-quality data for selected parameters from the domestic water source wells located within 4,000 feet of the ATGAS well pad, including the seven wells near-by wells, were compiled. Descriptive statistical analysis, e.g. minimum concentration, maximum concentration, mean, standard deviation, and mean plus one standard deviation were performed and are summarized in **Table 27**. These values were also utilized in evaluation of the analytical results for the April 27, 2011 samples. The general trends in the data are discussed in this section and specific discussion for each individual well is presented in the succeeding sections.

Laboratory-determined methane concentration data for the regional wells from the baseline sample and the April 27, 2011 sampling events have been summarized graphically in **Figure 34**. There was no baseline data for **Map Labels #s 86, 87 and 88**; there were no samples collected for **Map Labels #102 and 103** on April 27, 2011. The majority of the methane concentrations were below the laboratory detection limit of 0.026 mg/L. With the exception of the well at **Map Label #92**, the baseline sample methane concentration was higher or the same as the concentration for the same well in the April 27, 2011 samples. The data for **Map Label #92** appear to be anomalous due to difference in sample collection point between baseline and the April 27, 2011 location (See Section 5.2.2.7 below).

Chloride concentrations for the baseline samples and the April 27, 2011 samples for all of the regional water wells are summarized graphically in **Figure 35**. No baseline data were available for **Map Labels #s 86, 87 and 88**; no samples were collected from **Map Labels #s 102 and 103** on April 27, 2011. The chloride concentration for **Map Label #86** was non-detected at 1 mg/L and may be a possible outlier due to analytical error. In general, the baseline chloride concentration is comparable between the baseline sample and the corresponding sample from April 27, 2011 except at **Map Labels #s 92, 100, and 105** (see Sections 5.2.2.7, 5.2.2.15, and 5.2.2.16). The chloride concentrations in all the samples, except for **Map Label #101** (Section 5.2.2.11), were well below the USEPA Secondary Maximum Contaminant Level (SMCL) of 250 mg/L.

**Figure 36** summarizes the TDS for the regional water wells graphically. No baseline data is available for **Map Label #s 86, 87 and 88**; no samples were collected at **Map Label #s 102 and 103** on April 27, 2011. With the exception of **Map Label #101**, the TDS concentrations are generally consistent with baseline or within the range of analytical variability for the TDS and are all below the USEPA SMCL of 500 mg/L,

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except **Map Label #101**, which was lower than baseline. The TDS baseline concentration in the well at **Map Label #101** was above the SMCL.

Sodium concentrations for the baseline and April 27, 2011 samples are summarized graphically on **Figure 37**. No baseline data was available for **Map Labels #s 86, 87, and 88**; no samples were collected from **Map Label #102** and **#103**. The baseline sodium concentration for **Map Labels #92** and **#93** were non-detected at 1 mg/L and may be a possible data outlier due to laboratory error. In general, the sodium concentrations are comparable between the baseline and April 27, 2011 when analytical and sampling variability is taken into consideration.

Total manganese concentrations for the baseline and the April 27, 2011 samples are summarized graphically on **Figure 38**. No baseline data was available for **Map Labels #s 86, 87, and 88**; no samples were collected from **Map Labels #102** and **#103**. The baseline manganese concentrations for most of the wells are similar to the April 27, 2011 values. Wells at **Map Labels #s 80, 89, and 92** show higher manganese values over baseline. Manganese is very sensitive to the TSS content of the well water, and high TSS levels are often associated with elevated or variable total manganese values. The variability in manganese seen in the regional water wells is not caused by the ATGAS release, but rather is due to natural variability and slight difference in sampling methodologies which cause the TSS levels in a well to change.

The total iron concentration for the baseline and the April 27, 2011 samples are summarized graphically on **Figure 39**. No baseline data was available for **Map Labels #s 86, 87, and 88**; no samples were collected from **Map Labels #102** and **#103**. As noted previously, iron and manganese occur naturally frequently at elevated levels in groundwater in NE Pennsylvania. As with the manganese, the levels of total iron are very dependent on the amount of suspended solids present in a water sample. Typically the higher the sediment content the higher the total iron content. Therefore, iron can be highly variable in groundwater samples. The variability in total iron seen in the regional water wells is not caused by the ATGAS release, but rather is due to natural variability and slight difference in sampling methodologies which cause the TSS levels in a well to change slightly between sampling events.

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The total barium concentration for the baseline and the April 27, 2011 samples are summarized graphically on **Figure 40**. No baseline data was available for **Map Label #s 86, 87, and 88**; no samples were collected from **Map Labels #102 and #103**. Generally, the total barium values from the April 27, 2011 sampling event are similar to baseline values with a few wells showing some minor variability in the sample results. The variability in total barium seen in the regional water wells is not caused by the ATGAS release, but rather is due to natural variability and slight difference in sampling methodologies which cause the TSS levels in a well to change slightly between sampling events.

