Hi Audrey,

I have been working really hard with OGWDW for the past several months to make sure that the revised draft of the Chloramines Message Maps includes the comments that were provided by the ORD workgroup. Most recently, OGWDW and I worked on incorporating the comments received from Regions 2, 3, 6, and 8. We are getting closer to a final version now and OGWDW asked if I would share this draft with you. I have done my best to make sure that all of the ORD workgroup level comments were either incorporated or addressed. Mainly, I would like to get your input on the text in Question 19. This question is, "What is EPA's current focus regarding chloramines research? What other ongoing research is EPA aware of?" Both OGWDW and I thought it was really important that before this document is finalized that you are okay with the text in Question 19.

When you have a chance, please let me know if you have any comments on the text in Question 19, or if you have any suggestions on how the text might be improved. If you have comments on any of the other questions, please send those to me as well. It is most important however that you focus on Question 19 though.

I ask that you please do not share this draft document with anyone else. The ORD workgroup has not yet been given a chance to re-comment on this document. Since we last provided ORD workgroup-level comments 5/9/08, the discussions have been between OGWDW and myself. As I mentioned before, during my discussions with OGWDW the past few months, I have worked to ensure that all of the previous ORD workgroup-level comments have been either incorporated or addressed. Please do not hesitate to contact me if you have any questions.
Thanks,
Nicole

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1) What are chloramines?

Chloramines are disinfectants used to treat drinking water.
- Chloramines are most commonly formed when ammonia is added to chlorine to treat drinking water.
- The most typical purpose of chloramines is to protect water quality as it moves through pipes.
- Chloramines provide long-lasting protection as they do not break down quickly in water pipes.

The different types of chloramines are monochloramine, dichloramine, and trichloramine.
- When chloramines are used to disinfect drinking water, monochloramine is the most common form.
- Dichloramine and trichloramine are produced when treating drinking water but at much lower levels than monochloramine.
- Trichloramines\(^1\) are typically associated with disinfected water used in swimming pools.

The Environmental Protection Agency regulates the safe use of chloramines in drinking water.\(^2\)
- EPA requires water utilities to meet strict health standards when using chloramines to treat water.
- EPA chloramines regulations are based on the average concentration of chloramines found in a water system over time.
- EPA regulates certain chemicals formed when chloramines react with natural organic matter\(^3\) in water.

Additional Supporting Information:
1. Trichloramine formation does not usually occur under normal drinking water treatment conditions. However, if the pH is lowered below 4.4 or the chlorine to ammonia-nitrogen ratio becomes greater than 7:6:1, then trichloramine can form. Trichloramine formation can occur at a pH between 7 and 8 if the chlorine to ammonia-nitrogen ratio is increased to 15:1. Source: Optimizing Chloramine Treatment, 2nd Edition, AwwaRF, 2004
3. Natural organic matter is a complex mixture of compounds formed as a result of the breakdown of animal and plant material in the environment; Source: http://www.iwahq.org/templates/id_templates/layout_633184.aspx?Objectid=661579.
2) How long has monochloramine been used as a drinking water disinfectant? How is monochloramine typically used? How many people/water utilities use monochloramine?

**Monochloramine has been used as a drinking water disinfectant for more than 90 years.**

- Monochloramine has been shown to be an effective disinfectant based on decades of use in the U.S., Canada, and Britain.
- Monochloramine is usually used along with chlorine as part of the drinking water treatment process.
- Monochloramine helps protect people from waterborne diseases.

**Monochloramine is most often used to maintain water quality in the pipes.**

- Monochloramine provides long lasting protection of water quality.
- Monochloramine is effective as a disinfectant because it does not dissipate as quickly as chlorine.
- Monochloramine helps lower levels of potentially harmful regulated disinfection byproducts compared to chlorine.

**More than one in five Americans use drinking water treated with monochloramine.**

- Monochloramine use has increased in recent years due partly to new drinking water regulations developed to limit certain disinfection byproducts.
- New drinking water regulations limit the concentration of potentially harmful disinfection byproducts that may occur in drinking water.
- Several large cities such as Denver and Philadelphia have been using monochloramine as part of their treatment process for decades.

