



GEORGETOWN UNIVERSITY  
School of Nursing & Health Studies



**HARVARD**  
SCHOOL OF PUBLIC HEALTH

# **The Public Health System Response to the 2014 West Virginia Water Crisis**

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## Introduction

On Thursday, January 9<sup>th</sup>, 2014, approximately 10,000 gallons of crude 4-methylcyclohexane methanol (MCHM) spilled into the Elk River in Charleston, West Virginia. This occurred about a mile and a half upstream of the West Virginia American Water company (WVAWC) system intake, and subsequently contaminated the majority of the public water supply to nine counties in the state. The spill was detected the morning of its occurrence as it created a distinct odor. State and local officials worked throughout the rest of the day with the water company to identify the source of the spill and to characterize the risks facing consumers. By evening, WVAWC had issued a “do not use” (DNU) order and West Virginia Governor Earl Ray Tomblin appeared on television to announce that tap water was not safe for “drinking, cooking, washing, or bathing.”

Following this announcement, state and local health officials coordinated with the West Virginia National Guard to develop and implement an emergency water distribution plan. Meanwhile, WVAWC created a strategy to purge the chemical from the water supply system. Following guidance from the Centers for Disease Control and Prevention (CDC), officials agreed that an acceptable level of 1 part per million (PPM) of MCHM in the water supply must be reached in order to lift the DNU order. The concentration reached this threshold on Monday, January 13<sup>th</sup>, and the DNU order began being lifted in zones. By Friday, January 17<sup>th</sup>, the system was completely restored. Although many local, state, and federal officials declared the water safe and “acceptable for use,” many residents did not trust these assurances, and some avoided drinking tap water up to a year after the incident.

This report analyzes the public health system’s response to the crisis in the initial days and weeks following the spill with the goal of improving responses to future events. The “public health system” includes multiple levels of organizations and individuals, such as county and state public health departments, the CDC elected officials, the West Virginia National Guard, and other city, county, and state agencies that deal with emergency response and environmental issues. Private organizations in the affected area, such as the water company and hospitals, are also regarded as part of the public health system. This report analyzes the communication and coordination that occurred both within the public health system and in communications with the public. This report does not seek to review the events, policies, or actions that led to the contamination of the water supply nor does it attempt to assess any short- or long-term health effects associated with exposure to MCHM.

## Methods

This analysis is based on (1) a review of official reports, news articles, and other documents; (2) interviews conducted by the authors in Charleston on July 21-23, 2014; and (3) a “facilitated look-back meeting,” a no-fault discussion among key stakeholders to share their unique perspectives, held in Charleston on September 24, 2014. Interviewees and participants in the look-back meeting are identified in Appendix 1 but, honoring the conditions of participation, they are not quoted or identified by name in the report itself, and no conclusions should be attributed to any individual participant.

The authors are researchers from the Georgetown University School of Nursing & Health Studies and the Harvard T.H. Chan School of Public Health. This research, funded by the CDC, focuses on new approaches to learning from actual events affecting public health emergency preparedness system capabilities.<sup>1</sup> These approaches, which include root cause analysis, can be used in West Virginia and elsewhere to identify lessons learned from the response to public health emergencies and to improve responses to similar crises in the future. A secondary goal of this activity was to develop new methods for learning from actual public health emergencies. The findings and opinions expressed in this report are the views of the authors and do not necessarily represent the views of Georgetown University and the Harvard T.H. Chan School of Public Health.

This report was prepared at the invitation of the Kanawha-Charleston Health Department (KCHD). KCHD staff worked with the authors to identify individuals to be interviewed and to participate in the look-back meeting, and facilitated these activities. KCHD staff were given an opportunity to review a draft of this report for fact checking, but the conclusions are those of the authors.

This report is organized as follows. We begin with background information on the community and the organizations that responded to the incident, and then address two separate stages in the response: (1) recognition of the problem and characterization of its cause and (2) restoration of the water supply. In each stage we describe what happened and then analyze the public health system response using a root-cause analysis approach. We conclude with recommendations stemming from the analysis.