The specific conductance of the regional water wells for the baseline data and data collected during screening on April 21, 22, and 23, 2011 and the April 27, 2011 analytical data are compared and contrasted on the graph present on **Figure 41**. Referring to **Figure 41**, no baseline data was available for **Map Label #s 86, 87, and 88**; no samples were collected from **Map Labels #102 and #103** for analytical testing. However, screening data is available for the well at **Map Label #102**. Review of **Figure 41** shows little difference between background and the April 2011 screening or laboratory measurement of specific conductance. Outliers in the data likely caused by instrument calibration problems, transcription error, or instrument mis-reading by field personnel are suggest for the April 22, 2011 field reading in wells at **Map Labels #95, #96, and #97**, with the laboratory readings on April 27, 2011 being lower and very similar to baseline values in these three wells.

The specific conductance data indicates that none of the regional wells have been affected by the ATGAS incident.

### 5.2.2.6 Chamberlain (**Map Label # 80**)

The key organic compounds, light gases, VOCS or SVOCs were not detected in the April 27, 2011 sample. The general water-quality data for the Chamberlain well are generally consistent between the baseline sample collected on July 15, 2010 and the sample collected on April 27, 2011. Field-measured specific conductance, turbidity, pH and TDS data from April 27, 2011 agree with the analytical data for same parameters. The field-measurement of specific conductance on April 21, 2011 and April 27, 2011 are essentially the same. The concentrations of barium, calcium, iron, magnesium, and manganese are elevated in comparison with the baseline sample results; the sodium concentration is lower in comparison to the baseline sample. The barium, iron and manganese concentrations in the April 27, 2011 sample are

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consistent with regional baseline data. Based on the available data there is no significant difference in the key general chemistry parameters, chloride, specific conductance, and TDS, and it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.7 Chilson (Map Label #92)

None of the key organic compounds or VOCS and SVOCs were detected in the April 27, 2011 sample. The TDS, chloride, and total metals were elevated above the July 13, 2010 baseline sample results; however, the turbidity and total suspended solids were higher in the sample as well. Field measurements of specific conductance were similar on April 21, 2011 and April 27, 2011. The field measurements taken on April 27, 2011 were consistent with the analytical results for the sample collected on April 27, 2011. The concentrations of calcium and magnesium were non-detected in the baseline sample and the sodium concentration was 110 mg/L, these results would indicate that the baseline sample was collected at a location after the home water softener. The April 27, 2011 sample was collected before the well water entered the water softener; therefore, the results are not directly comparable. Field measurements with the FID on April 27, 2011 found methane levels 2.33 ppm and 2.68 ppm at the cold and hot tap, respectively; cold and hot headspace were monitored with concentrations of 19.16 ppm and 27.94 ppm, respectively. Methane was detected in the April 27, 2011 sample at 0.124 mg/L. The chloride and TDS in the April 27, 2011 sample are within the range expected based on the regional baseline groundwater quality. It does not appear that this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.8 Boyd (Map Label #79)

None of the key organic compounds, light gases, VOCS or SVOCs were detected in the April 27, 2011 sample. The general water-quality data for the Chamberlain well are generally consistent between the baseline sample collected on July 13, 2010 and the sample collected on April 27, 2011. Field measurements of specific conductance on April 21, 2011 and April 27, 2011 were similar. Methane, as determined by FID, was detected in the hot headspace on April 27, 2011; no other measurement locations had detections for methane. Based on the available data, there was no difference in the key general chemistry parameters, chloride, specific conductance, and TDS; therefore, it does not appear this well was affected by fluids released from the ATGAS well pad.

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### 5.2.2.9 Jennings (Map Label #98)

None of the key organic compounds or VOCS and SVOCs were detected in the April 27, 2011 sample. The water-quality data are generally consistent between the baseline sample collected on July 14, 2010 and the sample collected on April 27, 2011. The field measurement of specific conductance (335  $\mu\text{mhos/cm}$ ) on April 21, 2011 was similar to the laboratory specific conductance in the baseline sample (337  $\mu\text{mhos/cm}$ ) and the April 27 laboratory sample (347  $\mu\text{mhos/cm}$ ); the field specific conductance measurement was lower (228  $\mu\text{mhos/cm}$ ). Methane, as measured with the FID on April 27, 2011 was less than 2 ppm at all measurement locations. Based on the available data, there was no difference in the key general water-quality parameters, chloride, specific conductance, and TDS; therefore, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.10 Williams, Tom (Map Label #86)