**Additional Supporting Information:**

2. For more information on waterborne disease visit: [http://www.cdc.gov/nc idod/diseases/list_waterborne.htm](http://www.cdc.gov/ncidod/diseases/list_waterborne.htm).
3. Continuous disinfection in the distribution system controls the growth of microbes and the development of biofilm. Drinking water in the distribution system is not sterile, regardless of the degree to which water is treated. The water contains microbes that survive the drinking water treatment process and may reproduce and form a thin layer - a biofilm - in the pipes. Microbes that form biofilms are typically harmless. However, the microbes that grow in the pipes and form a biofilm on the pipe wall may contribute to various problems including: 1) the release of coliform bacteria into the water, 2) disinfectant demand, 3) aesthetic water quality problems (e.g. unpleasant taste or odor), and 4) pipe corrosion. In addition, biofilms have been known to harbor microbes that cause disease, especially in severely immunocompromised persons. See Drinking Water Distribution Systems -- Assessing and Reducing Risks—chapters 6 and 7, [http://www.nap.edu/catalog.php?record_id=11728#toc](http://www.nap.edu/catalog.php?record_id=11728#toc)
4. See the Stage 1 and Stage 2 Disinfection Byproduct Rules for more information on new drinking water regulations ([http://www.epa.gov/safewater/disinfection/index.html](http://www.epa.gov/safewater/disinfection/index.html)).
BASIC INFORMATION ABOUT DRINKING WATER DISINFECTION

3) Why is drinking water disinfected? What is the difference between primary and secondary disinfection? How is monochloramine used in a treatment plant?

**Drinking water is disinfected to protect public health.**
- Prior to the widespread use of disinfectants, many people became ill or died because of contaminated water.
- Disinfection reduces and eliminates illnesses acquired through drinking water.
- EPA and CDC believe the benefits of drinking water disinfection outweigh the potential risks from disinfection byproducts.

**Primary disinfection kills or inactivates bacteria, viruses, and other potentially harmful organisms in drinking water.**
- Disinfection prevents infectious diseases such as typhoid fever, hepatitis, and cholera.
- Some disinfectants are more effective than others at inactivating certain potentially harmful organisms.
- Disinfection processes vary from water utility to water utility based on their needs and to meet EPA treatment requirements.

**Secondary disinfection** provides longer-lasting water treatment as the water moves through pipes to consumers.
- Secondary disinfection maintains water quality by killing potentially harmful organisms that may get in water as it moves through pipes.
- Monochloramine is commonly used as a secondary disinfectant.
- Monochloramine may be more useful than chlorine in killing certain potentially harmful organisms in pipes such as those that cause Legionnaire's disease.

Additional Supporting Information:
1. Not all federally-regulated ground water utilities are required to disinfect their water. Regulatory authorities work with utilities to decide if treatment is necessary.
2. See question 2 for additional history on drinking water disinfection.
3. Potentially harmful organisms include disease-causing bacteria, viruses, and protozoa. Chlorination and chloramination are not effective at inactivating Cryptosporidium. For information on alternative disinfectants and other oxidants visit [http://www.epa.gov/safewater/mdbp/mdbptq.html#disinfect](http://www.epa.gov/safewater/mdbp/mdbptq.html#disinfect).
4. For more information on these infectious diseases visit the following websites:
   - [http://www.cdc.gov/ncld/ddbmd/diseaseinfo/typhoidfever_q.htm](http://www.cdc.gov/ncld/ddbmd/diseaseinfo/typhoidfever_q.htm) (for typhoid fever);
   - [http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5717a6.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5717a6.htm) (for hepatitis);
5. All utilities that use surface water are required to treat or remove 99.99% of viruses and also to filter their water. However, some surface water systems may obtain waivers for filtration if the water comes from a protected source. Surface water systems must also have a detectable disinfectant residual in their distribution system. Ground water systems are only required to disinfect as necessary and are not required to have a detectable disinfectant residual. Ground water systems that are found to be influenced by surface water (for example, wells located next to rivers) are required to follow the treatment requirements for surface water. In addition, States may have more stringent treatment requirements and may, for example, require all of their ground water systems to disinfect. For more information on EPA surface water treatment requirements visit: [http://www.epa.gov/safewater/mdbp/implement.html](http://www.epa.gov/safewater/mdbp/implement.html) and for information on requirements for ground water systems visit: [http://www.epa.gov/safewater/disinfection/gwr/basicinformation.html](http://www.epa.gov/safewater/disinfection/gwr/basicinformation.html).
6. Secondary disinfection is also known as using a disinfectant residual.

