Specific Statements Being Challenged

1. **ATSDR Statement: Currently Available Data**

Objection:

ATSDR stated that it "evaluated the currently available data against a range of possible exposure durations . . . ." (Overview, page iii) (emphasis added). This is clearly false. ATSDR only utilized a very limited data set from an "initial groundwater sampling event for the seven private wells closest to the well site . . . ." (page iii, paragraph 1). This confirms that ATSDR did not consider at least 29 additional data sets available for each of the wells and has therefore presented an outright falsehood by claiming that the "currently available data" was utilized in the Consultation. These 29-plus additional data sets, including pre-drill baseline data, were publicly available, having been provided to both the seven landowners and the PADEP well before ATSDR issued its Consultation and ATSDR's occasional references to the Studies indicates the agency's awareness of the existence of that data. By failing to use these data sets, ATSDR has failed to meet CDC/ATSDR Information Quality Act guidelines including requirements relating to accuracy, completeness, comprehensiveness, and use of the best available information.

Basis for Our Objection:

ATSDR did not utilize "the currently available data" for the seven wells under consideration in the Consultation. ATSDR's statement that it evaluated the "currently available data" implied that all data available to ATSDR was considered. However, by November 4, 2011 (the date of the Consultation), EPA had conducted an additional sampling event on these wells on July 5-6, 2011 and sampled three of the seven wells on September 20, 2011. The PADEP also sampled three of the seven wells on June 15, 2011 and all of the wells on April 27-28, 2011 and July 5-6, 2011. The EPA's July 6, 2011 data from the Haire Well (RW04) were available in the SAIC Report entitled, *Haire Water Well Water-Quality Investigation*, which ATSDR specifically mentions on page 17 of the Consultation, yet failed to consider. Chesapeake and its consultants collected at least 29 samples from each of the seven wells. These samples were collected over a period running from April 20, 2011 (i.e., less than one day after the well control incident) to July 6, 2011.

Therefore, there were approximately 211 additional samples available specifically from these seven wells that were not evaluated by ATSDR as part of the Consultation. These data sets were provided as part of weekly updates to the PADEP beginning in June 2011. These data sets (including both a table of data and all analytical laboratory reports) were also provided to each of the landowners for the seven water wells well before the issuance of the ATSDR Health Consultation. In addition to the initial data collected by the EPA on April 27 and 28, 2011 from these seven wells, the EPA and/or PADEP had collected approximately 27 additional samples from these seven wells. Data from these 27 samples were available to the ATSDR but not considered or provided in the ATSDR

Health Consultation, with the exception of a single PADEP analytical result for gross alpha.

In addition to the seven wells at issue, there were 22 other water wells located within 4,000 feet of the well pad which were sampled weekly from April 27, 2011 to May 18, 2011 for a total of approximately 82 additional samples. These 82 data sets were also provided to both the landowners and the PADEP in Chesapeake's weekly updates. Nineteen of these 22 wells also had pre-drill sample analyses available, which were provided to the landowner and PADEP.

ATSDR only used results from seven samples out of an actual available data set which consists of sample results for approximately 320 samples gathered by Chesapeake, PADEP, and EPA (all of which were available to the ATSDR) for wells located within 4,000 feet of the ATGAS well pad. This amounts to ATSDR selectively using just under 2.2 percent of the "currently available data" in the Consultation.

Further, the ATSDR does not provide in its "Interim Steps Currently in Place" on page 19 of the Consultation for a further or ongoing review of these data. Failure to consider all of the available data gives rise to considerable bias and a lack of completeness and accuracy which are evident in the Consultation, as well as defying established scientific practices of evaluating all reasonably available data and using the best available information related to the issue being investigated.

Relief Requested:

Chesapeake requests a public retraction of the November 4, 2011 Consultation and all associated press releases since it ignores hundreds of sample results that were publicly available and that, if considered, would have dramatically altered ATSDR's conclusions. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR first obtain from PADEP and EPA and analyze all available split sample data relevant for the seven wells under consideration and conduct an unbiased Health Consultation that adheres to ATSDR's own standards and considers all available data and not just the limited and unrepresentative data sets chosen by ATSDR in the Consultation.

2. ATSDR Statement: Naturally-Occurring and Variable Constituents

Objection:

Throughout the Consultation, ATSDR discusses detected levels of naturally-occurring, naturally-variable constituents without clearly and comprehensively explaining the natural occurrence and natural variability of those background constituents. As one example, ATSDR does not provide text that puts Table 3 (Well by Well Summary) of the Consultation into context with the pre-existing conditions in the individual wells prior to the ATGAS well incident. It should be pointed out that there are two Table 3's in the Consultation, an apparent error in numbering of the tables in that Consultation. Table 3

on page 8 of the Consultation will be referred to herein as the Table 3 (Well by Well Summary) and Table 3 on page 15 will be described as the Table 3 (Manganese) herein. In one instance, ATSDR indicates that barium is a naturally-occurring element and is found in most soils at significant concentrations. Yet ATSDR failed to include similar information regarding arsenic, bromide, calcium, chloride, iron, lithium, magnesium, manganese, methane/ethane, potassium, sodium, and radionuclides and their occurrence naturally in relatively high and/or detectable concentrations in soils.

Basis for Our Objection:

By not providing this context, the Consultation creates the false implications that these background levels of constituents are "contaminants" rather than naturally-occurring, that these constituents are somehow associated with oil and gas activities, and that the levels detected are evidence of something being wrong. The potential public health concerns were associated with substances identified in Table 3 (Well by Well Summary) were **all** pre-existing to the incident in question and have no association with oil and gas activity generally or the incident in question specifically. ATSDR does not elaborate on this factual context in its discussion of Table 3 (Well by Well Summary). Failing to put the data in that table in context, including by discussing the pre-drill and background data, misleads the reader to an erroneous conclusion that the release of materials from the ATGAS well pad or oil and gas activities might have been responsible for the introduction of these constituents and the development of these public health concerns. These failures create a lack of clarity and completeness and are misleading and, therefore, not adequately useful to or understandable by the public.

Relief Requested:

Chesapeake requests that ATSDR retract the Consultation in light of these failures. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR include a comprehensive discussion of the natural occurrence and natural variability of the substances discussed in the Consultation, starting with those listed in Table 3 (Well by Well Summary). Further, Chesapeake requests that ATSDR clearly explain that any potential public health concerns associated with the seven wells existed prior to the release of materials from the ATGAS well pad and prior to any oil and gas activity in the area. The tables in the Consultation should be renumbered since there are two Table 3's.

3. ATSDR Statement: Confusing Use of Units

Objection:

Throughout the Consultation, ATSDR has reported data results in parts per billion (ppb) and micrograms per Liter (µg/L) units but occasionally points to standards listed in parts per million (ppm) and milligrams per Liter (mg/L) units. This misleading transposition of units occurs specifically during the Consultation's discussion of chloride and methane. This practice is misleading to the reader, especially the lay reader, suggesting that the

results are unusually elevated. For example, in the chloride discussion on page 6 ATSDR uses both mg/L and µg/L. The lower numerical mg/L values are used to discuss background and standards and the much higher-appearing µg/L numerical values are used for concentrations present in the wells of interest. This same sort of cross reporting of units is also noted in the discussion on methane on page 7 of the Consultation. This is misleading as it could lead a lay reader to think the chloride or methane concentrations were considerably elevated rather than within the range of background values. Notably, EPA uses in its publicly available published drinking-water quality standards, Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs), the units of mg/L or ppm.

Basis for Our Objection:

The standard scientific convention in the field is to use ppm (mg/L) for metals and inorganics, such as chloride, rather than ppb (µg/L) units. The use of the ppb values is inflammatory and misleading to the public. The usage of different units does not conform to the concepts of transparency and communication set forth in the ATSDR guidelines for public health consultations. In addition, when comparing µg/L analytical results to an mg/L standard, the Consultation creates confusion and could lead the lay reader to assume the analytical results compare unfavorably to the standard. This practice impairs the Consultation's clarity and objectivity, as well as making it less useful to and understandable by the public. As noted, the EPA's published public drinking water MCLs and SMCLs for metals and inorganics are reported in units of mg/L or ppm.

Relief Requested:

Chesapeake requests that ATSDR publicly and formally retract the Consultation. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR revise the document to consistently present data for standards, background, and sample results using consistent units to avoid confusion. Chesapeake, further requests that the units utilized be mg/L, which is consistent with the units used in EPA's MCL/SMCLs for metals and inorganics.

4. **ATSDR Statement: Use of the Term "Chemicals" or "Contaminants" for Naturally-Occurring Constituents**

Objection:

Throughout the Consultation, ATSDR variously describes naturally-occurring substances in groundwater such as arsenic, iron, lithium, potassium, sodium and chloride as "Contaminants of Concern" or "Chemicals." ATSDR then calculated public health implications for these naturally-occurring substances and presented them in a Consultation that purports to be investigating the short-term release of materials from the ATGAS well pad. ATSDR also has been inconsistent in the use of the words "chemical" and "contaminants."

Basis for Our Objection:

Identification of substances which occur naturally in the groundwater in Bradford County as "chemicals" or "contaminants of concern" because they were higher in the pre-drill and/or post-blowout samples than ATSDR-identified comparison values is inflammatory and misleading to the public. The concentrations of arsenic, barium, bromide, calcium, iron, lithium, magnesium, manganese, methane/ethane, potassium, sodium, chloride, and gross alpha in the wells under consideration are naturally-occurring and are not anthropogenic in origin. Instead, these substances occur in the ground water throughout Bradford County, throughout Pennsylvania, and in the entire U.S. in concentration ranges similar to those measured in the samples considered in this Consultation. Characterization of these detected naturally-occurring elements as "contaminants" and the calculation of "risk" associated with these naturally-occurring concentrations are misleading to the reader in the context they are presented in, suggesting that they were added to the groundwater by the release from the ATGAS well pad. Such a conclusion is unsupported and, in fact, contrary to the data.

ATSDR failed to use pre-drill data to demonstrate that inorganics and metals were essentially unchanged between the two sampling events, and failed to recognize that the detected inorganics and metals were well within naturally-occurring ranges for groundwater in Bradford County. Further, several thousand pre-drill water-well analyses for Bradford County were publicly available to ATSDR having been provided to both the PADEP and landowners years and months prior to the Consultation. The ATSDR made no mention of these pre-drill data nor did they attempt to review those pre-drill data. ATSDR has engaged in the selective use of data rather than an objective scientific evaluation, representing unsound data evaluation practices. The levels of arsenic, barium, calcium, bromide, chloride, iron, lithium, magnesium, manganese, potassium, and sodium are naturally-occurring in groundwater in Bradford County. For example, in over 7,500 baseline samples from water wells in Bradford County, potassium has been detected in 79.6 percent of the samples and has been detected at concentrations ranging from 1,000 µg/L to 158,000 µg/L (mean of 1,710 µg/L; median of 1,430 µg/L). Approximately 72.8 percent (5,490 analyses) of pre-drill or baseline data for Bradford County exceeded the 1,100 µg/L value ATSDR utilized as a "Background Concentration" in Table 1 of its Consultation. Detections of potassium over 1,100 µg/L commonly occur naturally in groundwater throughout Bradford County. For barium in Bradford County, 289 water wells had detected concentrations of barium above the 2,000 µg/L MCL (3.8 percent) as determined during pre-drill baseline sampling, ranging in concentration from non-detected to 50,400 µg/L. ATSDR failed to note in the Consultation that barium frequently occurs naturally in groundwater in Bradford County above the MCL.

Groundwater contains naturally-occurring cations and metals, such as calcium, iron, magnesium, etc. Several of these are in fact essential nutrients and should not be treated as contaminants. Several of the comparison values ("CVs") utilized for the analysis are less or equal to background values, e.g. the sodium CV is lower than the background value and the manganese CV is the same or less than the background value. The iron

concentrations are very close to the background value. The arsenic background level is essentially the same as the arsenic MCL. Calling these elements and nutrients "contaminants" or "chemicals" suggests that they are unnatural and/or that they were introduced by artificial means, impliedly (in the context of a Health Consultation about the ATGAS well control incident) by the release from the ATGAS well pad. The ATSDR failed to consider or discuss that the detected concentrations of metals and common cations/anions often occur naturally above their reported "background concentration" in Table 1 of its Consultation. These failures impair the Consultation's transparency, clarity, and completeness as well as making it less useful to and understandable by the public.