None of the key organic compounds, light gases, VOCS or SVOCs were detected in the April 27, 2011 sample. No baseline sample was available for this sample location. The water-quality data for the April 27, 2011 sample are consistent with regional baseline data. Field measurements of methane with the FID found concentrations less than 2 ppm at all monitored locations on April 27, 2011. The field measurement of specific conductance on April 27, 2011 agrees with the laboratory-determined value. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.11 Moore (Map Label #101)

The key organic compounds, VOCs and SVOCs were not detected in the April 27, 2011 sample of groundwater from the Moore well (**Map Label #101**) which is located on the north side of Towanda Creek. A methane concentration of 13.3 mg/L was found; this is consistent with a methane concentration of 17.4 mg/L in the July 14, 2010 baseline sample for the same location. Ethane and propane were not detected in either sample. Field measurement of methane with the FID on April 27, 2011, detected concentrations of 97.65 ppm at the cold tap and 242 ppm at the hot tap. The water-quality data for the April 27, 2011 sample and the July 14, 2010 baseline sample are generally consistent. The chloride and TDS concentrations were lower in the April 27, 2011 sample than in the baseline sample. Field measurements of specific conductance taken on April 22, 2011 and 27, 2011 are similar to those from the baseline sample and the April 27, 2011 sample. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

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### 5.2.2.12 Petty (Map Label #89)

None of the key organic compounds, light gases, VOCs or SVOCs were detected in the April 27, 2011 sample. No methane was detected in field measurements taken on April 22, 2011. The water-quality data for the April 27, 2011 sample are generally consistent with the sample results of the baseline water sample collected on April 29, 2010. Results for calcium, magnesium and potassium were higher in the April 27, 2011 sample than the baseline sample; the sodium results were lower than in the baseline sample. Water from this well is treated by a water softener. The field measured specific conductance was higher on April 22, 2011 than on April 27, 2011; the field measured TDS on April 22, 2011 was similar to the baseline sample TDS. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.13 [REDACTED] (Map Label #96)

The key organic compounds, light gases, VOCs and SVOCs were not detected in the sample taken from the [REDACTED] water well (60 feet bgs). Field measurements for methane on April 27, 2011 found non-detected to 0.8 ppm at the wellhead. The water-quality data for the April 27, 2011 sample are consistent with the sample results of the baseline sample collected on July 15, 2010. The field measured specific conductance on April 22, 2011 was 759  $\mu$ mhos/cm and the TDS was 494 mg/L; on April 27, 2011 the specific conductance was 354  $\mu$ mhos/cm. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.14 Bly (Map Label #97)

Key organic compounds were not detected in waters sample from the Bly (Leroy Independent Baptist Church) well (**Map Label #97**) collected on April 27, 2011. Similarly, light gases, VOCs, and SVOCs were not detected in the sample. Field measurements of methane with the FID on April 17, 2011 found concentrations of 2.63 and 5.45 ppm in the cold and hot water headspace samples, respectively. The water-quality data are generally consistent between the April 27, 2011 sample and the baseline sample collected on July 14, 2010. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.15 Stamatios (Map Labels #104 and #105)

There are two groundwater wells, a domestic well (**Map Label #104**) and a well (100 feet bgs) used for livestock watering (**Map Label #105**), located north of Towanda

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Creek. None of the key organic compounds, VOCs, or SVOCs were found in the sample collected on April 27, 2011 at the domestic well (**Map Label #104**). The water-quality data for the domestic well (**Map Label #104**) was consistent with the water quality in the baseline sample. Field measurements of specific conductance are within the same range as the laboratory specific conductance for both the baseline and April 27, 2011 samples. Less than 2 ppm of methane was detected at any of the sampling locations on April 27, 2011. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

The key organic compounds, light gases, SVOCs and the majority of the VOCs were not detected in the April 27, 2011 sample of the shallow livestock watering well (**Map Label #105**). A detection of carbon disulfide (0.6 µg/L) was found in this well in the April 27, 2011 sample; the detection limit was 0.5 µg/L. Methane was also detected in the well in the April 27, 2011 sample (3.4 mg/L) and the baseline sample collected on November 18, 2010 (5.8 mg/L). Methane was detected in field measurements on April 27, 2011, ranging from 3.24 ppm at the wellhead to 5,728 ppm in the hot water headspace measurement. The chloride, specific conductance, TDS, iron, and sodium concentrations were slightly higher in the April 27, 2011 sample than were noted in the baseline sample. Field measurements of specific conductance on April 22, 2011 and April 27, 2011 were 523 and 570 µmhos/cm, respectively. The barium, calcium, magnesium, manganese, and potassium concentrations were consistent between the April 27, 2011 and baseline samples. The sodium/chloride (Na/Cl) ratio for the April 27, 2011 sample was 1.35 as compared to the Na/Cl ratio for fluids captured in the catchment basins adjacent to the ATGAS well pad which ranged from 0.36 to 0.44.