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4) What disinfectants are available for drinking water?

Most water utilities use chlorine as a primary disinfectant because of its effectiveness in killing potentially harmful organisms.\(^1\)
- Chlorine is effective in killing bacteria, viruses, and other potentially harmful organisms in water.
- One disadvantage of chlorine is it can react with natural organic matter\(^2\) present in water to form potentially harmful disinfection byproducts.
- Water utilities sometimes use chlorine several times during treatment because the initial dose loses its effectiveness over time.

Monochloramine is commonly used as a secondary disinfectant\(^3\) to protect the water as it travels from the treatment plant to consumers.
- Monochloramine is effective in killing bacteria, viruses, and other potentially harmful organisms but takes much longer to act than chlorine.
- One disadvantage of monochloramine is it can react with natural organic matter present in water to form potentially harmful disinfection byproducts.
- Monochloramine is more chemically stable than chlorine, which makes it longer lasting and an effective secondary disinfectant.

Water utilities may use ozone, UV light, or chlorine dioxide as primary disinfectants in the treatment plant.
- Ozone, UV light, and chlorine dioxide are effective in killing bacteria, viruses, and other potentially harmful organisms in water at the treatment plant.
- One disadvantage of ozone, UV light, and chlorine dioxide is they do not provide protection as water travels through pipes.
- Either chlorine or monochloramine must still be used in addition to any primary treatment process to protect the quality of treated water as it travels from the treatment plant to the customer.

Additional Supporting Information:
See question 3 for a discussion of primary and secondary disinfectants. See questions 5 and 6 for a specific discussion of chlorine and monochloramine as a primary and secondary disinfectant.
1. Potentially harmful organisms include disease-causing bacteria, viruses, and protozoa. Chlorination and chloramination are not effective at inactivating *Cryptosporidium*.
3. Secondary disinfection is also known as using a disinfectant residual.
5) How effective is monochloramine vs. chlorine as a primary disinfectant?

**Monochloramine can be an effective primary disinfectant in limited situations.**
- Monochloramine takes much longer than chlorine to kill most potentially harmful organisms.¹
- Monochloramine can be used as a primary disinfectant but the amount of time needed for treatment makes it impractical for most utilities.
- But because it is longer lasting than chlorine, monochloramine is often used as a secondary disinfectant.

**Chlorine is a very effective primary disinfectant.**
- Chlorine is very effective at killing most potentially harmful organisms.¹
- Chlorine kills most potentially harmful organisms quickly.
- Chlorine is the most frequently used primary disinfectant of drinking water.

**A combination of disinfectants is often used for primary disinfection.**
- Primary disinfection usually consists of multiple disinfection steps that may start as the water enters the treatment plant.
- When used as a primary disinfectant, monochloramine effectiveness is increased by combining it with other disinfectants.
- The choice of which combination of disinfectants to use varies from water utility to water utility based on their needs and to meet EPA treatment requirements.²

**Additional Supporting Information:**
See question 3 for a discussion of primary and secondary disinfectants.
1. Potentially harmful organisms include disease-causing bacteria, viruses, and protozoa.
Chlorination and chloramination are not effective at inactivating *Cryptosporidium*.
2. All utilities that use surface water are required to treat or remove 99.99% of viruses and also to filter their water. However, some surface water systems may obtain waivers for filtration if the water comes from a protected source. Surface water systems must also have a detectable disinfectant residual in their distribution system. Ground water systems are only required to disinfect as necessary and are not required to have a detectable disinfectant residual. Ground water systems that are found to be influenced by surface water (for example, wells located next to rivers) are required to follow the treatment requirements for surface water. In addition, States may have more stringent treatment requirements and may, for example, require all of their ground water systems to disinfect. For more information visit: [http://www.epa.gov/safewater/mdbp/implement.html](http://www.epa.gov/safewater/mdbp/implement.html) and for information on requirements for ground water systems visit: [http://www.epa.gov/safewater/disinfection/gwr/basicinformation.html](http://www.epa.gov/safewater/disinfection/gwr/basicinformation.html).
6) How effective is monochloramine vs. chlorine as a secondary disinfectant?  

**Both chlorine and monochloramine are effective secondary disinfectants.**
- Both chlorine and monochloramine protect the quality of treated water as water travels through pipes.
- Both chlorine and monochloramine produce disinfection byproducts, some of which are harmful to human health.
- EPA and CDC believe the benefits of drinking water disinfection outweigh the potential risks from disinfection byproducts.