Relief Requested:

Chesapeake requests public retraction of the Consultation based on its identification of naturally-occurring substances as "contaminants" or "chemicals of concern." Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR adequately present the pre-drill data available for the seven wells under consideration, along with pre-drill data from Bradford County as a whole. Further, Chesapeake requests that the calculation and description of risk associated with these naturally-occurring substances be removed from such a revised Consultation unless there is a basis for concluding that those substances are present in harmful concentrations as a result of the incident the Consultation was purportedly investigating.

5. **ATSDR Statement: Selectively Failed to Consider Available Pre-Drill/Baseline Data**

Objection:

ATSDR did not consider baseline data that was readily available for RW01, RW05 and RW07, three of the seven wells evaluated by ATSDR.

Basis for Our Objection:

Chesapeake made water-quality data for baseline pre-drill water samples for all seven wells available to EPA and PADEP. Apparently, ATSDR made no effort to obtain additional baseline data for RW01, RW05 and RW07. ATSDR did not utilize pre-drill data for RW01, RW05 and RW07; therefore, conclusions and evaluation of the data for these wells was conducted without necessary context. It is inappropriate to utilize only selected pieces of the pre-drill data. ATSDR's failure to use these data impairs the Consultation's accuracy and completeness and fails the requirement that the agency use the best available information.

Relief Requested:

Chesapeake requests that ATSDR retract the Consultation based on the selective failure to use the most relevant available background data. Should ATSDR thereafter publish a

new or revised Health Consultation, Chesapeake requests that ATSDR expressly consider the available site-specific baseline data for all parameters at all seven of the wells under consideration.

6. **ATSDR Statement: Inappropriately Utilized USGS Median Values as "Background" Instead of Ranges**

Objection:

ATSDR utilized background concentrations for a number of metals and inorganics from a single 1998 United States Geological Survey ("USGS") and Pennsylvania Geological Survey ("PGS") report (Report 68) and further used single values purported to be median values for the Devonian Lock Haven formation in Bradford County. Further, a background number was provided for arsenic, barium, calcium, chloride, iron, magnesium, manganese, potassium, and sodium which is identified as background for the Devonian Lock Haven. Some of the values provide in Table 1 of the Consultation cannot be verified in the 1998 USGS report. More importantly, it is inappropriate to use a single value rather than a range as "background." ATSDR used single median values for arsenic, calcium, magnesium, potassium, and sodium. A median background value in this context means that 50 percent of the background values were below this level while 50 percent were higher than this level. Clearly, a range of background values exists and selective use of a single median value that reduces that naturally-occurring variable range to a single concentration level is not reflective of "normal" background conditions, and is misleading to any reader of the Consultation, especially a lay reader. ATSDR fails to describe what background actually means, and proper science would have dictated that a discussion of all probable background ranges for these constituents be provided, as was done for some constituents in that 1998 USGS study. ATSDR selectively utilized and misrepresented data that was available in that 1998 USGS publication.

Basis for Our Objection:

As a specific example, ATSDR utilized a 9 µg/L value as the median arsenic concentration in the Lock Haven Formation in Bradford County citing the USGS 1998 report. Review of the original 1998 USGS document did not reveal a 9 µg/L as a median arsenic value; the 9 µg/L appears to have come from the Br205 well data provided in that report. This concentration was a single value from 1981 and it would appear that this single value was selectively chosen by ATSDR as "background." This is not a median value in the 1998 USGS study, but ATSDR represents it as a median value from that study (page 6 of the Consultation). The data in the original 1998 USG report showed three detected concentrations of arsenic in wells completed in the Devonian Lock Haven in Bradford County with concentrations of 9, 22 and 25 µg/L, with median of 22 µg/L and mean of 18.7 µg/L. Characterizing arsenic concentrations which were greater than 9 µg/L as "elevated" and "above background" is not supported by the referenced data set. The 25 µg/L concentration is a single concentration from Well Br357 which is completed in the Lock Haven Formation and is spatially much closer to the ATGAS well pad than the Br205 well, the apparent source of the 9 µg/L concentration. Further, there is

another well that is yet even spatially closer (well Br695) to the ATGAS site with a detected arsenic concentration of 67 µg/L as measured in 1984. Br695 is completed in glacial stratified drift (confined) which overlays the Lock Haven Formation in the area. The data available in the 1998 USGS publication is also available in the USGS National Water Information System (NWIS) historical on-line database. Within the NWIS database the historical pre-development detected concentrations of arsenic in the eleven analyses for the Lock Haven in Bradford County were found to range from 4 µg/L to 178 µg/L with a median value of 25 µg/L (mean 49.3 µg/L). Clearly the use of 9 µg/L as a background concentration is not representative of background arsenic concentrations in the groundwater in this area and ignored that naturally-occurring arsenic in groundwater above the 10 µg/L MCL is very common in the area near the ATGAS pad.

For barium on page 30 of the USGS 1998 study, the range of groundwater concentrations reported was 560 to 98,000 µg/L from the restricted flow zone of the Lock Haven Formation in Bradford County (median 2,100 µg/L). ATSDR correctly references the range for barium values in Table 1, but instead of using the reported median value of 2,100 µg/L, ATSDR chose to use the much lower value of 1,620 µg/L from a single well, Br205, as the background median value. This is not a median value from the 1998 USGS report, but ATSDR misrepresents it as a median value from that report (page 6 of the Consultation). ATSDR apparently chose to ignore the reported median value of 2,100 µg/L as background and instead, selected a specific value, 1,620 µg/L, which would be below the EPA MCL of 2,000 µg/L. In other locations within the 1998 USGS report, the median barium value is described as being 2,050 µg/L (page 36) and 2,000 µg/L (page 42) from the restricted-flow zone. The median barium background values in the USGS 1998 report are above the MCL. The ATSDR apparently chose the lower value from well Br205 without any scientific basis.

For calcium, potassium, and magnesium, only single background values of 39,000 µg/L, 1,100 µg/L, and 10,000 µg/L, respectively were presented in Table 1. ATSDR failed to identify that these values represented data from Bradford County as well as Tioga and Potter Counties. Review of the USGS 1998 study provided a range of background values, by using the data reported in Table 20 of the 1998 USGS report for the Lock Haven Formation in Bradford County. Ranges of values for the Lock Haven Formation could have easily been calculated and provided. There are similar issues for sodium. The text on pages 14 and 16 of the Consultation reports these median values as being from the Bradford County Lock Haven Formation which is an incorrect statement; the reported median values are for a three county area, Tioga, Potter, and Bradford.

For chloride, ATSDR reported a median value of 12,000 µg/L and a 10^{th} percentile value of 560,000 µg/L. The median value of 12,000 µg/L reported in the USGS study was for Potter, Tioga, and Bradford Counties rather than just for Bradford County as reported in the ATSDR document. The range for chloride from the Lock Haven Formation in Bradford County was reported to range from 1,000 µg/L to 3,500,000 µg/L. The 1998 USGS study reported that seven percent of the groundwater results for Bradford, Tioga, and Potter Counties exceeded the EPA SMCL for chloride, all from water wells in communication with the naturally-occurring restricted-flow zone containing naturally-

occurring shallow saline water. ATSDR chose to ignore that there are two distinct groundwater systems in the Bradford County area described in that 1998 USGS report: (1) an unrestricted groundwater flow zone that contains water of calcium carbonate type (zone of unrestricted flow which occurs in glacial stratified-drift deposits and in many of the till and shallow bedrock systems) and (2) zone of restricted groundwater flow which occurs principally in shallow bedrock formations in valleys such as the Devonian Lock Haven Formation, which is sodium chloride type water. The 1998 USGS report states that "water of the sodium chloride type is present at relatively shallow depths in most valleys," such as the area surrounding the ATGAS well pad. Wells of the naturally-occurring sodium chloride type have been inventoried in the 1998 USGS study on Table 12. Approximately 44 of the 223 wells studied in USGS Report 68 (approximately 20 percent) were completed in these restricted-flow zones of naturally-occurring sodium chloride type groundwater. Of these 44 water wells, 23 wells were completed in the Lock Haven Formation and 15 completed in the Catskill Formation. Within Bradford County, chloride values in these restricted-flow groundwater zones varied from 125,000 µg/L to 3,500,000 µg/L (median 348,000 µg/L as reported on page 42 of that report). It is apparent that the groundwater encountered in some wells, such as RW04, is consistent with this type of groundwater from these restricted-flow zones and, therefore, would have been expected to have a much higher chloride content. ATSDR either chose to selectively ignore the data from the restricted-flow zone groundwater or simply applied a bias in favor of the lower values. Regardless of its reason, ATSDR did not provide an adequate discussion of the existence of naturally-occurring saline groundwater common in the area even though it was discussed extensively in the 1998 USGS paper that was relied upon by ATSDR. These same issues also affect the presentation of sodium data in the ATSDR report.

For iron, ATSDR reported in Table 1 a background value of 270 µg/L and 10^{th} percentile value of 1,200 µg/L. The 1998 USGS study on page 31 stated that "elevated concentrations of dissolved iron and manganese are common in the groundwater of the study area. About 50 percent of the wells sampled yield water that exceed the EPA's SMCL (secondary maximum contaminant level) for iron and manganese of 300 µg/L and 50 µg/L, respectively." ATSDR failed to report this fact in the context of the Consultation. The iron median value is representative of a three county area rather than being solely from Bradford County as represented in the Consultation. The iron reported in the 1998 USGS report for the Lock Haven Formation ranged from 10,000 to 3,800,000 µg/L. The median value for manganese in Table 1 of the Consultation (50 µg/L) similarly represents a three county area rather than just Bradford County. The manganese range reported in that 1998 USGS study was from less than 10 to 2,600 µg/L for the Lock Haven Formation. In the over 7,500 baseline or pre-drill water well samples from Bradford County collected on behalf of Chesapeake, iron was detected above the SMCL in 1,906 wells, or 25.3 percent were above the SMCL; for manganese, 2,978 wells or 39.5 percent were above the SMCL. Again, ATSDR failed to adequately explain in its Consultation that manganese and iron concentrations well above the SMCL are expected to commonly occur naturally in groundwater in Bradford County, leaving the implication that the levels detected were in some way unnatural. The Consultation presents a variety of false, inaccurate, and/or misrepresented information in its discussions of "background"

levels, failing the Information Quality Act's tests for accuracy, completeness, and best available information, as well as using apparently selective background numbers that bias the results of the Consultation and make it misleading and, therefore, less useful to the public.

Relief Requested:

Chesapeake requests that ATSDR publicly retract the Consultation based on the numerous false statements it contains relating to background concentrations of metals and inorganics. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR accurately represent the sources and ranges of background concentrations, that the background concentrations in Table 1 appropriately be presented as ranges rather than single values, and that the data from the seven wells in question be evaluated relative to these ranges rather than against single median values. ATSDR should also revise the Consultation to correct inaccurate statements indicating that single values reported for constituents such as arsenic and barium were median values.

7. **ATSDR Statement: Failed to Consider Well Depth and Penetration of Natural Saline Zones**

Objection:

The ATSDR relied heavily on the 1998 Water Resource Report 68 prepared by the USGS and PGS. ATSDR fails to adequately discuss that report's recognition that numerous water wells within Bradford County penetrate zones of naturally-occurring saline groundwater and that a significant part of that report is dedicated to discussing the presence and natural occurrence of saline groundwater at shallow depths in the Lock Haven and Catskill Formations.

Basis for Our Objection:

RW04 is a well which is influenced by naturally-occurring saline groundwater at shallow depths. In fact, in the SAIC report which examines the water quality of RW04, it is shown that downhole water quality logging indicates a significant shift in water quality, e.g. specific conductance log, at the depth of 172 to 173 feet below ground surface (bgs). On Page 39 of USGS Report 68, Figure 20, are downhole-specific conductance profiles where dramatic changes are seen in two wells completed into the naturally-occurring saline zone in the Lock Haven Formation, where a large dramatic shift in water quality occurs at depths of approximately 205 and 145-150 feet bgs. These historic specific conductance logs mirror the abrupt and dramatic water quality changes seen in the logs of RW04. The two wells discussed on Figure 20, Br557 and Ti498, are both completed in the Devonian Lock Haven Formation. The water-producing zones in RW04 are likely in the same Formation.