### 5.2.2.16 Sentyz (Map Label #100)

None of the key organic compounds, VOCs or SVOCs were detected in the April 27, 2011 sample from the Sentyz groundwater well (**Map Label #100**). Methane was detected in both the April 27, 2011 (0.0284 mg/L) and the baseline water quality sample collected on July 14, 2010 (0.0832 mg/L). Methane was detected in the field screening conducted on April 27, 2011. Ethane and propane were not detected in the April 27, 2011 nor baseline sample. The data for the April 27, 2011 and baseline sample are generally consistent with the exception of Total Suspended Solids (160 mg/L – N1 qualified), chloride (19.8 mg/L – M8 – qualified), turbidity (6.3 NTU) and iron (0.674 mg/L) results which are slightly higher in the April 27, 2011 sample. Field measurements for turbidity were 8.9 NTU and 8.27 NTU at 8:50 am and 9:10 am on

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April 27, 2011; the field measured specific conductance was 461  $\mu\text{mhos/cm}$  (@ 8:50 am) and 410  $\mu\text{mhos/cm}$  (@ 9:10 am). Field measured TDS were 298 mg/L at 8:10 am. The Na/Cl ratio for this sample is 3.46 as compared to the Na/Cl ratio for fluids captured in the catchment basins adjacent to the ATGAS well pad which ranged from 0.36 to 0.44. The concentration of chloride, sodium, barium, specific conductance, and TDS are within the same range as baseline. Based on the available data, it does not appear that the well was affected by the fluids released from the ATGAS well pad.

### 5.2.2.17 [REDACTED] Beverly (Map Label #95)

The key organic compounds, light gases, VOCs, and SVOCs were not detected in groundwater sample from the [REDACTED] well (**Map Label #95**) in the sample collected on April 27, 2011. The field measurement of specific conductance conducted on April 27, 2011 was similar to the laboratory measured specific conductance. Methane was detected at all monitoring locations in field screening on April 27, 2011; the maximum concentration was 11.52 ppm in the hot headspace sample. The field measurement of specific conductance on April 21, 2011 was an outlier due to instrument calibration issues. The water-quality data are consistent with the baseline data for this well from a sample collected on July 13, 2010. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.18 Nicholls (Map Label #93)

None of the key organic compounds, light gases, VOCs, and SVOCs were detected in groundwater sample from the Nicholls well (**Map Label #93**) on April 27, 2011. This well is upgradient from the ATGAS well pad. Specific conductance was monitored in the field on April 21, 2011, April 22, 2011 and April 27, 2011; the measured concentrations on April 22, 2011 and April 27, 2011 were similar. The field specific conductance value recorded for April 21, 2011 was an outlier due to instrument calibration issues. Methane concentrations were less than 3 ppm at all locations on April 27, 2011. The water-quality data are generally consistent with the baseline data for this well. The baseline sample was collected on July 13, 2010. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

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### 5.2.2.19 Route (Map Label #94)

None of the key organic compounds, light gases, VOCs, and SVOCs were detected in groundwater sample from the Route well (**Map Label #94**) on April 27, 2011. Field monitored specific conductance on April 27, 2011 was similar to the laboratory measured specific conductance; the field monitored specific conductance was higher on April 22, 2011. Methane at generally less than 1 ppm was field measured on April 27, 2011. The water-quality data are generally consistent with the baseline data for this well. The baseline sample was collected on July 13, 2010. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.20 Pepper (Map Label #88)

The key organic compounds, light gases, VOCs and SVOCs were not detected in the groundwater sample from the Pepper well (**Map Label #88**) on April 27, 2011. No individual baseline data is available for this well. Field measurements of specific conductance and TDS on April 27, 2011 were the same as the laboratory measured concentration. Methane was less than 1.19 ppm at all monitored locations. Comparison of the concentrations of chloride, specific conductance, sulfate, TDS, arsenic, barium, iron, manganese and sodium are consistent with the regional baseline data as summarized in **Table 27** and nearest monitored well (**Map Label #80**). Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.21 Carl (Map Label #91)

Key organic compounds were not detected in a sample from the Carl well (**Map Label #91**) collected on April 27, 2011. Light gases, VOCs, and SVOCs were also not detected. Field monitored methane was less than 0.20 ppm at all locations. The field measured specific conductance on April 27, 2011 was similar to the laboratory measured specific conductance in the baseline sample and April 27, 2011. A baseline sample had been collected for this well on July 13, 2010. The data for general chemistry parameters and total metals are generally consistent between the two sample results. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.22 Ross (Map Label #87)