## **Background**

Charleston, West Virginia (population 50,000) is the state capital and houses the administrative offices of Kanawha County. This area is served by multiple city, county, and state agencies dealing with public health, environmental regulation, and emergency response including:

- the West Virginia Department of Health and Human Resources, which is responsible for human health and water regulation in the home;
- the West Virginia Department of Environmental Protection, which is responsible for regulation of the water outside the home and public works;
- the West Virginia Department of Homeland Security and Emergency Management;
- the West Virginia National Guard;
- the Kanawha Charleston Health Department, which is responsible for health services and public health issues in both Kanawha County and the city of Charleston;
- the Kanawha County Homeland Security and Emergency Management agency;
- other county administrations and private organizations such as the hospitals and school systems.

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<sup>1</sup> For more information on these methods, see <http://www.hsph.harvard.edu/h-perlc/toolkits/ci/>

Most of these agencies, are located in Charleston within a short distance of each other, as well as being close to the offices of the Mayor of Charleston and the Governor of West Virginia. The WVAWC water intake and filtration facility, the main hospitals, and the local television and other mass media offices are also nearby.

West Virginia American Water Company serves the population of Charleston and Kanawha County, as well as much of the eight surrounding counties, approximately 300,000 people in total. WVAWC is the local affiliate of a for-profit company that serves approximately 14 million people in more than 40 states and parts of Canada. In West Virginia, the company operates as a regulated utility, following both regulations set by state authorities and federal standards.

Charleston is located in the Kanawha River valley, which is sometimes referred to as the Chemical Valley due to the high concentration of chemical manufacturers and storage facilities. Chemical spills are common in the valley, but few are severe. In recent years a release of toxic phosgene gas at a DuPont plant resulted in the death of a worker and a pesticide waste tank explosion at a Bayer CropScience Institute emitted toxic fumes, killing two workers. The relative frequency of these events has a dichotomous effect on the reactions of the population; while some residents are desensitized to chemical spills others exhibit a heightened awareness to potential dangers. The frequency of spills may also make it difficult to recognize the full impact of larger scale events. The concentration of chemical plants in the area means that technical expertise is available locally to help deal with chemical spills. This includes both private experts at companies such as DuPont and a special Chemical, Biological, Radiological and Nuclear (CBRN) unit of the West Virginia National Guard with the capacity to deal with chemical issues. Both of these groups were called upon during the 2014 crisis.

## **Recognition of the problem and characterization of its cause**

The state Department of Environmental Protection (DEP) first became aware of the spill on the morning of January 9<sup>th</sup>, when a hotline call reported a licorice-like odor in the air. Before noon, DEP and the Kanawha County Homeland Security and Emergency Management (KCHSEM) had identified Freedom Industry's Etowah River Terminal (ETH), located approximately a mile and a half upstream of the West Virginia American Water (WVAWC) intake on the Elk River, as the source of the spill and MCHM as the contaminant. WVAWC and the state Department of Health and Human Resources (DHHR) were immediately informed, and Freedom Industries officially notified the DEP spill hotline at 12:03 pm.

Once aware of the spill, WVAWC took steps to cope with the MCHM in their system. WVAWC initially believed that it could filter out the MCHM, but by mid afternoon it was clear filtering was not a viable option. At 3:16 pm, WVAWC notified its Kanawha Valley customers via press release and social media (Facebook and Twitter) that its treatment teams were closely monitoring the chemical spill. An hour later, at 4:17 pm, WVAWC notified DHRR of its intent to issue a "Do not use" (DNU) order, and media alerts were posted at 5:14 pm to Kanawha, Putnam, Boone, Jackson, Lincoln counties.

In response to these events, DHHR's Center for Threat Preparedness (CTP) set up a 5 pm

conference call, which included state and Kanawha County public health, environmental, and emergency response officials, WVAWC leadership, the Governor, and his press secretary. The Governor declared a state of emergency at 5:15 pm, while the DHHR conference call was still in progress, and held a news conference at 6 pm. President Obama declared a federal disaster early the next day, permitting the Federal Emergency Management Agency (FEMA) to join the response.

DHHR activated its Health Command Center at 5:40 pm, which began contacting hospitals in the affected area at 6:00 pm. At 6:10 pm, the State Emergency Operations Center (EOC) was activated. The Kanawha Charleston Health Department (KCHD) issued an order closing permitted facilities at 6 pm and, as the extent of the contamination became understood, other counties were notified and alerts issued. The National Guard's CBRN team established an operations center at the WVAWC plant and immediately began to develop a method to test for MCHM in the water. The first results came back by 9 pm that evening.