For example, the water quality in Ti498 (well depth 158 feet bgs) clearly shows that the

zone at 150 feet bgs was a naturally-occurring saline zone with higher levels of barium, chloride, iron, manganese, calcium, sodium, potassium and magnesium, similar to what was found in RW04. Further, referring to Figure 20 of the 1998 USGS report, the large variation in water quality as evidenced by specific conductance demonstrates that depending on how the well was sampled or the prior use of the well (e.g. a very recent load of laundry or shower), the water quality could appear quite different. Under non-pumping conditions and using specific conductance as an indicator of water quality, the water quality in well Ti498 would have a specific conductance of approximately 700 µmhos/cm at a depth between 25 to 145 feet bgs and a conductivity of upwards of 18,000 µmhos/cm below a depth of 145 feet bgs. In fact, two separate water samples collected from well Ti498 prior to 1998 (and provided in USGS Report 68) show analytical results that are completely different. The sample from the restricted-flow zone at 150 feet bgs had a chloride level of 4,600,000 µg/L, while a sample collected from a mix of water in the well had a chloride level of 193,000 µg/L, or almost 24 times lower. Data from this 1998 USGS report clearly indicated how it was possible to obtain two dramatically different and distinct water-quality analyses from the same well, but this fact was ignored or not adequately considered or discussed in the ATSDR Consultation. This situation is analogous to the water-quality profile present in RW04. The ATSDR disagrees with SAIC that failure to adequately stress RW04 prior to baseline sampling was responsible for the differences noted in the water quality. ATSDR has thus failed to consider usage of the well prior to sampling in the Consultation. SAIC in its evaluation of the well considered the effects of sustained continual usage in addition to the purge volume. Resting conclusions solely on the basis of purge volume (see Table 4 of the Consultation), as ATSDR does, presents an incomplete analysis, misrepresents SAIC's data presentation in the Haire report, and leads to false and inaccurate conclusions.

ATSDR recognized that the evaluation of the baseline in RW04 is complicated by usage and purging of the water well and recognized the temperature differences noted during the baseline sampling. In Table 4 ATSDR makes a comparison of purge volume and concentrations, ATSDR fails to consider that the changes in water quality are probably more related to long- and short-term usage of the well just prior to sampling events, as stated several times in the SAIC report. For example, the only change that occurred between the May 14 and the July 6, 2011 in well RW04 was that the well was taken out of active use on May 18, 2011 and was not used again prior to the July 6, 2011 EPA sampling except for packer testing in early June, 2011. This lack of use can account for the differences in water quality. The water quality in the July 6, 2011 EPA sample was almost identical to the July, 2010 baseline sample results, as pointed out in the SAIC report, but apparently not considered by ATSDR. The ATSDR indicated the source of the elevated inorganic/organic constituents are inconclusive; however, the SAIC report coupled with USGS Report 68 (1998) conclusively show that the pre-drill sample was not representative of all water qualities in this water well and is dependent on the long-term usage of the well prior to sampling. It is also easy to understand how a water sample could be obtained from a well such as shown in Figure 20 of the 1998 USGS Report 68, and the water quality from the upper zones and lower zones to be completely different. Instead the pre-drill sample represented only the water quality from the upper portion of well RW04. ATSDR has misrepresented the material and conclusions contained in the

SAIC report; SAIC well evaluation focused not on the impacts of purging but the impact on quality due to the long-term usage of the well prior to sampling (SAIC report conclusions 7 and 8).

During continued sustained use of RW04 such as was occurring on May 9, 2011, short term water quality-changes within 15 minutes were noted during sampling of the well. Specific conductance values ranging from 2,800 to 11,000 µmhos/cm were noted in field sampling in the first fifteen minutes of purging. A graph showing the variation was provided in Appendix F of the SAIC report on RW04.

The ATSDR recognized in conversations with the landowner of RW04 that in 1998 the water quality was saline at below 172 feet bgs. ATSDR seems to discount this historical fact and the fact that the landowner had historical recognized water-quality issues with the well where it would become more salty after heavy sustained use. ATSDR characterized these issues as a "hypothesis." On August 9 and 10, 2011 the lower portion of RW04 was sealed which isolated the naturally-occurring saline water, and the water quality above this interval is virtually identical to the pre-drill sample. This further confirms that the zone encountered as 172 bgs was responsible for the poor quality water in the well just as the resident at RW04 has repeatedly stated and noted as far back as 1998. The landowner actually knew the exact depth that the saline groundwater was entering the well as far back as 1998, and has repeatedly stated that fact, but the ATSDR has selectively chosen to ignore this fact.

ATSDR characterizes the conclusions made by SAIC as a "hypothesis." The extensive investigation conducted at this well coupled with the historical information provided by the landowner of RW04 has confirmed the SAIC conclusions as factual rather than as a "hypothesis." To continue to characterize them as such reflects a decision by ATSDR to ignore the available data.

ATSDR contends that SAIC contradicts itself regarding the visible outflow at 172 feet bgs. It is apparent that ATSDR did not fully comprehend the results of the geophysical and video logging results. Clearly ATSDR is unfamiliar with and has no understanding of the behavior and interaction of naturally-occurring saline water with overlying fresh water in wells. ATSDR's statement that there are contradictions within the SAIC report is puzzling since there are none within the SAIC report on RW04.

ATSDR states that methane was not discussed in the SAIC report on RW04. Discussions of the methane values were provided on page 14 of the SAIC report along with relevant graphs. In addition, ATSDR fails to point out that on page 30 of the 1998 USGS report, it states "[w]ells that penetrate zones containing highly saline groundwater commonly produce hydrogen-sulfide and/or methane gas." The restricted–flow zone in well RW04 produces low levels of methane gas.

The report prepared by SAIC was developed to address the source of the apparent water-quality issues at RW04 and more significantly the potential effects of potential subsurface contamination from other activities, such as drilling and hydraulic fracturing. ATSDR

has misrepresented the entire body of the report which specifically addressed the issues – the "ultimate source" of alleged groundwater contaminants – ATSDR was tasked with investigating. The SAIC report conclusively demonstrates that the ATGAS incident, which included drilling, hydraulic fracturing, and an uncontrolled release event, did not impact the water quality at RW04 (see Conclusion 1 in the SAIC report). All those factors were considered by SAIC in preparation of the report. In addition, ATSDR relies heavily on the results provided in 1998 USGS Report 68, but selectively fails to discuss, point out, or consider results in that report that conclusively support and verify results seen in well RW04 as being of a natural occurrence.

ATSDR states that it is "unknown whether the completed well remediation will improve water quality." Data available for the water quality at RW04 following the plugging of the zone below 172 bgs has shown that the water quality at RW04 has considerably improved and is consistent with the natural levels in that well that occur above 172 feet bgs. This demonstrates that eliminating the influence of the naturally-occurring saline groundwater at that depth successfully addressed the concerns associated with this well.

Further, during the packer testing in June, 2011, the sealing of the bottom fracture at 172 bgs was thoroughly evaluated. Data was presented in the SAIC report on RW04 that this strategy would be successful in addressing the water-quality issues in RW04. ATSDR apparently did not adequately evaluate the results of the packer testing which demonstrated this fact. As previously stated, data collected from RW04 after these actions have demonstrated clear improvement in the water quality at RW04, confirming SAIC's conclusions about RW04

ATSDR states on page 2 of its Consultation that it did not "attempt to comprehensively evaluate all of the information" in the SAIC report on RW04 even though the agency has made a number of conclusive statements regarding RW04. Due to the extreme complexity of the water quality issues in RW04, it is inappropriate for ATSDR to make conclusions regarding RW04 based on only a "preliminary evaluation" of the very thorough SAIC report, as stated on Page 2 of the Consultation. This appears to be selective use of data, fails to provide complete and comprehensive information, affirmatively fails to utilize the best available information, and is inconsistent with good scientific practice. Based on the findings of the SAIC report, there were no effects on RW04 from natural gas activities at the ATGAS 2H well pad, including from the drilling, hydraulic fracturing, and uncontrolled fluid release. The Consultation fails Information Quality Act tests of completeness and use of the best available information by failing to adequately consider and discuss known information about naturally-occurring saline groundwater at similar depths, the effects of well usage on test results, and the extensive publicly-available work previously performed by SAIC on these issues. Failure to consider this information also renders the Consultation inaccurate and biased, therefore, less useful to the public.

Relief Requested:

Chesapeake requests that ATSDR publicly retract the consultation based on its inaccurate

and poorly-founded statements regarding the water quality in RW04. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR include a comprehensive discussion of the nature and quality of the naturally-occurring saline groundwater and potential effects on water wells in Bradford County and that it thoroughly consider the extensive work conducted by SAIC.

8. **ATSDR Statement: Use of "Pre-Blowout" to Describe Pre-Drilling Baseline Condition**

Objection:

In numerous locations throughout the Consultation, ATSDR uses the word "pre-blowout" to describe pre-drill or baseline samples. This phrasing is inflammatory and inaccurate.

Basis for Our Objection:

The use of the term "pre-blowout" to describe earlier groundwater data is inappropriate and inflammatory. The samples in question were part of a pre-drill baseline sampling program which was conducted before any drilling activities took place. The use of the term "pre-blowout" is not suitable to describe pre-drilling baseline data because those samples were collected many months before the incident in question, were wholly unrelated to the incident in question, and also because the term "pre-blowout" implies causation with respect to that incident. This usage fails Information Quality Act standards for accuracy and objectivity and, by raising an unsupported implication about causation, is misleading in a manner that makes the Consultation less useful to the public. The more appropriate term to use is "pre-drilling" or "baseline" sample to describe these sample results.

Relief Requested:

Chesapeake requests that ATSDR publicly retract the Consultation and, should ATSDR thereafter publish a new or revised Health Consultation, use the more appropriate and accurate term "pre-drilling" or "baseline" to describe sample results which represent samples collected prior to the initiation of natural gas drilling activities in area near the ATGAS well pad.

9. **ATSDR Statement: Selectively Attributing Variation in Concentrations**

Objection:

The Consultation suggests in several places – most notably in Conclusion 1 – that upward variation in certain constituents between pre-drill and post-incident samples may entail causation. In addition to relying on the fallacy of *post hoc ergo propter hoc* – "after this, therefore because of this" – ATSDR has been selective and inconsistent in its analysis of causation. In many of these "before and after" samples, levels of the monitored constituents actually *declined*, yet ATSDR obviously does not attribute the cause of the

declines in these constituents to oil and gas activities. It is clear that these declines as well as the detected increases – especially with the benefit of the full array of sampling data – demonstrate the natural variability of naturally-occurring constituents and differences in sampling execution; they do not prove causation by oil and gas activities.

Basis for Our Objection:

In Appendix D of the Consultation, for example, the presented data clearly reflect that, certain detected constituent levels in wells RW02, RW03, and RW06 actually declined, sometimes markedly, between the pre-drill and post-incident sampling events. ATSDR expressly highlights the increases between sampling events and attributes potential causal significance to them but does not discuss the decreases or attribute any causal significance to those declining numbers. By not discussing the decreases and what those decreases mean for the Consultation's *post hoc ergo propter hoc* logic, ATSDR has failed to present a complete picture, has baked a one-way bias into its analysis, and has failed to utilize sound scientific reasoning. The failure to discuss or explain these variations reflects a lack of accuracy, completeness, and objectivity and tends to produce misleading conclusions which render the Consultation less useful to the public.

Relief Requested:

Based on these failures relative to the standards of the Information Quality Act, Chesapeake requests that ATSDR publicly retract the Consultation. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR expressly note the declines in numerous monitored constituents between the pre-drill and post-incident sampling events and to expressly explain that both the increases and declines in those constituents appear to be attributable to natural variability and inevitable differences between the manner in which the sampling or analysis was conducted.

10. <u>ATSDR Statement: Failure to Perform Exposure Pathway Analysis</u>

Objection:

The ATSDR did not conduct an exposure pathway analysis. Specifically, ATSDR did not prove that transport through an environmental medium occurred or was even possible under the circumstances. Instead, ATSDR made an assumption that transport had occurred even though such an assumption was not supported by any scientific investigation by or information available to ATSDR.