Key organic compounds were not detected in a sample from the Ross well (**Map Label #87**) collected on April 27, 2011. Light gases, VOCs, and SVOCs were also

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not detected. No individual baseline data is available for this well. Methane was not detected in any of the field monitoring locations. The field measured specific conductance was similar to the laboratory result. Comparison of the concentrations of chloride, specific conductance, sulfate, TDS, arsenic, barium, iron, manganese and sodium are consistent with the regional baseline data as summarized in **Table 27**. The analytical results for the April 27, 2011 sample are similar to those in the nearest domestic well (**Map Label #97**). Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.2.23 Ryerson (**Map Label #99**)

The Ryerson well (**Map Label #99**) is an approximately 300 foot bgs well which was sampled on April 27, 2011. This well is located upgradient from the ATGAS well pad. A baseline sample was collected from this location on July 14, 2010. No key organic compounds, light gases, VOCs, and SVOCs were detected in the April 27, 2011 sample. Methane was not detected in the field monitoring conducted on April 27, 2011. The data are generally consistent between the baseline sample and the April 27, 2011 sample; however, some differences were noted in the concentrations of magnesium, iron, calcium, barium, turbidity, total suspended solids, TDS, chloride, and specific conductance. The April 27, 2011 sample results for the listed parameters were generally higher than in the baseline sample but within the regional baseline data results as summarized in **Table 27**. Field data available for April 22, 2011 and April 27, 2011 has results for specific conductance, turbidity, and TDS which are similar to the April 27, 2011 analytical results.

### 5.2.2.24 Williams, Tim (Map Label # 106)

The Williams well (**Map Label #106**) is equipped with a reverse osmosis and water softener treatment system and is located north of Towanda Creek. The April 27, 2011 sample was taken at the tap before the treatment system. The key organic compounds, VOCs (except carbon disulfide), and SVOCs were not detected in the sample collected from the Williams well (**Map Label #106**) on April 27, 2011. Carbon disulfide was detected at a concentration of 1.07 µg/L (the detection is 0.5 µg/L). Carbon disulfide is a common laboratory contaminant. Methane was detected in the April 27, 2011 sample (1.02 mg/L) as well as in the November 23, 2010 baseline sample (1.66 mg/L). No ethane or propane was detected in either sample. Methane was detected during field screening at the cold and hot water taps on April 27, 2011. The concentrations of chloride, specific conductance, and TDS are higher in the April 27, 2011 sample than in the baseline sample as are total suspended solids and

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turbidity. The field-measured specific conductance on April 21, 2011 was an outlier due to instrument calibration issues. The field and laboratory specific conductance values for the April 27, 2011 sample are consistent. The calcium, magnesium, and sodium concentrations are consistent between the baseline and April 27, 2011 samples. Based on the available data, it does not appear this well was affected by fluids released from the ATGAS well pad.

### 5.2.3 Standards Comparison

A comparison to key USEPA water-quality standards that apply to public drinking water system was made for the groundwater quality data from all domestic water wells and springs sampled during the ATGAS investigation. The comparison was made for all USEPA MCLs and key SMCLs that are associated with the components of the ATGAS fluids. This analyses shows that one well (**Map Label #36**) exceeds the arsenic MCL, but the arsenic was above the MCL in the July 14, 2010 baseline sample. Arsenic is naturally occurring in this well. Barium exceeded an MCL in two wells (**Map Labels # 39 and 101**). Barium was over the baseline MCL in the well at **Map Label #101** on July 14, 2010 and is naturally occurring in this well. Barium also exceeded the MCL in the well at **Map Label #39**, and the reason for this natural exceedence is discussed in the special investigation report in **Appendix H**. No other MLCs were exceeded for any other parameters, including organic compounds.

The comparison to key USEPA SMCLs related to parameters that are specific to the ATGAS release fluids (chloride, foaming agents, and TDS) show chloride exceeded the SMCL in wells at **Map Labels #39 and 101**. The chloride and TDS in the well at **Map Label #101** were above the SMCL in the baseline sample and are naturally occurring. The chloride and TDS in the well at **Map Label #39** exceeded the SMCL, and the reason for the natural exceedence is discussed in the special investigation report in **Appendix H**. The MBAS SMCL was exceeded in the baseline sample from the well at **Map Label #39**.

A summary of this comparison to MCLs and key SMCLs (MBAS, chloride, and TDS) is provided in **Table 28**. In summary, no MCL or SMCL exceedence is attributable to the ATGAS incident, and all exceedences are naturally occurring.