### *Analysis*

According to participants of the facilitated look-back, a number of things went well at this stage of the incident. Although chemical leaks are common in this area and accepted to some degree, and despite little being known about the risks of exposure to MCHM (see below for more about this issue), WVAWC as well as state and local officials understood that this incident presented an urgent public health concern and issued a DNU order. Once WVAWC recognized they could not filter out MCHM, the only alternative was to shut down the system completely. This would have created sanitation problems as well as public safety concerns, particularly in fighting fires. Moreover, because of the complexity and age of the water distribution system, simply shutting off the supply could have caused the system to collapse. Perhaps the DNU could have been issued a few hours earlier if WVAWC knew more about the chemicals stored upstream from its plant, but there is little disagreement that issuing the DNU was the right decision.

Within hours of the recognition that the spill was a public health issue, alerts were issued, state and local emergency command centers were activated, and the public notified, all following established protocols. According to a survey conducted by the Harvard T.H. Chan School of Public Health, 81 percent of the population heard about the event on January 9<sup>th</sup>, mostly through TV or radio. Local stores and supermarkets were out of bottled water within an hour of the Governor's press conference, which suggests that residents were aware of the DNU order. This can be credited to the actions of the local media and the official emergency response agencies. Additionally, no injuries were reported among responders despite bad weather.

Most of the public complied with the DNU order, although some did not fully understand why it was issued. Thus, while the objective of spreading the message in time for the 6 pm news on January 9<sup>th</sup> was achieved, the rapid response did not provide a complete understanding of the situation, which complicated matters as the water supply was restored.

Look-back participants noted problems in getting the word out to hospitals, local health departments, businesses, and the public. Although communication protocols were followed, the number and variety of stakeholders, plus multiple command and communication centers, made coordination of inter-agency efforts difficult. In particular, local health departments did not feel that they were notified in a timely manner. Some messages were sent through unusual channels. Hospital messages, for example, were sent directly from the State Health Officer to the CEO rather than following established protocol. Although the many informal communication channels present in the tightknit Charleston area were able to overcome some of these challenges, one lesson from the 2014 water crisis is that emergency communication protocols, which may work well for other types of emergencies, should be reconsidered when preparing for large-scale public health emergencies.

## **Restoration of the water supply**

Once the DNU was issued, the response efforts focused on ensuring that residents had water for drinking and cooking and maintaining the continuity of operations in hospitals, schools, and businesses. The National Guard led a coordinated effort to truck water into the affected area and set up distribution points; by all accounts this went well. Hospitals in the area followed their existing emergency response plans, but some discovered gaps in those plans about the necessary amount of water. For example, one hospital realized their plans were based on the assumption that other hospitals in the area would be operating as normal, rather than all having to respond to the same crisis.

Simultaneously, WVAVC worked in conjunction with state and local officials to develop a strategy for restoring the public water supply. MCHM was commonly used to wash clay and rock from coal before it is burned. The standard source of information on hazardous chemicals, the Material Safety Data Sheet (MSDS), says that "no specific information is available ... regarding the toxic effects of this material for humans." Some officials noted that MCHM isn't "hazardous" because it's not a material whose shipment is regulated by the federal Department of Transportation. This uncertainty was reflected in WVAVC President Jeff McIntyre's statement on Friday, January 10<sup>th</sup>, the day after the spill, that MCHM "is not a chemical that's typical to be in the water treatment process. ... We don't know that the water is not safe, but I can't say that it is safe."

To resolve this uncertainty, DHHR officials called the federal Agency for Toxic Substances and Disease Registry (ATSDR), affiliated with the Centers for Disease Control and Prevention (CDC), immediately after they were aware of the spill. ATSDR estimated that 1.0 parts per million (ppm) would be an acceptable level for drinking water, but this was based on little more than the MSDS and some limited animal studies and ATSDR did not provide any rationale for this standard. According to tests performed by the National Guard's CBRN team, the concentration of MCHM in the water system dropped from 2.0 to 1.7 parts per million on January 10<sup>th</sup>.