Basis for Our Objection:

The potential transport of released material into groundwater was investigated thoroughly by Chesapeake's third party consultants and discussed extensively in several reports submitted to the PADEP. These reports support the conclusion that no transport of materials to groundwater used for drinking had occurred as a result of the release.

Therefore, a completed exposure pathway does not exist. Indeed, given the physical properties of the materials released, the terrain and geology of the area, and the short time between the incident and the testing in question, it seems likely that a completed exposure pathway could not exist. ATSDR did not adequately consider these factors and apply proven science on exposure pathways to support its speculation. The absence of such a discussion impairs the completeness, objectivity, and accuracy of the Consultation.

Relief Requested:

Chesapeake requests that ATSDR publicly retract the Consultation based on these failures. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR consider whether and how transport of the released material into groundwater from the release of materials from the ATGAS well pad could have physically occurred.

11. <u>ATSDR Statement: Failure to Note Duplicate Samples, Selective Inclusion of Results from Duplicates</u>

Objection:

ATSDR appears to have selectively chosen analytical results from between divergent split sample results for RW04 and, possibly, other wells.

Basis for Our Objection:

It appears that independent duplicate sampling results were available for RW04 and that only one of the sample results was reported in the Consultation when two were available. It is unclear from the text of the Consultation why one sample or sample value was chosen for use rather than the other. For RW04, based on information on the EPA's independent analytical results, it appears that ATSDR chose to use the higher of the concentrations between the divergent duplicate results for barium, lithium, and methane. For example, the methane concentration chosen by ATSDR for use in the Consultation was 6,200 µg/L versus 2,600 µg/L in the duplicate sample; the specific conductance results chosen were 7,600 µmhos/cm versus 5,900 µmhos/cm in the duplicate; for TDS, ATSDR chose to use the 4,700,000 µg/L result versus 2,800,000 µg/L in the duplicate; and for chlorides, ATSDR chose to use the 2,900,000 µg/L result versus the 1,900,000 µg/L concentration found in the duplicate. ATSDR failed to adequately explain its selection of which duplicate data to use and in Table 1 only one of the two available data points is even presented. The choice of selecting one result when independent analysis of the same sample reflects a different result casts doubt on the accuracy of the analysis. ATSDR's failure to discuss these differences reflects a lack of transparency and completeness in the Consultation. ATSDR's choice to selectively use the higher number in these cases reflects a lack of objectivity and inherently subjects ATSDR's analysis to bias. In all of these respects, the Consultation fails the tests set out in the Information Quality Act and associated guidance.

have considered this information in preparing the Consultation, although pre-drill testing data had been supplied to the PADEP and landowners of Bradford County, and was available to the ATSDR for review, well before issuance of the Consultation.

Area	Number of Pre-drill Testing Samples	Number of Pre-drill Testing Samples with Arsenic Detections Above MCL	% of Pre-drill Testing Samples Above Arsenic MCL
Bradford County, PA	7,512	320	4.3

ATSDR also failed to consider the findings of USGS regarding naturally-occurring arsenic in groundwater. (See A Retrospective Analysis on the Occurrence of Arsenic in Ground-Water Resources of the United States and Limitations in Drinking-Water-Supply Characterizations.) USGS found that a significant percentage of groundwater wells in the United States have naturally-occurring arsenic levels which exceed the 10 µg/L MCL.

ATSDR also failed to consider a 2006 USGS Report titled "Reconnaissance of Arsenic Concentrations in Ground Water from Bedrock and Unconsolidated Aquifers in Eight Northern-Tier Counties of Pennsylvania," USGS Open File Report 206-1376. This 2006 USGS report presents arsenic data collected by the USGS from water wells in July 2005, and March-June 2006, from eight northern Pennsylvania Counties, including Bradford, Potter, Tioga, and Susquehanna Counties, well before significant shale gas development commenced in the area. This study was publicly available but ATSDR appears to have ignored the findings in that report regarding arsenic occurrence in the Lock Haven Formation prior to significant shale gas development. This 2006 USGS report on page 1 states: "[c]oncentrations of total arsenic were significantly greater (95-percent confidence level) in the Lock Haven Formation than in the other bedrock units." This 2006 USGS report also notes on page 4 with regard to groundwater that "[d]etectable concentrations of arsenic are relatively common throughout Pennsylvania . . . ." Page 7 of this 2006 USGS report also states that "the Lock Haven Formation is known for its brackish or saline water and the presence of hydrogen sulfide . . ." and that "[s]aline water was reported by well owners or confirmed the water-quality analysis at depths that ranged from 95 to 290 ft." Page 11 the 2006 USGS report states that "[d]etectable concentrations (4.0 µg/L or greater) of arsenic were measured in the water from 18 wells (10.8 percent) from four counties – Bradford, Sullivan, Tioga, and Wayne." It is further noted that "[c]oncentrations of total arsenic ranged from less than 4 µg/L to 188 µg/L and that 6 percent of the samples had concentrations of arsenic greater than the USEPA MCL of 10 µg/L." Page 13 of the 2006 report states that "[a]rsenic was detected with greater frequency in the water wells completed in the Lock Haven Formation than in the water of wells completed in other formations that underlie the study area." The 2006 USGS report further states that "[t]he Lock Haven Formation was represented by 60 wells. Water from 12 of the 60 wells (20 percent) had detectable concentrations of arsenic. Where detected in the water of sampled wells, total-arsenic concentrations ranged from 4.5 µg/L to117 µg/L; the median was 14.2 µg/L." This very significant 2006 USGS

document was readily available but ATSDR appears not to have considered its findings regarding the common occurrence of arsenic in groundwater in the Bradford County area and in the area of RW02 before significant shale gas development occurred in these counties. The omission of this highly relevant, publicly available information highlights the incompleteness of ATSDR's information and the poor science and bias behind the Consultation.

Further, the Consultation's risk calculations are presented as factual absolute risks. However, any risk calculation requires many conservative assumptions and estimates which tend to overestimate risk. ATSDR does not discuss the fact that the risk values presented are, in fact, estimates which represent potential worst cases and do not take into account individual variability and potential response to carcinogens. For these reasons, the Consultation fails Information Quality Act tests because it is inaccurate, not objective, incomplete, and not useful to the public.

Relief Requested:

Chesapeake requests that ATSDR publicly retract the Consultation. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR amend Conclusion 3 to remove ATSDR's inflammatory and misleading statements and to clearly indicate that the arsenic present in RW02 is naturally-occurring and clearly unrelated to oil and gas activity. Chesapeake requests that ATSDR remove any statements regarding "elevated" or "higher" levels of arsenic in RW02 unless they clearly indicate the comparison being used and the significance of any difference in the levels. Chesapeake requests that ATSDR consider all publicly available data that describes the common occurrence of arsenic in groundwater in northeastern Pennsylvania. Finally, Chesapeake requests that ATSDR be more transparent about the subjective and highly conservative nature of the risk values it presents as fact.

17. <u>ATSDR Statement: Failed to Consider Impact of Higher Solids on Arsenic Levels Detected in RW03</u>

Objection:

ATSDR states on page 6 of the Consultation that in the post-incident sample the arsenic concentration was 9.4 µg/L for RW03 and in the "pre-blowout" sample arsenic was not found above the detection limit. ATSDR does not make any attempt to state or define what the detection limit was in analyzing the pre-drill sample or to put both results into proper context. ATSDR also failed to take into account the very high levels of total suspended solids and the effects of entrained sediment in groundwater samples on detected concentrations of total metals i.e. arsenic, manganese, aluminum, and iron in RW03 (pages 6 and 7 of the Consultation).

Basis for Our Objection:

The statement about arsenic on page 6 of the Consultation is clearly misleading. The

detection limit for the pre-drill (baseline) sample was 10 µg/L; the post-incident result was reported as 9.4 µg/L *which is below the detection limit for the pre-drill sample*. The implication of the statement is that the post-incident sample result for arsenic is higher than the pre-drill sample result; this is not true based on the data and the statement provided in the Consultation is clearly misleading.

The very high concentration of total suspended solids in RW03, 80,000 µg/L in EPA's sample result versus 69,600 µg/L in Chesapeake's split result, would very easily account for the changes noted in total metal analyses for arsenic, barium, aluminum, iron, etc. Dissolved analyses for some parameters are available for this location for the split sample collected on April 28, 2011 by Chesapeake and the iron and aluminum concentrations are as follows: dissolved iron <50 µg/L, total iron 4,780 µg/L; and dissolved aluminum <20 µg/L, total aluminum 6,630 µg/L. Comparative results for the EPA split samples are 3,100 µg/L total iron and 2,400 µg/L total aluminum. When samples are heavily impacted by sediment, total metals are not reflective of the true dissolved concentration in the groundwater and should not be relied on for interpretation. This fact is widely known and published extensively in the relevant scientific literature; apparently either ATSDR chose to ignore this fact or failed to recognize the effect that high sediment content in water samples can have on total metal and radionuclide analyses. The reason so much sediment was entrained in the samples from well RW03 on April 28, 2011 was that the well had been pumped to near dryness during well purging and sampling, overstressing the well and causing sediment to flow into the well. Failing to adequately explain the detection limit and sediment impact issues resulted in a Consultation that is misleading, not objective, unclear, and incomplete, facts that make the Consultation less useful to the public.

Relief Requested:

Chesapeake requests that ATSDR publicly retract the Consultation. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR provide appropriate context about detection limits when it makes statements regarding arsenic and other metals in RW03. Further, Chesapeake requests that ATSDR include in the Consultation a discussion of the relationship between total suspended solids and the occurrence of metals and how that relationship appears likely to have affected the results in question.

18. <u>ATSDR Statement: Inappropriate Use of Arsenic CREG Which is Far Below the Detection Limit</u>

Objection:

It is inappropriate to use a cancer risk evaluation guide (CREG) for arsenic of 0.02 µg/L (page 9 of the Consultation) which is two orders of magnitude below the standard analytical detection limit of 2 µg/L.

Basis for Our Objection:

Use of a value for evaluation, such as the CREG, which is below the standard analytical detection limit, is misleading, inappropriate, and inflammatory. It also provides no useful information regarding potential risk since all of the analytical results, pre-drill and post-incident, are above this value.

Relief Requested

Chesapeake requests that ATSDR retract the Consultation based on the aforementioned factors. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR omit comparisons to the CREG or fully explain that such comparisons are not useful given that the standard detection limits render such comparisons unreliable and irrelevant.

19. <u>ATSDR Statement: Gross Alpha Radiation</u>

Objection:

In Conclusion 7 on Page v and Page 20 and Recommendation 3 on Page v and Page 20 of the Consultation, ATSDR indicates that bottled water is necessary for residents served by RW03 based on a single gross alpha activity level which exceeded the EPA MCL of 15 pCi/L. On Page 8, the Consultation suggested that the RW03 gross alpha result was "8 times higher than the PADEP result." Such a recommendation based on a single, flawed data point is scientifically unsupportable at best. Further, the Consultation's claims about the RW03 gross alpha result are flawed in several other ways as well.

Basis for Our Objection:

ATSDR relied on a single measurement of gross alpha in making a sweeping recommendation. As was clearly evident in the ATSDR data, the sample on RW03 collected on April 28, 2011 by EPA contained elevated levels of total suspended solids (80,000+ µg/L) and Turbidity (190+ NTU). Table 1 of the Consultation incorrectly identifies the sample date for RW03 as 4/27/2011. It was, in fact, collected on April 28, 2011 as verified by GES who witnessed the EPA split sampling on behalf of Chesapeake. The total suspended solids and turbidity in the sample collected on April 28, 2011 were due to an unusually long purge interval (i.e., well was pumped to near dryness) which resulted in excess sediment being entrained in the samples. ATSDR chose to ignore the body of data available from the literature which indicates that gross alpha is expected to be higher in samples with higher levels of suspended solids, and failed to even discuss the effect of the high sediment content on the sample results.