**Monochloramine has several advantages over chlorine as a secondary disinfectant.**
- Monochloramine is more chemically stable than chlorine.
- Monochloramine produces fewer potentially harmful regulated disinfection byproducts than chlorine.
- Monochloramine is longer lasting than chlorine offering continued disinfection, and making it useful for killing certain harmful organisms found in pipes such as those that cause Legionnaires' disease.

**The choice of which secondary disinfectant to use varies from water utility to water utility based on their needs.**
- Regulatory agencies and water utilities work together in selecting primary and secondary disinfectants.
- Regulatory agencies and water utilities balance a wide range of factors in deciding which disinfectant to use.
- Either chlorine or monochloramine are used as secondary disinfectants by water utilities.

**Additional Supporting Information:**
1. See question 3 for a discussion of primary and secondary disinfectants. Secondary disinfectants are also known as residual disinfectants. See questions 17 and 18 for advantages and disadvantages in monochloramine use.
2. See question 2 for a more information about protecting the quality of water as it travels through pipes.
3. EPA has enforceable regulations to limit occurrence of disinfection byproducts in drinking water for a group of four total trihalomethanes (TTHMs): (chloroform, bromodichloromethane (BDCM), dibromochloromethane (DBCM), and bromoform), a group of five haloacetic acids (HAA5) (monochloroacetic acid (MCA), dichloroacetic acid (DCA), trihaloacetic acid (TCA), monobromoacetic acid (MBA), and dibromoacetic acid (DBA)), and the individual byproducts chlorite and bromate. The maximum contaminant levels for these disinfection byproducts are: TTHMs (0.080 mg/L), HAA5 (0.060 mg/L), chlorite (1.0 mg/L), bromate (0.010 mg/L). See Stage 2 Disinfection Byproducts Rule (71 FR 388, January 4, 2006) for more information on disinfection byproducts and discussion of uncertainties, [http://www.epa.gov/fedrgstr/EPA-WATER/2006/January/Day-04/w03.pdf](http://www.epa.gov/fedrgstr/EPA-WATER/2006/January/Day-04/w03.pdf).
5. Factors include the type and condition of source water, how much water needs to be treated, complexity of operation, etc. Guidance manuals are available at: [http://www.epa.gov/safewater/disinfection/stage2/compliance.html](http://www.epa.gov/safewater/disinfection/stage2/compliance.html). Hard copies are available by ordering publications through EPA's Water Resource Center (phone: 202-566-1729).

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7) Why are disinfection byproducts a public health concern?

**Drinking water research indicates that certain byproducts of water disinfection have the potential to be harmful.**

- Some research indicates that certain byproducts of water disinfection are linked to increases in cancer incidence, including bladder cancer.
- Some research indicates that certain byproducts of water disinfection can be linked to liver, kidney, central nervous system problems, and reproductive effects.
- Some research indicates that certain byproducts of water disinfection can be linked to anemia.

**Assessments of the risks of water disinfection can be highly uncertain.**

- Scientists from many organizations conduct research on the effects of disinfection byproducts.
- In some cases research results are contradictory; some studies show links to adverse health effects and others do not.
- Regulatory documents describe the uncertainties in risk assessments of disinfection byproducts.

**The Environmental Protection Agency considers risk and uncertainty in establishing regulations for water disinfection.**

- Regulators weigh the public health benefits of disinfection against the risks of the potentially harmful disinfection byproducts.
- EPA sets limits for certain disinfection byproducts which are linked to health effects such as bladder cancer.
- EPA and other organizations continue to conduct research on disinfection byproducts.