## 5.3 SPRINGS

### 5.3.1 Analytical Characterization

A total of 2 spring samples were collected from a total of 2 parcels (**Figure 23**) on April 27, 2011. Sampling locations are summarized on **Table 25**. The analytical data

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from the springs is summarized in **Table 29**. Parcels sampled were located within 4,000-foot radius of the ATGAS release site. Samples were collected following SAIC's SOP for water sampling. Methane screening was conducted in accordance with SAIC's SOP for Methane Gas Screening.

### 5.3.1.1 Field Quality Control and Quality Assurance

Sampling information was documented in the sampling log book. The information gathered was submitted to SAIC's QA/QC field officer upon completion of the sampling activities. The information was reviewed for completeness, accuracy and adherence to SOPs. Following SAIC's QA/QC review the information was submitted for entry into the database system.

### 5.3.1.2 Calibration of Water-Quality and Methane Screening Meters

Calibration of the water-quality meters and the methane screening instruments was conducted prior to the first sample location of the day and in accordance with the manufacturer's instructions for each instrument. Outside ambient air was used for zero calibration of the methane screening meters. Methane concentrations of 100 ppm and 10,000 ppm were used as the span gases for calibration of the FID. The LEL meter calibrated to a methane concentration of 50%LEL (2.5% by volume). The calibration of water-quality meters utilized a three-point calibration for pH (4, 7, and 10 SU) and turbidity (0, 1, and 10 NTU), and a single point calibration for specific conductance (1,413  $\mu\text{mhos/cm}$ ). The calibration of all instruments was verified through a bump test subsequent to calibration and prior to use at each additional property. The instruments were calibrated such that the calibration and/or verification standards bracket the readings observed in samples. Methane screening instruments were calibrated using a concentration of methane gas greater than the screening values collected during sampling activities.

Calibration results for each instrument were documented in the sampling log book and were reviewed by the SAIC's QA/QC field officer prior to shipment of the sample. All calibrations performed during the sampling activities meet SOP requirements.

### 5.3.1.3 Spring Collection Methods

A total of 2 samples were collected from spring source locations on April 27, 2011 (**Table 25**). Water-quality field measurements were collected for pH, turbidity, specific conductance and temperature directly at the sampling location prior to sample collection (**Table 24**). A spring located on Mr. Brent May's property (**Map Label #83**)

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which services his residence, was collected from the kitchen tap following completion of the purge and collection of water-quality parameters. The spring located on Mr. Dale Petty's property (**Map Label #107**) was sampled directly from the metal containment vessel located at the spring outlet by submerging the non-preserved containers directly in the metal containment vessel and utilizing a non-preserved laboratory-supplied container to fill the preserved containers. The laboratory-supplied containers were labeled, photographed, and placed on ice. A COC was prepared and photographed. The completed COC was reviewed by the SAIC Quality Assurance/Quality Control (QA/QC) field officer prior to shipment. Samples were shipped under custody seal by overnight courier to TestAmerica Laboratories, Inc. located in Nashville, Tennessee. A laboratory trip blank was submitted with each sample for analysis of Target Compound List (TCL) volatile organic compounds (VOCs) by EPA Method 80260B (low-level).

### 5.3.1.4 Methane Screening

Methane screening was conducted at each water source sampling location. All screening results were reviewed by the SAIC QA/QC field officer following sample collection. The results of the methane screening are included in **Table 24**. All screening values were bracketed by the methane standard concentration used in calibration of the screening instruments.

## 5.3.2 Discussion

### 5.3.2.1 Petty (Map Label #107)

None of the key organic compounds, light gases, VOCs, and SVOCs were detected in the groundwater sample from the livestock watering spring located at **Map Label #107** on April 27, 2011. A baseline sample had been collected at this location on April 29, 2010. The field and analytical data for the April 27, 2011 sample are similar to baseline values. Methane was not detected during field screening on April 27, 2011. There was some variability between the water quality found in the baseline sample and the water quality as measured in the April 27, 2011. Chloride, specific conductance, barium and iron are slightly higher in the April 27, 2011 sample than in the baseline sample; however, all other parameters are consistent between the two samples. The water quality found in the April 27, 2011 sample is consistent with the regional baseline water quality for the area. Based on the available data, it does not appear this spring was affected by fluids released from the ATGAS well pad.

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### 5.3.2.2 May (Map Label #83)

The key organic compounds, light gases, VOCs, and SVOCs were not detected in the groundwater sample from the spring located at **Map Label #83** on April 27, 2011. A baseline water sample was collected from this spring on May 6, 2010. The analytical results for the baseline water sample and the sample collected on April 27, 2011 are consistent. Methane was not detected during field screening on April 27, 2011. Based on the available data, it does not appear this spring was affected by fluids released from the ATGAS well pad.