ATSDR's assertion that bottled water is a necessary precaution "until more information is available" is inflammatory and misleading to the public, especially because significantly "more information" was available at the time of the Consultation. ATSDR ignored at least 25 more recent water samples, which showed normal background levels of gross alpha radiation. In addition, 4 gross alpha results collected before the EPA sample on

April 28, 2011 were all well below the MCL of 15 pCi/L, including the samples collected the day before and day after the EPA sampling event. The elevated level of gross alpha (present in the single sample ATSDR relied upon) occurred during a sampling event when the samples were unusually high in total suspended solids and turbidity, which is known to be associated with higher than normal gross alpha activity. Further, Chesapeake conducted a filtered analysis on a split from the very same single elevated gross alpha sample; the filtered sample result was well below the MCL for gross alpha (9.3 ±2.8 pCi/L), clearly demonstrating that the elevated gross alpha level in ATSDR's analysis was related to the presence of sediment in the sample. Not only did EPA have additional samples for RW03 from the July 2011 and September 20, 2011 samplings, PADEP also had radiochemical results for samples in July 2011 as well as approximately 30 sample results available from Chesapeake's samples. The only sample from well RW03 that had excessive amounts of entrained sediment was the April 28, 2011 EPA sample and associated splits. The turbidity and total suspended solids content of all other samples collected from this well never came close to the suspended sediment or turbidity values noted during that April 28, 2011 EPA sampling event.

On Page 8, ATSDR indicated that the RW03 gross alpha result available from the EPA sample was "8 times higher than the PADEP result" for the same sample. The PADEP result from that April 28, 2011, sampling of 4.1 ± 1.7 pCi/L was below the EPA MCL. ATSDR chose to ignore the lower PADEP result, which would have indicated no issues. ATSDR failed to contact either Chesapeake or PADEP to request the gross alpha result for Chesapeake's split of this sample. Chesapeake's result clearly showed that the gross alpha result was related to the excessive sediment in the sample as collected by EPA on April 28, 2011. For scientists, when presented with a significant difference between split sample results, the standard practice is to resample. However, instead of resampling, ATSDR chose to cherry-pick sample values that allowed them to point to the highest possible result rather than the most accurate possible result. This choice reflects a clear bias in the preparation of the Consultation.

Finally, even though ATSDR acknowledged that it "does not expect adverse health effects from the radionuclide levels present in [RW03]," ATSDR does not state that (i) the radionuclide levels are naturally-occurring, (ii) the radionuclide levels are unrelated to oil and gas activities, and (iii) that the sample ATSDR chose to use had a high radionuclide result due to sampling error. Failure to put these "observations" in its fuller context has resulted in misleading and highly inflammatory claims about radiation. The Consultation clearly fails Information Quality Act standards relating to transparency, objectivity, accuracy, clarity, and completeness as a result of these choices, rendering the Consultation far less useful to the public.

Relief Requested:

Chesapeake requests that ATSDR publicly retract the Consultation. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR's Recommendation 3 and Conclusion 7 and related discussions be removed or substantially rewritten to remove all inflammatory and misleading statements.

Chesapeake requests that ATSDR amend Recommendation 3 and Conclusion 7 to clearly indicate that any radionuclides present in RW03 are naturally-occurring and unrelated to oil and gas activity. Chesapeake requests that ATSDR use proper data analysis and sampling techniques when analyzing and reporting sampling results. Finally, Chesapeake requests that ATSDR contact both the landowner at RW03 and her legal counsel to formally retract the statements regarding the need for bottled water to be supplied and the potential for health effects associated with gross alpha.

20. <u>ATSDR Statement: Erroneous Sample Date for RW03 Sample</u>

Objection:

The sampling date listed in Table 1 for the sample date of RW03 as 4/27/2011.

Basis for Our Objection:

Data available from GES who conducted sampling on behalf of Chesapeake has verified that the EPA split sampling event at RW03 was conducted on April 28, 2011. The above statement in the Consultation is simply inaccurate.

Relief Requested:

Should ATSDR revised or publish a new or revised Health Consultation, Chesapeake requests that ATSDR amend Table 1 to clearly indicate the correct sample date for RW03.

21. <u>ATSDR Statement: Methane/Ethane in RW04</u>

Objection:

ATSDR asserts that the presence of dissolved methane together with dissolved ethane suggests groundwater is impacted by natural gas activities (Conclusion 1, page iii and page 16). In these discussions, ATSDR failed to indicate that duplicate sample results for methane and ethane in RW04 were considerably different (i.e., 6,200 µg/L versus 2,600 µg/L); and for ethane (i.e. 2.6 µg/L versus 1,000 µg/L) For scientists, when presented with a significant difference between split sample results, the standard practice is to resample. However, instead of re-sampling, ATSDR chose to cherry-pick sample values that allowed them to point to the most elevated possible result rather than the most accurate possible result. ATSDR also did not examine the inherent variability in the dissolved methane data for these wells. Clearly, ATSDR did not consider all publicly-available baseline data for Bradford County, but chose to engage in speculation after disregarding conflicting data also obtained from a single sampling event.

Basis for Our Objection:

Drinking water aquifers in Bradford County are known to be affected by the natural

presence of methane and ethane which are both thermogenic and biogenic in origin. In fact, approximately 27.3% of the more than 7,500 baseline samples collected by Chesapeake in Bradford County contain detectable amounts of naturally-occurring dissolved methane, with 3.9% having concentrations greater than 7,000 µg/L (299 samples) and 1.2% having concentrations over 20,000 µg/L (91 samples).

Naturally-occurring methane gas can occur at any depth. To attribute this "stray gas" to a particular source, detailed isotropic analyses must be performed. ATSDR did not perform these analyses as part of the Consultation; instead it relied on mere speculation to determine that "groundwater near this site is impacted by natural gas activities." (Conclusion 1, page iii). These statements are purely speculative statements and completely unsupported by relevant data. Presenting such speculation to the public, the media, and policymakers as providing a scientific link between the presence of certain constituents and a particular cause in a Consultation that purports to be scientific and unbiased is both contrary to ATSDR's mission, Congressional directives in the Information Quality Act, and scientific ethics. Without additional information regarding methane to ethane ratios and isotopic analyses of carbon and hydrogen, no such attribution to a specific source or category of sources can be responsibly made.

In addition, ATSDR specifically and extensively cites various data from a 1998 USGS report in its Consultation. However, ATSDR fails to mention an important fact presented in that report (at page 30): "wells that penetrate zones containing highly saline groundwater commonly produce hydrogen-sulfide and/or methane gas." RW04 penetrated a zone of naturally-occurring saline groundwater; therefore, higher dissolved methane concentrations should have been expected and the results detected were well within the background range of methane concentrations in Bradford County. RW04 is one of the thousands of wells in Bradford County that has measurable amounts of naturally-occurring methane in the well water. The evidence clearly shows that RW04's water-quality issues are not related to natural gas exploration and production, but are in fact, naturally-occurring due to RW04's penetration into a naturally-occurring saline zone near the bottom of the well. The existence of this naturally-occurring salt water zone at shallow depths in the Lock Haven Formation was described in both the 1998 and 2006 USGS reports, but ATSDR has failed to recognize or consider this fact. ATSDR's statement that methane and ethane being present together suggests groundwater impacts from natural gas activities is both factually incorrect and highly misleading to the public. Detectable quantities of present methane and ethane together have occurred in approximately 105 of the more than 7,500 baseline samples in Bradford County. The detection of methane and ethane together in a sample is not an indication that a well has been impacted by natural gas from exploration or production activities.

Further, the Consultation continued to exaggerate when it claimed to have found a "10-fold [increase in methane] compared to the pre-blowout concentrations." ATSDR again failed to follow standard practice with regard to evaluating split sample results where significant differences existed between individual results obtained from the same sample. And again, instead of re-sampling, ATSDR chose to cherry-pick results that allowed it to better support its apparently pre-conceived conclusion. Even if we accepted the cherry-

picked result, the methane increase was not "10-fold," but only 8.2 times the prior result. For context, the value of EPA's split sample was 2,600 µg/L.

For the other wells, ATSDR acknowledges that methane concentrations are variable and failed to even consider the pre-drill data for three of the seven wells. ATSDR did not acknowledge the natural variability of methane concentrations and did not account for this natural variability in analyzing the results for RW04. Indeed, in wells where concentrations went down, ATSDR did not assert that oil and gas development somehow reduced levels of these constituents in the environment. ATSDR presumably viewed downward natural variability as the obvious explanation; yet ATSDR's presumption is that any upward variability must be tied to oil and gas activity.

In addition, it appears that ATSDR skewed numbers in the Consultation to help support desired conclusions. For example, pre-drill methane data for RW02 is reported in the text as 340 µg/L; this is obviously inaccurate and lower than the actual value of 349 µg/L listed in Appendix D of the Consultation.

ATSDR also presented the sample results and comparison of results using units in a misleading way. For example, ATSDR states that dissolved methane ranged in concentrations from 7.4 µg/L to 6,200 µg/L, but notes that methane concentrations below 10 mg/L are generally considered safe. ATSDR compared methane concentrations of 6,200 µg/L to "safe" levels of 10 mg/L; this use of different units is highly misleading to the public. If ATSDR was attempting to present unbiased information that would be meaningful to the public, it would have pointed out that a methane concentration of 6,200 µg/L is well below the "safe" level of 10 mg/L (i.e., 10,000 µg/L). ATSDR's choice of units in this context presents a confusing at best and almost certainly misleading interpretation of the data that does not conform to the requirements of transparency and communication set forth in the ATSDR guidelines for public health consultations. For all of these reasons, the Consultation fails Information Quality Act standards for accuracy, objectivity, and completeness, and also makes the Consultation less useful to the public.

Relief Requested:

Chesapeake requests that the Consultation be publicly retracted. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR's statements regarding methane and ethane and the related discussion be amended to remove ATSDR's inflammatory and misleading statements as described above. Chesapeake requests that ATSDR amend Conclusion 1 to remove the unsupported suggestion that groundwater has been impacted by natural gas activities. Chesapeake requests that ATSDR use proper data analysis and data evaluation techniques when analyzing and reporting sampling results. Finally, Chesapeake requests that ATSDR conduct an unbiased characterization of methane in the groundwater of Bradford County and report the results in an unbiased Consultation based on the actual data.

22. <u>ATSDR Statement: Blank-Qualified Data Render RW04 Oil and Grease Results Wholly Illegitimate</u>

Objection:

ATSDR relied on "blank-qualified" data for Oil and Grease (HEM) to make unsupportable conclusions regarding the presence of hydrocarbons, especially in RW04.

Basis for Our Objection:

The data utilized to make statements regarding the presence of hydrocarbons in the well water samples under consideration was compromised by the presence of 2,900 µg/L Oil and Grease (HEM) in the blank sample (Appendix C of the Consultation). The samples results for RW01, RW02, RW03, RW05, RW06 and RW07 are below the concentration found to be in the blank. ATSDR makes conclusions regarding the presence of additional hydrocarbons in RW04 (Conclusion 1), however, based on a "blank-qualified" data result of 3,200 µg/L. The presence of nearly the same level of hydrocarbons in the "blank" suggests cross-contamination or other error which completely undermine the validity of that sample. When the potential contribution of 2,900 µg/L of hydrocarbons found in the blank is deducted from the result, the concentration left over would be 300 µg/L. Such a detection, if accurate, would certainly not support the dramatic conclusions presented by ATSDR in the Consultation. Further, EPA analyzed the samples in question for a range of other hydrocarbons, all of which were non-detected, suggesting that all of the detected HEM was a result of sampling or laboratory error or naturally-occurring compounds. The ATSDR fails to mention that organics detected by the HEM Oil and Grease method may include naturally-occurring hydrocarbons such as waxes, animal fats, mineral and vegetable oils, soaps, sulfur compounds, chlorophyll, etc. ATSDR makes no attempt to discern if the HEM is from naturally-occurring hydrocarbons but instead rushes to a conclusion suggesting that they must be from the ATGAS incident. This reflects incomplete explanation, a lack of objectivity, and an inaccurate and misleading approach to this issue.

The Consultation's conclusions regarding hydrocarbon increases based on blank-qualified HEM data are inaccurate, incomplete, inappropriate, unclear, biased, and misleading to the public.

Relief Requested:

Chesapeake requests the public retraction of the Consultation, especially with regard to Conclusion 1 and the related discussion suggesting that the presence of additional hydrocarbons reflects a potential impact of natural gas activities on the water quality in RW04. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR fully explain the existence and import of the blank-qualified data it relied upon in the Consultation.

23. <u>ATSDR Statement: Erroneous Conversion of Methane Concentrations</u>

Objection:

The conversion of methane concentration of 87 percent in air to a concentration in µg/L is incorrect (page 15).