**Additional Supporting Information:**

1. EPA has enforceable regulations to limit occurrence of disinfection byproducts in drinking water for a group of four total trihalomethanes (TTHMs) (chloroform, bromodichloromethane (BDCM), dibromochloromethane (DBCM), and bromofluor) and a group of five haloacetic acids (HAAs) (trichloroacetic acid (TCA), dichloroacetic acid (DCA), chloroacetichloroacetic acid (MCA), monobromoacetic acid (MBA), and dibromoacetic acid (DBA)), and the individual byproducts chlorite and bromate. The maximum contaminant levels for these disinfection byproducts are: TTHMs (0.080 mg/L), HAAs (0.060 mg/L), chlorite (1.0 mg/L), bromate (0.010 mg/L). See Stage 2 Disinfection Byproducts Rule (71 FR 388, January 4, 2006) for more information on disinfection byproducts and discussion of uncertainties, [http://www.epa.gov/fedreg/EPAWATER/2006/January/Day-04/w03.pdf](http://www.epa.gov/fedreg/EPAWATER/2006/January/Day-04/w03.pdf).
2. For more information on anemia and disinfection byproducts visit [http://www.epa.gov/owwdw/hfacts.html](http://www.epa.gov/owwdw/hfacts.html).
3. Also see question 8 for a discussion of how the regulated disinfection byproducts serve as indicators of other disinfection byproducts.

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8) How does EPA regulate disinfection byproducts (DBPs)?

EPA uses the presence of regulated disinfection byproducts as indicators of the presence of other disinfection byproducts.¹
- EPA sets limits for two individual and two groups of disinfection byproducts (DBPs)² that are linked to health problems.
- Disinfectants react with natural organic matter² to produce disinfection byproducts, some of which are of health concern.
- Recent EPA drinking water regulations require water utilities to reduce the concentrations of particular disinfection byproducts.³

**Water utilities must test water regularly to make sure regulated disinfection byproducts are within EPA limits.**
- EPA recently strengthened regulatory limits for certain disinfection byproducts.²
- Regardless of the disinfectant used, the types and concentrations of disinfection byproducts will also vary from day-to-day and among utilities.
- The concentration and type of disinfectant byproducts depends on many factors, including source water type, water temperature, the levels of natural organic matter in the water as well as the amount and type of disinfectant used.

**EPA conducts research to better understand disinfection byproducts in drinking water.**
- EPA scientists coordinate their research on disinfection byproducts with scientists from many organizations.
- Scientific studies are focused on identifying disinfection byproducts that may need to be regulated.⁴
- EPA scientists and decision makers review regulations of disinfection byproducts every six years to determine if they need to be revised.⁵

**Additional Supporting Information:**
1. EPA has enforceable regulations to limit the occurrence of disinfection byproducts in drinking water for a group of four total trihalomethanes (TTHMs) (chloroform, bromodichloromethane (BDCM), dibromochloromethane (DBCM), and bromofrom), a group of five haloacetic acids (HAAs) (monochloroacetic acid (MCA), dichloroacetic acid (DCA), trihaloacetic acid (TCA), monobromoacetic acid (MBA), and dibromoacetic acid (DBA)), and the individual byproducts chlorite and bromate. The maximum contaminant levels for these disinfection byproducts are: TTHMs (0.080 mg/L), HAAs (0.060 mg/L), chlorite (1.0 mg/L), bromate (0.010 mg/L). See Stage 2 Disinfection Byproducts Rule (71 FR 388, January 4, 2006) for more information on disinfection byproducts and discussion of epidemiological data on chlorinated water exposure and cancer, [http://www.epa.gov/fedreg/EPANWATER/2006/january/Day-04/w03.pdf](http://www.epa.gov/fedreg/EPANWATER/2006/january/Day-04/w03.pdf). TTHMs and HAAs typically occur at higher levels than other known and unknown disinfectant byproducts. The presence of TTHMs and HAAs is representative of the occurrence of many other chlorinated disinfectant byproducts; thus, a reduction in TTHMs and HAAs generally indicates a reduction of other types of disinfectant byproducts.
2. The two groups are total trihalomethanes and haloacetic acids. The two individual DBPs are chlorite and bromate.
3. Natural organic matter is a complex mixture of compounds formed as a result of the breakdown of animal and plant material in the environment. Source: [http://www.iwahq.org/][http://www.iwahq.org/]
4. See the Contaminant Candidate List online at [http://www.epa.gov/OGWDW/cpl/tcl5.html](http://www.epa.gov/OGWDW/cpl/tcl5.html) for contaminants EPA proposes to review.
5. EPA scientists consider new disinfection byproducts research as part of the six year review process. For information on the six year review process visit: [http://epa.gov/safewater/review.html](http://epa.gov/safewater/review.html).
9) How do the kinds and concentrations of disinfection byproducts formed by monochloramine compare to those formed by chlorine?

Water treated with chlorine and monochloramine contain different types and concentrations of disinfection byproducts.