The contaminated water had to be flushed from the distribution system before water could be restored. The WVAVC distribution system is complex and it takes approximately 72 hours for the water

to move from the water filtration site on the Elk River to the end of the distribution system. The infrastructure is also aging, and lifting the DNU order for the entire system could have caused it to fail, especially in the cold weather. WVAWC thus devised a plan to lift the DNU order by zones, allowing the system to remain pressurized and clearing the contaminated water. Based on the ATSDR's calculations, WVAWC planned to lift the DNU order by zones as soon as the concentration of MCHM dropped below 1 ppm. By Monday, January 13<sup>th</sup>, the water was declared "safe" by Governor Tomblin, Charleston Mayor Danny Jones and others, and the DNU order was lifted in the first zone. On Friday, January 17<sup>th</sup>, the order was lifted in the ninth and final zone.

WVAWC created a color-coded map on its website to indicate when each zone should be flushed. The company also published information on how homeowners should flush their own systems at the appropriate time. Despite these efforts, some residents did not understand the plan or how to flush their home systems, and many flushed too early because they were eager to get their water operational. The state EOC understood that schools and hospitals had to be treated differently in the flushing process, due to the large quantity of water within their systems, but this was not clearly communicated.

As early as Sunday, January 12<sup>th</sup>, questions had emerged about the rationale for the 1 ppm level and the data on which it was based. At this time CDC was unable to say that the water was "safe" to use. On Wednesday, January 15<sup>th</sup>, CDC issued a one-page letter citing "limited availability of data" on MCHM but maintaining the 1 ppm threshold as "a protective level to prevent adverse health effects." In addition, "out of an abundance of caution" CDC recommended that pregnant women avoid using the water. That evening, midway through the week in which the DNU order was being lifted, DHHR issued an advisory to pregnant women not to drink the water until MCHM is undetectable. The order noted, however, that women should not expect adverse effects from water consumed past January 13<sup>th</sup>.

Uncertainties about the safety of the water continued, and even grew, after the final DNU order was rescinded. The estimated quantity of MCHM released increased from 2,500 gallons, as reported on January 9<sup>th</sup> to 10,000 gallons by January 27<sup>th</sup>. On Friday, January 17<sup>th</sup>, some of the data on which CDC based its calculations began to emerge, and experts noted that the critical difference between "pure" and "crude" forms of MCHM when assessing the risk of exposure. On January 21<sup>st</sup>, DHHR reported that two other chemicals, PPh and DiPPh, were also present in the faulty tank which caused the spill, and CDC released a toxicity report for these chemicals on February 3<sup>rd</sup>. CDC, while initially unwilling to say that the water was "safe," issued a statement on February 5<sup>th</sup> that the water was "appropriate to use." On Friday, February 21<sup>st</sup>, six weeks after the spill, CDC declared the water "safe."

As the National Guard CBRN unit improved its testing strategy they became able to detect lower concentrations of MCHM. On Sunday, January 18<sup>th</sup>, Governor Tomblin announced that concentrations of 10 parts per billion (ppb) could be detected, but that concentrations below CDC's threshold of 1 ppm (100 times higher) were still regarded as safe, except for use by pregnant women. Other experts suggested that other testing methods could detect concentrations as low as 1 ppb. On March 22<sup>nd</sup>, ten weeks after the initial spill, WVAWC reported that MCHM was undetectable at intake, but that water leaving the plant had persistent low levels of MCHM.

MCHM has a detectable odor even at very low concentrations, and many residents reported smelling it for weeks after the DNU orders were lifted. In early February, almost daily odor complaints caused school closures for several weeks (adding to extended closures due to weather earlier in the year). DHHR emergency operations continued into February to address these and other ongoing public concerns. Starting on February 18<sup>th</sup>, officials began hosting public forums for concerned citizens and local groups, such as People Concerned About Water, to discuss these issues. A lack of trust in public officials and the lingering odor of MCHM may explain why some residents refused to use the public water supply for months to a year after the water crisis was deemed over.

The state Bureau of Public Health established the West Virginia Testing Assessment Project (WV TAP) to conduct an independent scientific assessment of the safety of the public water supply in light of the lingering odor that same February. The WV TAP team reported in April that affected residents were accurate in their perception that MCHM remained in the system at very low concentrations, as tests consistently detected concentrations below 10 ppb of MCHM in residences a full month after the spill. The report also concluded that concentrations below 120 ppb for MCHM, 880 ppb for PPH and 260 ppb for DiPPH are safe for all uses and for all members of the population during short-term exposures.