Basis for Our Objection:

Methane is a simple asphyxiant at very high concentrations. Below the flammability limits, methane has practically no physiological effects (Clayton et al, 1981). The 87 percent concentration which causes asphyxiation is based on a study in mice and should not be directly applied to humans.

The concentration of 87 percent in air is a volume to volume measurement. This concentration cannot be converted directly to a concentration in water in µg/L, which is a weight to volume measurement, as is implied in the ATSDR document. At standard temperature and pressure, 87 percent methane in air would be equal to 56,932,000 µg/L of air. The Consultation's discussion of methane concentrations in air is inaccurate and incomplete.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR amend the Consultation to include the correct conversion of methane concentrations in air. Further, Chesapeake requests that ATSDR affirmatively explain that methane in air is not directly related to dissolved methane in water.

24. <u>ATSDR Statement: Sodium</u>

Objection:

ATSDR stated that water from well from RW04 would exceed the recommended dietary guideline for sodium for general and sensitive populations. Further, ATSDR indicated that sodium was "elevated" in wells RW02, RW03, RW05, RW06, and RW07. The use of the term "elevated" to describe naturally-occurring levels of sodium in groundwater is misleading, inaccurate, and inappropriate (Conclusion 2, page iii and iv). ATSDR states that the chloride SMCL is 250 mg/L because "water with chloride concentrations greater than this level tastes salty to most people." ATSDR discusses the association of sodium chloride and effects on blood pressure, cardiovascular and renal disease. Additionally, on page 16 of the Consultation, in the discussion on sodium, ATSDR presents information such that it appears that the sodium in the groundwater in the wells under consideration is the result of human activities and anthropogenic sources.

Basis for Our Objection:

Sodium concentrations are naturally occurring in wells RW02, RW03, RW04, RW05, RW06 and RW07 and not associated with the pressure control event during hydraulic stimulation operations at the ATGAS well pad. The use of the term "elevated" to describe these naturally-occurring concentrations is inappropriate, inaccurate, and misleading. Concentrations of sodium in pre-drill testing samples in these water wells ranged from 8,350 µg/L to 136,000 µg/L with an average of 66,700 µg/L. Five of the seven pre-drill testing samples, including RW02, RW04, RW05, RW06 and RW07, had sodium concentrations above the current EPA Drinking Water Advisory of 20,000 µg/L. EPA has acknowledged that the 20,000 µg/L guidance is out of date and probably set too low. It should be noted that EPA and WHO declined to propose a specific drinking water guideline for sodium because no firm conclusions could be drawn about the association between sodium in drinking water and the occurrence of hypertension (WHO, 2003).

With the exception of RW04 the sodium concentrations in 29 or more samples taken from each the seven nearby wells did not show any significant changes from the pre-drill baseline data.

For RW04, sample results for sodium were found to stabilize at concentrations similar to that found in the pre-drill sample (132,000 µg/L) when the well was not under heavy sustained use. The average sodium concentration for RW04 was 121,000 µg/L with a range of 51,300 to 167,000 µg/L during sampling conducted after RW04 was no longer in use for domestic purposes after May 18, 2011. This data is similar to pre-drill data and strongly supports SAIC's conclusion that results could be obtained similar to the pre-drill sample and not be fully representative of water quality within RW04. The reason for the changes in sodium (and other parameters) were thoroughly described in SAIC's report on RW04 submitted to the PADEP.

Chesapeake has conducted an extensive pre-drill testing program in the Marcellus Shale in areas where Chesapeake has interests, including Bradford County, Pennsylvania, where the ATGAS 2H well is located. Chesapeake pre-drill testing shows that a large percentage of samples tested from Bradford County naturally exceed the 20,000 µg/L as shown in the table below. The ATSDR did not fully consider the sodium pre-drill testing data that was provided to EPA in April 2011 during the first sampling event. The pre-drill testing data had also been previously supplied to the seven landowners and PADEP, and was available to the ATSDR. In addition, thousands of pre-drill data reports for Bradford County, Pennsylvania has previously been supplied to the PADEP and were available to ATSDR, but were not reviewed or considered.

Area	Number of Pre-drill Testing Samples Through 11/30/11	Number of Pre-drill Testing Samples with Sodium Detections Above EPA DWEL of 20,000 µg/L	% of Pre-drill Testing Samples With Sodium Detections above the DWEL of 20,000 µg/L
Bradford County, PA	7,543	3,447	45.7

Sodium occurs naturally in most groundwater. As would be expected, sodium detected in the water wells under consideration is naturally-occurring. In over 7,500 samples of water from wells collected in Bradford County, sodium was detected in 99.3 percent of the samples with a range of 1,000 µg/L to 3,700,000 µg/L (mean: 42,000 µg/L, median 18,100 µg/L). Approximately 45.7 percent of these baseline samples in Bradford County alone have sodium results which exceed the 20,000 µg/L evaluative criteria utilized by the ATSDR.

The USGS NURE-HRRS database for samples collected mostly in 1977 shows that approximately 19 percent of the 208 samples from Bradford County, Pennsylvania, had sodium concentrations in excess of 20,000 µg/L. A recent study released by the Center for Rural Pennsylvania found no relationship between natural gas activity and sodium levels in groundwater wells pre- and post-drilling (Boyer et al, 2011).

The supporting EPA documentation for the chloride SMCL as well as information on the taste threshold for chloride available from the WHO, indicates that the taste threshold for chloride is dependent upon the cation associated with the chloride and generally ranges between 200,000 and 300,000 µg/L. The association of chloride in drinking water and potential associations with effects on blood pressure has not been documented in the literature; these associations have been tied to the sodium content rather than the presence of chloride. Chloride toxicity has not been observed in humans except in the special case of impaired sodium chloride metabolism, e.g. in congestive heart failure. Healthy individuals can tolerate the intake of large quantities of chloride provided that there is a concomitant intake of fresh water. Little is known about the effect of prolonged intake of large amounts of chloride in the diet. As in experimental animals, hypertension associated with sodium chloride intake appears to be related to the sodium rather than the chloride ion (WHO, 2003).

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR properly characterize the rationale for the SMCL for chloride in the Consultation. Chesapeake requests that ATSDR amend the Consultation to appropriately characterize the potential health effects associated with chloride in drinking water. Chesapeake further requests that ATSDR put the detection of sodium above 20,000 µg/L

in proper context by fully explaining that it is naturally occurring in baseline samples at these levels and not as a result of natural gas-related activity.

25. <u>ATSDR Statement: Bromide</u>

Objection:

ATSDR presents a discussion of bromide as a contaminant of concern in Conclusion 4 (page iv and page 20) and did not indicate it is naturally occurring in groundwater (page 4).

Basis for Our Objection:

ATSDR acknowledges that bromide is not a concern but still presents it as if it was a contaminant of concern and related to the well control incident. Bromide is naturally occurring in groundwater and surface waters in the Bradford County area. The Consultation failed to provide adequate information indicating that bromide was naturally occurring and was to be expected in groundwater in Bradford County (pages 4 and 6 of the Consultation). From the very large 1977 USGS NURE-HRRS database the mean bromide value in groundwater from water wells in Bradford County PA was 96.4 µg/L (5.4 µg/L to 2,900 µg/L), and for surface water it was 56 µg/L (<2.5 to 1,340 µg/L). A limited set of pre-drill baseline data is available for Bradford County, all of which was collected subsequent to the baseline data collected from the seven wells in question. No bromide data was collected from the baseline samples for these seven wells. However, based on the limited baseline dataset for Bradford County, approximately 290 samples from water wells have been collected for analyses (detection limit 1,000 µg/L), and 25 samples (8.6%) had detectable concentrations above this detection level. Of these 25 samples, the bromide ranged from 5,335 µg/L to 24,600 µg/L, mean of 8,530 µg/L and median value of 7,480 µg/L. The bromide values for the seven wells are well within these background ranges for Bradford County, clearly indicating that none of these wells have been impacted with bromide as a result of the ATGAS incident.

Data are available for RW04 from April 2011 to September 2011. The bromide concentrations in the well were much lower after the well was taken out of service in May, 2011; the bromide levels dropped to between <1,000 to 2,730 µg/L. This further confirms SAIC's conclusion that RW04 is stratified and contains different water quality in the lower portion of the well. The occurrence of bromide is closely associated with the levels of chloride, and is naturally-occurring in well RW04. Although no pre-drill bromide concentrations are available from these wells, the patterns are similar to those for chloride. Additionally, even if bromide were a concern, the treatment system installed on RW04 reduces the concentration of bromide in the finished water. Sample results available for finished water after the treatment system show non-detected levels at <1,000 µg/L of bromide.

Relief Requested

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR adequately explain the natural occurrence and background levels associated with bromide and affirmatively conclude that natural gas activity has not affected bromide concentrations in groundwater.

26. <u>ATSDR Statement: Lithium</u>

Objection:

In RW04 and RW06, lithium was detected at a level exceeding the EPA Regional Screening Level and the Pennsylvania Medium Specific Concentration as discussed in Conclusion 5. ATSDR failed to adequately explain that lithium is naturally occurring in groundwater. Additionally ATSDR indicated in Conclusion 6 and elsewhere that the estimated lithium exposures could be of concern to individuals currently undergoing lithium therapy and other prescription drugs. This appears to be inflammatory and misleading to the public.

Basis for Our Objection:

Lithium is naturally occurring in groundwater and surface waters. ATSDR's failure to fully explain the natural occurrence of lithium is misleading in a report purporting to discuss the environmental effects of a well control incident. ATSDR also provided no background data in the Consultation but yet chose to describe the detected lithium concentrations as elevated. Concentrations found in the seven nearby domestic wells ranged from <50 µg/L to 193 µg/L and are naturally-occurring. A limited baseline pre-drill data-set is available for lithium in Bradford County. Of the 136 baseline samples analyzed, lithium was detected above the analytical detection limit of 50 µg/L in 31 samples, or 22.8 % of the samples tested. Of these 31 samples, the lithium ranged from 61.3 µg/L to 1,360 µg/L, mean of 220 µg/L and a median value of 122 µg/L. Clearly, lithium frequently occurs naturally in groundwater in Bradford County, and often in levels that naturally exceed the EPA Regional Screening Level and the PA Medium Specific Screening Concentration of 73 µg/L. Notably, the treatment system installed at RW04 reduces the concentrations of lithium to non-detect levels.

There was no evidence that any of the residents at RW04 or RW06 were currently undergoing treatment with any of the prescription drugs or lithium treatment. Therefore, inclusion of the major discussion of these issues appears to be inflammatory and designed to alarm well owners. Examining lithium as if it were a contaminant associated with the well control incident and the failure to put it in the proper context of natural occurrence was misleading.

ATSDR also failed to consider and discuss data available in the literature which would support that lithium in groundwater has a beneficial effect. Flanagan examined suicide rates in relationship to lithium and groundwater. The study determined that in areas

where the lithium concentration in groundwater was low, there were higher rates of suicide. The results of this study are suggestive that lithium may be beneficial.

Based on the Consultation's discussion of lithium, we believe that the Consultation fails Information Quality Act tests regarding completeness, objectivity, accuracy, and usefulness to the public.

Relief Requested

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that it provide a full contextual explanation regarding the natural occurrence of lithium, the absence of any link between detected lithium and natural gas activity, and a more complete picture of the potential health benefits associated with lithium in groundwater.

27. <u>ATSDR Statement: Strontium</u>

Objection:

ATSDR states on Page 3 that there is a notable increasing trend in strontium levels and warrant further consideration in future hydraulic fracturing-related groundwater sampling events.

Basis for Our Objection:

Since strontium results were not included in the pre-drill data evaluated by ATSDR statements regarding an "increasing trend" are inaccurate, false, and misleading. There are no pre-drill baseline data available for comparison; therefore, no trend exists as presented in Appendix D. A trend cannot be determined from a single data point; without two data points a comparison cannot be made. The ATSDR did not have sufficient data on which to make a comparison. Strontium is naturally-occurring in groundwater in Bradford County, PA. The strontium concentrations in the wells under consideration are well within the expected background range of water wells with sodium chloride type water and range from 140 to 80,000 µg/L (Table 12, USGS 1998). Further, baseline data for strontium is now being collected in NE Pennsylvania, but subsequent to baseline data collected from the seven wells in question. In a limited baseline data set for Bradford County, approximately 2,518 samples from water wells have been collected for strontium analyses, and strontium was detected in 2,353 of the samples or in 93.4% of the samples collected. The strontium ranged from <50 µg/L to 64,400 µg/L, mean of 790 µg/L and median value of 384 µg/L. The strontium detected in groundwater from the seven wells is naturally occurring and within ranges of background found for Bradford County.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR appropriately eliminate statements suggesting an increasing trend in strontium levels or any association of those levels with natural gas activity.