- Compared to chlorine, water treated with monochloramine contains fewer regulated disinfection byproducts that have been linked to human health problems.
- The formation of disinfection byproducts is influenced by source water type and the type of disinfectant used.
- Formation can vary daily with the amount of natural organic matter in the water, temperature, rainfall, and distance from the treatment plant or other factors influencing water quality.

Compared to chlorine, water treated with monochloramine contains lower concentrations of regulated disinfection byproducts.

- Compared to chlorine, water treated with monochloramine contains lower concentrations of the two major types of regulated disinfection byproducts.
- Compared to chlorine, water disinfected with monochloramine contains fewer regulated disinfection byproducts linked to bladder cancer.
- Regardless of the disinfectant used, the types and concentrations of disinfection byproducts will vary from each utility and also from day-to-day.

Compared to chlorine, water treated with monochloramine may contain higher concentrations of unregulated disinfection byproducts.

- EPA scientists are currently studying the unregulated disinfection byproducts that form in water treated with monochloramine.
- Compared to chlorine, water treated with monochloramine may contain different unregulated disinfection byproducts than chlorinated water.
- EPA and other organizations continue to conduct research on unregulated disinfection byproducts.

Additional Supporting Information:
1. TTHM and HAA5 are the regulated disinfection byproduct groups that form at lower concentrations with monochloramine. See question 7 for more information about TTHM and HAA5. See question 19 for more information about unregulated DBP research.
2. Examples of these unregulated disinfection byproducts include nitrosamines (including nitrosodimethylamine, NDMA), lodo-trihalomethanes, and lodo-acids. See question 7 for additional detail on disinfection byproducts. For more information about EPA research on unregulated disinfection byproducts see question 19. Specific information on NDMA can be found at http://www.epa.gov/tio/download/contaminantfocus/epa542f07006.pdf

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10) Why are water utilities switching to monochloramine?

New EPA regulations require water utilities to reduce levels of regulated disinfection byproducts.¹
- Water utilities are required to comply with EPA's revised regulations.
- Water utilities are assessing if they need to make changes to comply with revised EPA regulations.²
- To meet the new regulations, a subset of utilities has decided to change their secondary disinfectant from chlorine to monochloramine.

Water treated with monochloramine contains reduced levels of regulated disinfection byproducts compared to water treated with chlorine.³
- Monochloramine produces lower concentrations of regulated disinfection byproducts because it is less reactive than chlorine with natural organic matter.³
- The formation of disinfection byproducts is influenced by source water type and the type of disinfection used.
- Formation can vary daily with the amount of natural organic material in the water, temperature, rainfall, and distance from the treatment plant or other factors influencing water quality.

Water utilities switching from chlorine to monochloramine report fewer consumer concerns about water quality.
- Water utilities switching from chlorine to monochloramine report fewer consumer concerns about the taste of water.⁴
- Water utilities switching from chlorine to monochloramine report fewer consumer concerns about odor.⁵
- Consumers may still notice a chlorine smell when utilities use monochloramine.⁶

Additional Supporting Information:
2. See question 11 for additional ways utilities could comply.
3. Natural organic matter is a complex mixture of compounds formed as a result of the breakdown of animal and plant material in the environment; Source: http://www.lwahq.org/templates/lid_templates/layout_633184.aspx?Objectid=661579
4. Certain home drinking water treatment systems and filters can reduce or eliminate chlorine taste and odor. See question 29 for more specific information about these devices.
11) Other than chlorine and monochloramine, what options could water utilities consider to reduce the levels of disinfection byproducts?

**Water utilities have several options for reducing disinfection byproducts other than chlorine and monochloramine.**

- One option for reducing disinfection byproducts is to reduce the amount of time water spends in pipes.
- One option for reducing disinfection byproducts is to use ozone or ultraviolet (UV) light.
- One option for reducing disinfection byproducts is improved filtration to reduce natural organic matter in water that react with disinfectants to form byproducts.

**The options for reducing disinfection byproducts have disadvantages.**

- Better system management to reduce the amount of time water spends in pipes or improved filtration methods may not be enough to reduce regulated byproduct levels.
- Ozone, UV and some improved filtration processes require a high level of sophistication, expertise, and management skills to operate successfully.
- One disadvantage of ozone and ultraviolet (UV) light is they require the installation of new and expensive technology, making it unpractical for many utilities.