### *Analysis*

Participants in the facilitated look-back sessions noted a number of things that went well in the restoration stage of the response. First, the DNU order was largely successful in reducing the use of the contaminated water. According to the Harvard survey, 60 percent of the population in the affected area complied with the order, compared to 20 percent in the rest of the state. In a KCHD survey of Kanawha County residents, 77 percent reported not using the public water supply during this time. Of those who did, the most common uses were washing hands (55 percent) and bathing and/or showering (78 percent). Of the users, 37 percent drank the water, 41 percent used it to brush their teeth, and 29 percent used it for cooking.

Despite the reduction in public water use, 32 percent of respondents in the KCHD survey reported that someone in their household experienced an illness they felt was related to the spill. Rashes or skin irritations were the most commonly reported signs, appearing in 64 percent of the households that reported a health condition attributed to the spill. Some also reported being worried, stressed and/or angry during and after the incident, but this might be related to uncertainty about the risks and the situation rather than MCHM exposure *per se*. KCHD and CDC sentinel data from hospital emergency departments both showed spikes when the DNU was issued and during the flushing process.

The coordinated effort led by the National Guard to truck water into the affected area and set up distribution points was also considered a success. As look-back participants put it, there were no riots, no one was hurt, and expected response times for other emergencies were maintained. The National Guard's CBRN unit also quickly developed and scaled up a sophisticated system for testing the MCHM level in the water supply. There was, however, one incident in which the "water buffalos," brought in to supply water to residents, were filled with water from WVAW's system, which undermined

trust in the emergency response system.

The biggest challenge faced by the public health system during this incident was risk management under uncertainty, and the implications of this on public communication. At the time of the spill, and even after the careful analysis of the WV TAP report, little was known about the health risks of exposure to MCHM. The official Material Safety Data Sheet (MSDS) carried little information, and CDC's initial analysis said that a 1 ppm concentration was acceptable. Many in the coal industry believe that occupational exposure to MCHM at higher levels than were present in West Virginia's water is harmless.

It is difficult to know whether CDC's original 1 ppm threshold adequately communicated the present uncertainty or whether the agency could have been pressed for a more precise estimate. However, given that the DNU order caused significant costs in terms of social and economic disruption, one can understand the motivation of officials to declare the water safe as soon as the concentration of MCHM was below 1 ppm. On the other hand, the limited evidence could not rule out the possibility of health effects at this concentration, and CDC would not declare the water "safe" until five weeks after the last DNU order was lifted. Regardless of the science, most agree "water is not supposed to smell like licorice." Thus from a public health perspective, one might say it is better to be safe than sorry and wait for definitive evidence of safety.

The inability of science to provide clear evidence about the water's safety was compounded by what seemed to be constantly changing "facts." Two days after the first zone reached the 1 ppm threshold deemed sufficient to prevent adverse health effects, CDC recommended that pregnant women avoid using the water "out of an abundance of caution." Furthermore, as testing methods were developed, smaller and smaller concentrations of MCHM could be detected. Although this did not signify any changes in the estimates of what was harmful, it added to the sense that the experts didn't know what was safe.

The most important consequence of the changing estimates, disparate statements, and uncertainty was an undermining of trust in officials. In ambiguous situations, risk communication experts recommend that health officials acknowledge the uncertainty and tell the public what is known, what is unknown, and what they are doing to get more information. Officials might have stressed that the 1 ppm threshold for lifting the DNU orders represented a compromise between uncertain health risk and the known consequences of the disruption in the water supply, as opposed to their strong assurances of water safety. This would have allowed residents to make their own decisions about how they used the water while providing them as much information as possible. As one look-back participant put it, officials should not "be more confident than they have a right to be."

Many residents did not understand the technical complexities of purging the MCHM from the WVAVC distribution system. The system could not simply be turned off and on again when it was safe. Rather the distribution pipes, as well as homes and businesses, had to be flushed in a specific sequence over a matter of days. Many residents neither understood the complex process of flushing their own homes nor that it needed to be done at a particular time. Hospitals, schools, and other large facilities

required different procedures for flushing, and this was not always made abundantly clear. Look-back participants felt that the confusion on these matters further undermined trust in officials.

Look-back participants suggested developing channels of communication through trusted sources as a way to combat lack of trust and improve communications. For some residents this might be elected representatives or faith communities. Emergency response officials could facilitate this by maintaining contact with leaders of these groups and by preparing and distributing one-pagers on key points to be communicated, such as the rationale and procedures for flushing home water systems. As discussed above, being honest about what is not known can help to build trust. One look-back participant suggested adding a science advisor into emergency response planning.