28. <u>ATSDR Statement: Barium</u>

Objection:

Inclusion of discussion regarding environmental sources of barium (page 10 of the Consultation) implies that the naturally-occurring barium in groundwater in Bradford County was somehow related to natural gas drilling activities. Comparison of the barium concentrations to a literature-based, single value concentration is inappropriate.

Basis for Our Objection:

ATSDR presented the range of background barium values to be 560 – 98,000 µg/L from the Devonian Lock Haven formation; however, in the text the comparison was made only to the concentration from a single USGS well (Br205) rather than to that naturally-occurring range. The 1998 USGS database shows this value is a single analysis from Br205 and the concentration is reported at 1,600 µg/L. The ATSDR text appears to indicate that there were multiple analyses for barium available in the USGS document for Br205 by use of the term "median," this is not the case; only a single value is listed in the USGS database for Br205. This is misleading, in that it implies that the maximum concentration of barium from the wells under consideration was above background. All of the measured concentrations were well within the background range for barium from the cited literature and from baseline data collected in Bradford County. From over 7,500 baseline samples collected from water wells in Bradford County, 7,348 (97.4%) had detectable concentrations of barium ranging from <10 µg/L to 50,400 µg/L. Approximately 289 (3.8 %) of these baseline samples had barium detected over the MCL of 2,000 µg/L. On page 36 and Table 12 of the USGS 1998 report, the natural occurrence of barium greater than the MCL is described as occurring from the restricted-flow zone of the Lock Haven and Catskill Formations. All of the barium concentrations in the wells were well within this background concentration range. Further, for all the wells except RW04, the barium concentrations were generally consistent between the baseline sample result and the April 27 or 28, 2011 sample results. The barium concentration in RW04 reflects the naturally occurring water quality that occurs within the lower stratified portion of the well.

ATSDR provides in the Consultation a lengthy description of the health effects of exposure to barium. Selective presentation of data appears to be associated with ATSDR's notion that the barium found in groundwater was related to mobilized barium due to the presence of released fluids from the ATGAS well pad.

Inclusion of a discussion of potential sources of barium in the environment implies that the concentrations measured in the seven wells had been impacted by anthropogenic activities which is clearly not the case at this site.

Relief Requested:

Chesapeake requests public retraction of the Consultation. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR provide an adequate comparison of barium and other naturally-occurring substances to appropriate background ranges rather than single values. Further, Chesapeake requests that ATSDR present consistent information regarding the natural occurrence of barium and other substances, such as arsenic, calcium, lithium, manganese, and magnesium in the Consultation.

29. ATSDR Statement: Barite

Objection:

ATSDR included a discussion of "Barite" on page 10 of the Consultation.

Basis for Our Objection:

There was no evidence that barite was used or released from the ATGAS well pad or that it has any association with oil and gas activities; discussion of barite in a report investigating a well control incident is inappropriate and inflammatory and has no scientific basis for inclusion.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that the discussion of barite be removed from the Consultation as irrelevant to the inquiry in question.

30. ATSDR Statement: Erroneous Transcription of Iron Data for RW02

Objection:

ATSDR states on page 7 that the iron concentration at RW02 is 500 µg/L and in Table 1 it is listed as 550 µg/L.

Basis for Our Objection:

Analytical data contained in tables and text must be the same and correct. The discrepancy in question is an inaccuracy in the report.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR verify the data utilized in the Consultation and correct all errors in the text and

tables regarding analytical results.

31. <u>ATSDR Statement: Health Effects of Iron</u>

Objection:

Although technically accurate, inclusion of discussions of rare health effects associated with iron on consumption of certain pharmaceuticals which might interact with an element, etc., are inflammatory and lead the reader to conclude there are significant potential health effects associated with the release of materials from the ATGAS well pad and this is not the case.

Basis for Our Objection:

Iron deficiency is the most common known form of nutritional deficiency which occurs in the United States. Its prevalence is highest among young children and women of childbearing age (particularly pregnant women). The percentage of iron absorbed (i.e., iron bioavailability) can vary from less than 1% to greater than 50% (19). The main factor controlling iron absorption is the amount of iron stored in the body. The gastrointestinal tract increases iron absorption when the body's iron stores are low and decreases absorption when stores are sufficient. Among adults, absorption of dietary iron averages approximately 6% for men and 13% for nonpregnant women in their childbearing years. The higher absorption efficiency of these women reflects primarily their lower iron stores as a result of menstruation and pregnancy. Iron bioavailability also depends on dietary composition. Primary prevention of iron deficiency means ensuring an adequate intake of iron. ATSDR's characterization of iron in drinking water as a potential health concern appears to be contrary to recommendations from both the CDC and the National Institutes of Health, that supplementation with iron fortified foods, water, etc. is necessary to avoid iron deficiency. As stated on page 31 of the 1998 USGS Report, elevated concentrations of dissolved iron are common in groundwater of Bradford, Tioga, and Potter counties with about 50% of the wells sampled during that pre-1998 investigation having iron levels above the EPA SMCL. The ATSDR references this 1998 USGS report but fails to point out this statement that shows iron is naturally occurring in groundwater in the area, and iron frequently occurs naturally above the EPA SMCL. In addition, pre-drill baseline data collected for Bradford County show that iron was detected in approximately 4,432 of the over 7,500 water well samples analyzed, and 25.3% (1,906 samples) exceeded the EPA SMCL. The iron concentrations in this database ranged from <50 µg/L to 350,000 µg/L, mean of 1,310 µg/L and median of 236 µg/L. Iron concentrations in all water wells evaluated in the ATSDR Consultation were well within background levels for the area, and none of these wells were impacted by the ATGAS incident.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR clarify that natural gas activity is not a source of increased iron in the wells and

acknowledge in its discussions of iron that groundwater can be a source of iron which assists in preventing iron deficiency in most persons.

32. <u>ATSDR Statement: Claim of Increasing Trend in Lithium Values</u>

Objection:

ATSDR states that GTI reported an "increasing trend" in lithium values and attributes potential responsibility for the lithium concentrations in RW04 to natural gas activity.

Basis for Our Objection:

The GTI report (Hayes, 2009) provides concentration data for both influent water and 5-day flowback water samples from wells in 19 locations within the Marcellus Formation. Lithium is known and expected to occur in produced formation water. Lithium is also known to occur naturally in groundwater as discussed earlier; therefore the presence of lithium is not unexpected in the groundwater. Lithium is now included in the Chesapeake baseline sampling program. Lithium results are available for 136 baseline water well samples collected from water wells in Bradford County, lithium was detected in 31 samples. The range of detected values was from 61.3 µg/L to 1,360 µg/L with an average detected value of 220 µg/L. The Consultation misleads the public by suggesting that there was an increasing trend of lithium values in groundwater in the seven water wells in the ATGAS pad area. The ATSDR only had a single value for each of the seven water wells they were considering, and no baseline lithium values are available from these seven water wells. No trend can exist when data from only one sampling is available for review.

The lithium concentrations encountered in RW04 are naturally present in the geologic formation and therefore are present in the groundwater. Attribution of lithium at RW04 to natural gas activity was not supported by the data presented in the ATSDR Consultation.

Relief Requested:

Chesapeake requests public retraction of the Consultation. Should ATSDR thereafter publish a new or revised Health Consultation, Chesapeake requests that ATSDR omit these false and misleading statements regarding increasing trends in lithium concentrations in groundwater and/or the attribution of lithium concentrations to natural gas activity.

33. <u>ATSDR Statement: Background Manganese Concentrations in Groundwater</u>

Objection:

ATSDR reported background groundwater concentration values for manganese in groundwater of 4 µg/L to 32 µg/L on page 14 of the Consultation citing the 2008 draft

Toxicological Profile for Manganese (ATSDR, 2008).

Basis for Our Objection:

ATSDR had previously reported in Table 1 the site-specific background values for manganese in groundwater and also had baseline sampling results of manganese for the wells under consideration. It is misleading to the reader to suggest that the manganese concentrations for the seven wells in question are not within background values. Further, the background values noted as ranging from 4 to 32 µg/L were cited in the referenced document in the context of finished public drinking-water supplies (ATSDR, 2008, page 361). Within the same document, the preceding paragraph presents specific ranges of manganese in groundwater and reports the range of groundwater manganese concentrations to be between 20 and 90 µg/L (ATSDR, 2008, page 358). Baseline manganese data for water wells completed in Bradford County show that out of over 7,500 analyses, manganese was detected in 4,214 of the samples, or in 55.9% of the samples tested. Manganese was detected over the EPA SMCL of 50 µg/L in 2,978 of the samples or 39.5 % of the samples tested. Manganese ranged in this baseline database for Bradford County from <15 µg/L to 124,000 µg/L, mean of 210 µg/L and median of 23.8 µg/L. Manganese frequently occurs naturally in groundwater in Bradford County above the EPA SMCL, and that natural occurrence is well documented in the literature. The 1998 USGS report, on page 31, states that about 50% of the wells sampled in that study exceeded the EPA SMCL for both iron and manganese. The ATSDR references this 1998 USGS report but fails to point out this statement showing manganese is naturally occurring in groundwater in the area and that manganese frequently occurs above the EPA SMCL. The manganese that occurs in groundwater from the seven wells is naturally occurring and well within background ranges for Bradford County, and none of these seven wells were impacted by the ATGAS incident. ATSDR's failure to discuss known indications that manganese is naturally and commonly present above the SMCL reflects a failure to use complete information, the best information, objectivity, and good scientific practices.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR correct the incorrect statements regarding manganese concentrations in groundwater and revise the Consultation to reflect the data available from the literature, data from Bradford County baseline samples, and the baseline samples associated with the seven wells in question.

34. <u>ATSDR Statement: Manganese Health Effects</u>

Objection:

The Consultation provides incomplete and misleading summaries of toxicological information regarding the relationship between health effects and manganese in well water (page 15).

Basis for Our Objection:

ATSDR, in citing its own draft Toxicological Profile for Manganese (ATSDR, 2008), failed to provide the entire context of the toxicological information presented regarding potential health effects and manganese exposure from well water. ATSDR chose to summarize only two of the several studies discussed in the Toxicological Profile on pages 274 and 313 in the context of potential neurological health effects associated with exposures with manganese. ATSDR states on page 313 of the Toxicological Profile that "evidence for neurotoxicity in humans following oral exposure to manganese is inconclusive due to several limitations in the majority of the reports." The Japanese study cited on page 15 was found to be limited by ATSDR as evidenced in this statement from page 313: *"*[a]lthough many of the symptoms reported were characteristic of manganese toxicity, several aspects of this outbreak suggest that factors in addition to manganese may have contributed to the course of the disease.*"* Presentation of this selected material regarding manganese toxicity and the failure to adequately explain the limitations of the data appears designed to mislead and alarm the public.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR revise the discussion regarding health effects associated with manganese in drinking water to adequately reflect the nature and limitations of the whole body of data on this issue.

35. <u>ATSDR Statement: Chlorides</u>

Objection:

ATSDR states that the chloride SMCL is 250 mg/L because "water with chloride concentrations greater than this level tastes salty to most people."

Basis for Our Objection:

The supporting EPA documentation for the chloride SMCL as well as information on the taste threshold for chloride available from the WHO, indicates that the taste threshold for chloride is dependent upon the cation associated with the chloride and generally ranges between 200 and 300 mg/L (WHO, 2003).

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR properly characterize the rationale for the SMCL for chloride in the Consultation.

36. ATSDR Statement: Unfounded Recommendation for Additional Sampling Near ATGAS Well Pad

Objection:

ATSDR has recommended additional sampling be conducted in the area adjacent to the ATGAS well pad.