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### **6.0 INITIAL CONCLUSIONS**

This report examines the first two weeks of actions and water-quality characterization undertaken after the April 19, 2011 well control incident at the ATGAS well pad. Based on review of the data presented in this report, the following conclusions have been drawn:

#### **6.1 INCIDENT RESPONSE**

- 1) Fluids containing hydraulic stimulation materials mixed with produced formation water were released to the surface environment following the well-control incident at the ATGAS well pad. Approximately 10,000 gallons of this fluid were released from the well; all other fluids from the well were captured by emergency actions. Fluids from the well pad mixed with rainwater and flowed overland and likely impacted soils to the north of the pad and a farm pond; some of the fluids mixed with rainwater flowed into a drainage ditch-swale system and the UNT to Towanda Creek. Only the lower 500 feet of the UNT was affected by this release.
- 2) Chesapeake responded to the incident quickly. The well control team developed a thorough, deliberate plan for dealing with the incident. Response and sampling teams worked 24 hours per day, 7 days per week, during and beyond the first two weeks following the incident. Additional actions were undertaken to reinforce containment area berms and to provide for additional equipment during the days following the incident in anticipation of significant precipitation in the area.
- 3) Chesapeake and contractors collected several hundred samples and conducted thousands of field readings during the first two weeks following the incident. Sampling efforts are continuing as of the date of this report. Partial final environmental data has been provided to the PADEP on a weekly basis as it has become available. To date, no sample results have been received by Chesapeake of the USEPA or PADEP split samples results for several spilt sampling events conducted since April 20, 2011.
- 4) Chesapeake coordinated with the PADEP, OSHA, USEPA, and county emergency response personnel. Chesapeake worked cooperatively with PADEP and USEPA for collection of split environmental samples. Chesapeake has met on a frequent basis, typically weekly with representatives of the PADEP to share the status of various activities regarding the ATGAS well pad and surrounding area.
- 5) Environmental data has undergone intense quality assurance and quality control activities. However, outliers in the data occur due to instrument calibration issues, transcription errors by sampling team members, laboratory error, and mis-reading of field instruments.
- 6) The volume of material released to the environment was limited by containment and collection and pumping of the released fluids.
- 7) Chesapeake has investigated the cause of the well control incident and has implemented responsive measures to ensure vendor compliance with requisite standards and company oversight of equipment testing.

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### 6.2 ENVIRONMENTAL MONITORING

- 1) Chesapeake provided for environmental monitoring of air, surface water, and groundwater which began on April 20, 2011. The discharge from the ATGAS pad has been extensively evaluated.
- 2) The hydraulic stimulation fluids contained several components including hydrogen chloride, ethanol, methanol, propargyl alcohol, various compounds containing sodium, quaternary ammonium compounds, petroleum distillate, and a polymer.
- 3) Based on the components present in the hydraulic stimulation materials, glutaraldehyde, ethanol, methanol, propargyl alcohol, and quaternary ammonium compounds were utilized as key parameters to detect the presence of hydraulic stimulation materials.
- 4) Produced formation water was expected to be present in the fluids released during the incident. Produced formation water is known to contain elevated concentrations of chloride, sodium, barium, strontium, TDS, and specific conductance. These compounds were utilized as key parameters to detect the possible presence of produced formation water.
- 5) Surface water and groundwater samples were analyzed for an extensive list of parameters, including the key organic parameters associated with hydraulic stimulation fluid, general water-quality parameters, metals (total and dissolved), USEPA Appendix IX volatile organic compounds and semi-volatile organic compounds, light gases, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and radiochemistry parameters.
- 6) Radiochemistry data was not available for inclusion in this Report.
- 7) Air monitoring conducted in the area using hand-held and remote units found no levels of concern related to the ATGAS incident.