The long duration of this event presented another management challenge. The restoration of the water supply stage, which extended well beyond the lifting of the last DNU order, was longer than most emergency plans anticipated. There were multiple EOCs in operation simultaneously, and many officials had to adopt supplementary responsibilities” during this period, dealing with emergency duties in addition to their regular ones. The central role of WVAV in the response also complicated the management of this phase, as they had not been involved in local or state emergency preparedness. WVAV did not seem to have an emergency response plan, which is required by the Environmental Protection Agency but not by West Virginia, and was unfamiliar with standard National Incident Management Systems (NIMS) procedures. Although effective *ad hoc* solutions to these communication and coordination problems were developed during the incident, it was suggested that a more inclusive regional planning process could improve the response to future events of this type.

## Conclusions

The public health system responded effectively in many ways to the 2014 water crisis in the Kanawha Valley. Within hours of the recognition that the spill was a public health issue, a DNU order and alerts were issued, state and local emergency command centers were activated, and the public notified, all following established protocols. The public learned of the contamination quickly and took action immediately. No groups seemed to be disproportionately uninformed.

However, while established communication protocols were followed, the number and variety of stakeholders and multiple command and communication centers, made it difficult to get the word out to local health departments, hospitals, businesses, schools and the public. Local health departments did not feel that they were informed in a timely manner, and some messages were sent through unusual channels, complicating the response. To address this issue in the future, **emergency communication protocols should be reconsidered for large-scale public health emergencies to ensure that local health departments and hospitals are more fully incorporated.**

A number of things went well in the restoration stage of the response. The DNU order was largely successful in reducing the use of the contaminated water, the coordinated effort led by the National Guard to truck water into the affected area and set up distribution points successfully ensured

that residents had water for drinking and cooking, and the National Guard's CBRN unit quickly developed and scaled up a sophisticated system for testing the MCHM level in the water supply.

The biggest challenge that faced the public health system during this incident involved risk management under uncertainty. Little is known about the health risks of exposure to MCHM, and CDC's initial analysis said that a 1 ppm concentration was acceptable. However, the limited evidence didn't rule out the possibility of health effects at this concentration, and CDC did not declare the water "safe" until six weeks after the spill. This inherent uncertainty, plus what seemed to be constantly changing facts, undermined the public's trust in officials. In future, similar situations **officials should acknowledge the uncertainty and tell the public what is known, what is unknown, and what they are doing to get more information.** Residents could then have made their own decisions with as much information as possible.

The other challenge officials faced was managing a long-duration event. The restoration of the water supply took longer than most emergency plans had anticipated, multiple EOCs were in operation simultaneously, and many officials had to simultaneously deal with regular and emergency duties. The central role of WVAW, which had not been involved in local or state emergency preparedness, further complicated the management of this phase of the response. In order to improve communications and management during a long-duration wide-scale event in the future, **a more inclusive regional planning process should be undertaken.** Enactment of the Model State Emergency Health Powers Act<sup>2</sup> could also help to address these issues.

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<sup>2</sup> For more information see <http://www.publichealthlaw.net/ModelLaws/MSEHPA.php>

## **Appendix 1: Informants**

*Individuals interviewed on July 21-23, 2014*

### State government

Secretary Karen Bowling, Department of Health and Human Resources

Jerry Rhodes, DHHR Center for Threat Preparedness

Secretary Randy Huffman, Department of Environmental Protection

Larry Messina, Department of Military Affairs and Public Safety

Brian Burns and Michael Kitts, National Guard

Shayna Varner, Deputy Press Secretary, Governor's Office

### Local government

Mayor Danny Jones, City of Charleston

Grant Gunnoe, Department of Homeland Security and Emergency Services, City of Charleston