Basis for Our Objection:

ATSDR did not make use of any of the currently existing data available for the area adjunct to the ATGAS well pad. It seems incongruous to request additional data collection when ATSDR essentially ignored other available data. Chesapeake has collected over 735 samples following the pressure control event in order to determine whether or not there were any short- or long-term impacts to the surrounding environment, including the groundwater aquifer that is currently utilized as a drinking water source by nearby residents. Data for approximately 300 samples collected from all nearby water wells have been transmitted to the PADEP and provided to the individual well owners prior to the November 4, 2011 issuance of the Consultation. The seven water wells nearby have been sampled a minimum of 29 times each by Chesapeake since the pressure control event occurred. A report summarizing the first two weeks of sample results for the domestic wells (April 20 to May 2, 2011) was submitted to the PADEP on August 30, 2011. A report which evaluated soil, sediment and shallow perched groundwater sample results was provided to the PADEP on October 17, 2011. The data available in these reports support Chesapeake's conclusions that groundwater was not impacted by the pressure control event which occurred on April 19 and 20, 2011. ATSDR did not review either of these reports. If ATSDR had reviewed this more extensive data set rather than relying on a single set of sample data, it would be anticipated that other conclusions would have been reached. No further evaluation is necessary at this site.

Relief Requested

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR first fully consider the tremendous array of existing data before suggesting sweeping new sampling and investigation efforts.

37. ATSDR Statement: Unfounded Recommendation for Extensive Regional Sampling and Studies

Objection:

Chesapeake objects to ATSDR's use of data from a single sampling event involving seven water wells as constituting sufficient evidence to recommend that lengthy and expensive environmental studies and substantial drinking water well testing are warranted in all of the Marcellus Shale. Especially in light of substantial additional data that ATSDR failed to consider altogether, this premature conclusion reflects a lack of

objectivity, evidence of bias, and an absence of sound scientific reasoning.

Basis for Our Objection:

Chesapeake and its contractors have collected over 7,500 baseline water well samples in Bradford County. Other natural gas operators have collected thousands of additional samples as well. Baseline water sampling in areas of natural gas development is required by the PADEP and data are reported to the PADEP. There is no need for additional sampling of water wells in the areas underlain by the Marcellus Shale. Natural gas development is active in other parts of the United States and it appears that ATSDR is only interested in residents with water wells in areas underlain by the Marcellus.

Methane, ethane, lithium and strontium are already included in the Chesapeake baseline sampling program. Similarly, Chesapeake does not believe that addition of radiochemistry and radon to baseline sampling programs is warranted at this time in the absence of any evidence of concern.

Relief Requested

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR eliminate recommendations for sweeping and costly region-wide studies based on the extensive existing data that invalidates the Consultation's conclusions suggesting the existence of any basis for such an effort.

38. <u>ATSDR Statement: Unfounded Recommendation for Extensive Residential Testing Based on Single Sampling Event</u>

Objection:

Chesapeake is disturbed that ATSDR would use data from a single sampling event for seven water wells to conclude that residents should conduct substantial drinking water well testing each year.

Basis for Our Objection:

The data do not support this recommendation. ATSDR appears to ignore the state water regulatory programs for private water wells. These agencies have not required this level of testing on an annual basis. This would represent an undue economic burden on private well owners. In many areas with natural gas activity, natural gas production companies are providing baseline water sampling and these states have their own requirements for water well sampling. State environmental laboratories are not equipped to handle this level of testing of private water wells; third party analytical laboratory testing would be expensive and further, the laboratory capacity is probably insufficient to handle this level of testing.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR omit any such recommendation in light of the substantial additional data collected about the incident in question and the existence of appropriate state regulatory programs for private wells.

39. <u>ATSDR Statement: Inaccurate Statement About Duration of Environmental Sampling</u>

Objection:

ATSDR indicated in the data limitations section that environmental sampling data were limited to a 7- to 8-day period after the well control incident.

Basis for Our Objection:

ATSDR did not consider the body of air, soil, sediment and surface water sampling data which was available for the area adjacent to the ATGAS well pad. Air-quality monitoring was initiated on April 20, 2011 within about 15 hours of the well control incident. Headspace methane readings were available for all samples collected during the ATGAS investigation of water wells. The first two weeks of data were made available to the PADEP in the initial site characterization report submitted to the PADEP on August 30, 2011 (SAIC and GES, 2011). Additional air-quality monitoring data were presented in the final surface water and well water site characterization report which was submitted to the PADEP on December 22, 2011 (SAIC, GES and IEM, 2011). Soil, shallow groundwater, and sediment sampling results were provided to the PADEP on October 18, 2011 in the soil, sediment, and shallow groundwater report (SAIC, 2011b).

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR consider all of the available data and make accurate statements regarding the existence and duration of such data.

40. <u>ATSDR Statement: Ready Mobilization of "Naturally-Occurring Chemicals"</u>

Objection:

ATSDR states "naturally occurring chemicals are readily mobilized in the environment by natural gas drilling and hydraulic fracturing activities." (Page 2). Further, ATSDR states that relatively higher concentrations of naturally-occurring chemicals can be found in deep formations compared to surface soils. This statement is false. The use of the word "chemical" to characterize naturally-occurring elements in soils is also inappropriate.

Basis for Our Objection:

ATSDR makes a broad statement regarding the impact of natural gas drilling on naturally-occurring chemical mobilization. This general statement is not necessarily true. No scientific basis for the statement that naturally-occurring chemicals are readily mobilized by natural gas drilling and hydraulic fracturing activities were provided in this document to support this statement. No references were cited which support this statement. Surficial soils often contain concentrations which are orders of magnitude higher in concentrations of elements, such as lead, arsenic, iron, manganese, barium, etc., than natural formation fluids from natural gas producing zones.

Chloride, strontium, lithium, manganese, etc. are elements and elemental constituents of soils, geological formations and formation fluids. The word "chemical" is inflammatory and suggest to the uninitiated reader that these were manufactured products which were added to soils, etc.

Relief Requested:

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that ATSDR correct its previously inaccurate statements regarding mobilization of naturally-occurring constituents by natural gas drilling and hydraulic fracturing and relative concentrations of those constituents in shallow soils versus deep formations.

41. <u>ATSDR Statement: Recommendation for Surface Water and Fish Samples, Sharing of Data with Health Professionals</u>

Objection:

ATSDR indicates as a part of the Public Health Action Plan that additional groundwater sampling results will be reviewed as well as data from surface water and fish samples. Further ATSDR has indicated that results of the Consultation will be shared with community members and health professionals.

Basis for Our Objection:

The data from two additional rounds of sampling conducted by the EPA in July and September, 2011 were available prior to the release of the Consultation which would have fulfilled the need for additional groundwater sampling. Further, Chesapeake shared the results and analytical reports of the domestic groundwater sampling with the individual landowners. ATSDR did not avail themselves of the reports provided to the PADEP, prepared for Chesapeake by URS, which detailed the results of surface water monitoring and fish tissue sampling. These results had been provided to the PADEP for several months prior to the release of the Consultation in November 2011. Additionally, PADEP had been provided with the SAIC and GES prepared report which detailed the results of surface-water sampling that had been conducted from April 19, 2011 to May 2,

2011 (SAIC and GES, 2011).

Relief Requested:

Chesapeake would request that due to numerous flaws in the Consultation that ATSDR publicly retract and not use it as the basis for any meetings with the community or health professionals. Should any such meetings occur, Chesapeake requests that ATSDR include a full presentation on the serious flaws and limitations of the Consultation. Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that it reflect the performance of all relevant studies and include consideration of all of the existing and available data.

42. <u>ATSDR Statement: Recommendation that Post-Treatment Sampling Results Be Provided to Public Health Authorities</u>

Objection:

In Recommendation 1, ATSDR has recommended that post-treatment system results from RW04 be shared with public health authorities.

Basis for Our Objection:

Private water well quality is not regulated by ATSDR and as such it is the well owner's decision whether or not to share the results of any post-treatment system sampling with ATSDR. The treatment system was installed and other actions were undertaken at RW04 as a voluntary action on behalf of Chesapeake unrelated to the well control incident. The treatment system has been sampled on three occasions. These data have been shared with the PADEP and are included in the final site surface water and water well characterization report which was submitted to the PADEP on December 22, 2011 (SAIC, GES and IEM, 2011).

Also, ATSDR in Recommendation 1 incongruously recommended that post-treatment results for Chesapeake installed treatment system at RW04 should be shared with public health authorities but did not include a similar recommendation for sharing post-treatment results from the EPA-installed treatment system at RW02.

Relief Requested

Should ATSDR publish a new or revised Health Consultation, Chesapeake requests that it remove this suggestion.

Conclusions

The objections described document significant omissions, errors, and unsupported interpretative statements and recommendations that result in the Consultation failing to meet the requirements of the OMB, HHS, and CDC/ATSDR Guidelines and the

underlying statute. These inadequacies in the quality of the information presented have adversely affected the Affected Parties.

To address these errors and publicly correct the record on issues that profoundly affect public policy, environmental protection, regulation, and litigation, Chesapeake hereby requests that ATSDR (i) formally and publicly retract the Consultation and (ii) acknowledge its errors and announce the retraction of the Consultation in a press release as part of a public rollout calculated to effectively reach the same audience reached through the original issuance of the Consultation and associated press release. Thereafter, should ATSDR publish a Health Consultation covering the same subject matter, Chesapeake requests that ATSDR utilize the best available information and peer-reviewed sound science, select and present its data in an objective manner, and provide a clear, accurate, complete, and scientifically sound consultation containing none of the numerous errors identified herein.

If additional clarification is desired regarding any specific objections, or there are any questions from ATSDR, the Affected Parties will be glad to provide additional input. We look forward to receiving ATSDR's acknowledgement of this Request for Correction and a response within sixty (60) days as specified in the CDC/ATSDR Guidelines and to resolving these concerns with the Consultation. We appreciate your consideration of the matters addressed herein and request that ATSDR promptly grant the Affected Parties the relief requested in connection with each of the items addressed above as and to the extent required by the CDC/ATSDR, HHS, and OMB Guidelines and the Data Quality Act.

Sincerely yours,

/S/

Timothy A. Wilkins
Bracewell & Giuliani, LLP
On behalf of Chesapeake Energy Corporation

cc: Thomas R. Frieden, Administrator
Christopher J. Portier, Director
ATSDR

References Cited:

ATSDR, 2008. Toxicological Profile for Manganese (update draft)

Boyer, EW et al, 2011. The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies, Center for Rural Pennsylvania, October.

Centers for Disease Control, 1998. Recommendations for the Prevention and Control of Iron Deficiency in the United Stated, MMWR 47:1-36.

Clayton and Clayton, 1981. Patty's Industrial Hygiene and Toxicology, Volume 2B Toxicology.

Flanagan, WM, 2006. Dissolved Lithium Concentrations, Gender, Race, and the Geography of Texas Suicide Mortality Rates 1980-1998: A Correlation Study, University of North Texas.

Hayes, T, 2009. Sampling and Analysis of Water Streams Associated with the Development of Marcellus Shale Gas, Final Report, Gas Technology Institute, December 31.

Low, DJ and DG Galeone, 2006. Reconnaissance of Arsenic Concentrations in Ground Water From Bedrock and Unconsolidated Aq1uifers in Eight Northern-Tier Counties of Pennsylvania, Report 2006-1376.

SAIC, 2011a. Haire Water Well Water-Quality Investigation, Leroy Township, Bradford County, PA, July 13.

SAIC, 2011b. ATGAS Investigation Soil, Sediment, and Shallow Groundwater Characterization Report, October 18.

SAIC and GES, 2011. ATGAS Investigation Initial Site Characterization and Response, April 19, 2011 to May 2, 2011, August 30.

SAIC, GES, and IEM, 2011. ATGAS Investigation Final Surface Water, Springs and Water Well Site Characterization Report, December.

USGS, 1999. A Retrospective Analysis on the Occurrence of Arsenic in Ground-Water Resources of the United States and Limitations in Drinking-Water-Supply Characterizations, Report 99-4279.

USGS, 2011. National Uranium Resource Evaluation (NURE) database, queried on-line at www.usgs.gov.

USGS, 2011. National Water Information System, web interface, queried on-line at www.usgs.gov.

WHO, 2003. Chloride in Drinking Water, Background Document for development of WHO Guidelines for Drinking-water Quality.

Williams, JH et al, 1998. Hydrogeology and Groundwater Quality of the Glaciated Valleys of Bradford, Tioga, and Potter Counties, Pennsylvania, Water Resource Report 68, Pennsylvania Geological Survey.

#3907102.1