### 6.3 SURFACE WATER

- 1) Surface water samples were collected in the catchment basins, drainage ditch-swale system, the UNT, and Towanda Creek. There were short-term impacts to the surface waters in a pond near the ATGAS well pad (**Map Label #32**), the drainage ditch-swale system, and the UNT in the first few days following the incident.
- 2) Liquids collected from the catchment basins and in the pond near the ATGAS well pad (**Map Label #32**) were found to contain key organic parameters for the presence of hydraulic stimulation fluid and key inorganic parameters consistent with the presence of produced formation water. These liquids were contained and not released into the other surface water systems. The pond (**Map Label #32**) was drained in coordination with the PADEP.
- 3) Some of the key organic parameters, 2-butoxyethanol and ethanol, were found in the drainage ditch swale (**Map Labels #6 and #10** on April 20, 2011). No propargyl alcohol was detected. There were no other detections of these compounds at any location in the drainage swale in samples collected during the period of April 20 to May 2, 2011. Quaternary ammonium compounds and glutaraldehyde were not detected in any of the samples in the drainage swale system. In the sample collected on April 20, 2011 from **Map Label #6** there was a detection of pyridine (10.7 µg/L). Pyridine has been found to be associated with produced water from the Marcellus (GTI, 2009). There were no other detections of pyridine for any sample locations from the drainage swale from April 20, 2011 to May 2, 2011.
- 4) No key organic compounds, VOCs, or SVOCs were found in any sample collected in the UNT. No key inorganic compounds were found to be elevated in the UNT until after the confluence with the drainage swale. Chloride, TDS and specific conductance was found to be elevated in samples collected on April 20, 2011 below this confluence. Concentrations of these parameters returned to background levels in the samples collected on April 26, 2011.

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5) No key organic compounds, VOCs, or SVOCs were found in any sample from Towanda Creek. Waters in Towanda Creek appear to be impacted in the area immediately adjacent to the confluence with the UNT (**Map Label #15**) as evidenced by higher than background concentrations of chloride, specific conductance, and total dissolve solids. Concentrations of these parameters returned to background conditions within 2,200 feet downstream from the UNT on April 20, 2011.

6) Initial ecological characterization in the drainage ditch-swale system, the UNT and Towanda Creek conducted on April 20, 2011, April 22, 2011 and April 26, 2011 observed no adverse impacts to the biological communities.

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**6.4 GROUNDWATER**

1) No key organic specialty compounds, VOCs or SVOCs were found in the seven nearby groundwater wells or in the regional groundwater wells sampled. All of the groundwater wells sampled from April 20, 2011 to May 2, 2011 appear to be unaffected by the fluids released during the ATGAS well-control incident. Apparent changes in water quality appear to be related to natural variability, local precipitation events, differences in sampling methods between sampling events, and the amount of TSS present in a water sample.

2) The [REDACTED] water well (**Map Label #39**) was the only nearby well for which water quality was significantly different from the baseline sample. Further investigation of this well was conducted and has been reported in a separate special investigation report previously submitted to the PADEP. It was concluded that differences in water quality noted in this well were unrelated to the ATGAS well control incident.

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### **6.5 ADDITIONAL REPORTING**

Chesapeake will prepare a report for the PADEP which details the intermediate- and long-term findings associated with the well control event at the ATGAS well pad. The report will provide the field and analytical chemical results of environmental media sampling conducted in the vicinity of the ATGAS well pad from May 3, 2011 to August 3, 2011.

Media to be included will be:

- Surface water from the ponds, UNT, drainage swale, and Towanda Creek;
- Groundwater from the near-by domestic water wells;
- Groundwater from the regional water wells and springs;
- Groundwater from monitoring wells installed in the immediate vicinity of the ATGAS well pad in July, 2011;
- Soils and sediment sampled pursuant to the Sampling and Analysis Plan approved by the PADEP in May, 2011; and
- Recovered water samples from tankage.

Additionally, the report will discuss the radiochemistry results for the entire data set, including the results for samples discussed in this Report. The results of several ecological receptor surveys conducted in May, 2011 and June, 2011, and fish tissue sampling results will also be included.

If corrective actions are necessary to be undertaken in the area surrounding the East and West Catchment Basins located on the north side of the ATGAS well pad, these actions will be described in a separate Sampling, Analysis and Corrective Action Plan which will be presented to the PADEP under separate cover. The Intermediate- and Long-Term Findings Report will provide descriptions of any corrective actions performed and confirmation sampling conducted to document completion of these actions.

The submission date for the report will be dependent upon the nature and length of time necessary to conduct any corrective actions and to receiving final validated analytical and radiochemical data from the third-party laboratory. It is anticipated that the report will be available no later than December 30, 2011.

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**TABLES**

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## **FIGURES**

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## **APPENDICES**

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**APPENDIX A**  
**Volume of Material Released Methods**

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**Exhibit 1**

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**Exhibit 2**

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**APPENDIX B**  
**Hydraulic Fracturing Fluid Product Disclosure**

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**APPENDIX C  
USGS Precipitation Data**

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**APPENDIX D**  
**Test America Letters Regarding Data Issues**

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**APPENDIX E**  
**GES Remote Air Monitoring Raw Data**

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**APPENDIX F**  
**URS Ecological Investigation Reports**

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**APPENDIX G  
USGS Stream Gage Information, Franklindale and  
Monroeton Sites**

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**APPENDIX H**

**██████████ Water-Well Investigation Report, July 13, 2011**

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