Dale Petry, Kanawha County Office of Emergency Management

Phillip Galapon & Julie Miller, Boone County Health Department

### Private sector

Lillian Morris, Charleston Area Medical Center

Ken Ward, *Charleston Gazette*

Bray Cary, West Virginia Media

Jennifer Pettigrew, "Ms. Groovy" Restaurant

Maya Nye, People Concerned About Water

*Participants at the September 24, 2014 facilitated look-back meeting*

State government

Delegate Nancy Guthrie, West Virginia House of Delegates

Jerry Rhodes, DHHR Center for Threat Preparedness

Mike Dorsey, Department of Environmental Protection

Melissa Cross, Department of Military Affairs and Public Safety

Michael Kitts, National Guard

Local government

Nasandra Wright and Janet Briscoe, KCHD

C.W Sigman, Kanawha County Office of Emergency Management

Brenda Isaac, Lead School Nurse, Kanawha County schools

Private sector

Nanci Keenan, Charleston Area Medical Center

Jennifer Pettigrew, “Ms Groovy” Restaurant

Maya Nye, People Concerned About Water

Project staff

Michael Stoto, Rachael Piltch-Loeb, and Christopher Long, Georgetown University

Elena Savoia, Harvard T. H. Chan School of Public Health

John Law and Ayan Jha, KCHD

## Appendix 2. Timeline

### *Stage 1: Recognition of the problem and characterization of its cause*

Thursday, January 9, 2014

- 8:15 am: WV Department of Environmental Protection (DEP) notified of odor complaint via hotline
- 11:30 am: DEP and Kanawha County Homeland Security and Emergency Management (KCHSEM) identify Freedom Industry's Etowah River Terminal (ERT) as the source and MCHM as the substance leaking
- Noon: WV American Water (WVAW) and WV Department of Health and Human Resources (DHHR) informed of spill
- 12:03 pm: Freedom officially notifies DEP spill hotline
- Noon – 4 pm:
  - Efforts to stop the spill at ERT facility
  - WVAW believes they can filter water, then realizes this will not work
- 2:13 pm: Kanawha County Homeland Security and Emergency Management (KCHSEM) press release
- 4:17 pm: WVAW notifies DHHR of intent to issue "Do not use" order
- 5:00 – 5:50 pm: DHHR conference call
- 5:15 pm: Gov. Tomblin declares state of emergency
- 6:00 pm: News conference
- 8:00 pm: KCHD closes local businesses

Friday, January 10, 2014

- Federal disaster declared and FEMA called in

### *Stage 2: Restoration of the water supply*

Friday, January 10, 2014

- Material safety data sheet (MSDS): "no specific information is available ... regarding the toxic effects of this material for humans"
- WVAW President: MCHM "is not a chemical that's typical to be in the water treatment process" ... "We don't know that the water is not safe, but I can't say that it is safe"
- Some officials quick to assure the public that MCHM isn't "hazardous" because it's not a material whose shipment is regulated by the federal Department of Transportation
- Material CDC/ATSDR advises that 1.0 parts per million would be an acceptable level for drinking water, rationale not given
- Water sampling begins, labs identified to analyze samples and concentration drops from 2.0 to 1.7 parts per million

Saturday, January 11

- Spill volume estimate increased

Sunday, January 12

- Questions emerge regarding rationale for 1 ppm level and the data on which it was based

Monday, January 13

- Water declared “safe” by Governor, Charleston mayor, others
- DNU order lifted by zones, originally as the concentration of MCHM drops below 1 ppm

Wednesday, January 15

- CDC issues caution to pregnant women using water
- DHHR advises pregnant women not to drink until MCHM is undetectable
- Should not expect adverse effects from drinking since January 13

Thursday, January 16

- Eastman toxicity data publicly released
- Facebook post: “West Virginia American Water has followed the regulatory guidelines and testing protocols required to lift the Do Not Use order ban, and we are fully confident that we are providing customers with drinking water that meets all regulatory standards.”

Friday, January 17

- DNU order lifted in last zone
- Questions arise regarding pure vs. crude MCHM

Saturday, January 18

- State announces detection limit changed to 10 parts per billion

Tuesday, January 21

- Presence of PPh and DiPPh in tank reported
- Gov. Tomblin advises residents they should make their own decisions about using water

Monday, January 27

- Spill volume estimate increased

Monday, Feb. 3

- CDC releases toxicity report for PPh and DiPPh

Wednesday, Feb. 5

- CDC declares water to be “appropriate to use”
- Almost daily odor complaints from schools and some school closures for several weeks

Friday, Feb. 21

- CDC declares water to be “safe”

Fri.-Sat. Mar. 21-22

- WVAW reports MCHM undetectable at intake but water leaving plant has persistent low levels of MCHM