**Utilities must still use chlorine or monochloramine to protect drinking water from harmful organisms in pipes.**

- The major disinfection alternatives to chlorine and monochloramine can reduce the formation of some disinfection byproducts but can increase the production of others.
- The major treatment alternatives for reducing disinfection byproducts do not by themselves provide adequate protection for drinking water as it moves through water pipes.
- EPA is encouraging water utilities to consider a full-range of alternative technologies and operational practices for reducing disinfection byproducts.

**Additional Supporting Information:**

2. Certain regulated disinfection byproducts will increase over time as water continues to react with natural organic matter. Natural organic matter is a complex mixture of compounds formed as a result of the breakdown of animal and plant material in the environment. Source: http://www.iwahq.org/templates/id_templates/layout_633184.aspx?ObjectID=661579. Options for reducing water age include flushing programs and eliminating dead-end locations in pipes.
3. UV is effective at inactivating disease-causing protozoa such as Cryptosporidium.
4. In some cases, natural organic matter (precursors to DBP formation) can be removed. Removal technologies include nanofiltration, enhanced coagulation, granular activated carbon, enhanced coagulation, or ozone followed by biologically active filtration.

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12) Does EPA require water utilities to use monochloramine? Who approves the decision for a water utility to use monochloramine?

*Each water utility chooses the most effective approach for disinfecting water and meeting regulations.*

- Water utilities work with regulatory agencies in deciding the best way to meet EPA regulations.
- Water utilities work with regulatory agencies in deciding the best way to reduce or eliminate harmful disinfection byproducts.
- Water utilities work with regulatory agencies in deciding whether to use monochloramine.

**EPA does not require water utilities to use monochloramine.**

- EPA does require water utilities to comply with EPA drinking water regulations.
- EPA's Regional Offices provide technical assistance to water utilities for complying with EPA drinking water regulations.
- EPA works with regulatory agencies regarding EPA drinking water regulations.

**Water utilities typically receive approval from a state agency or other authority for changes in disinfection processes.**

- Water utilities work with regulatory agencies to weigh the advantages and disadvantages of using monochloramine or other disinfectants.
- Water utilities typically notify customers of plans to use monochloramine.
- Contact your water utility for information about disinfection practices used to treat your water.

*Additional Supporting Information:*

13) What assistance does EPA provide water utilities considering a switch from chlorine to monochloramine?

**EPA provides regulatory guidance for water authorities considering a switch to monochloramine.**

- EPA provides regulatory guidance primarily through state regulatory agencies,¹ which in turn provide guidance to water utilities.
- Water utilities look primarily to state agencies for guidance since it is typically these agencies that approve changes in water treatment processes.
- Water utilities provide detailed information about drinking water quality to interested parties on request.

**EPA provides training for state and local water authorities considering changes in disinfection processes.**

- EPA develops guidance documents to help state and local water authorities better understand drinking water regulations.
- EPA works with state and local water authorities when they request additional guidance regarding EPA drinking water regulations.
- EPA manuals on water treatment and disinfection processes are available as printed documents or through the internet.²

**EPA representatives attend professional meetings to explain regulations regarding chlorine, monochloramine, and other disinfectants.**

- EPA provides specialized training on new disinfection byproduct regulation.
- EPA's Regional Offices provide technical assistance to water authorities seeking specific guidance on the new disinfection byproduct regulations.
- EPA has established a Drinking Water Academy for EPA staff, state regulators, tribes, and others on implementing new drinking water regulations.³

**Additional Supporting Information:**
1. A primacy agency has the primary responsibility for administering and enforcing regulations. Under the Safe Drinking Water Act; states, U.S. territories, and Indian tribes that meet certain requirements (such as setting regulations that are at least as stringent as EPA's) may apply for, and receive, primary enforcement authority.
2. Guidance manuals are available at:
   - Nitrile/Nitrate and lead control when changing disinfectants are discussed in EPA's simultaneous compliance manual which can be found at:
3. Information on the Drinking Water Academy is available at:
   - [http://www.epa.gov/cogwdw/dwa.html](http://www.epa.gov/cogwdw/dwa.html).

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14) How did EPA evaluate the safety of monochloramine for use as a drinking water disinfectant?

**EPA evaluated monochloramine primarily through an analysis of human health and animal data.**
- Research reviewed in EPA's safety analysis is contained in EPA's *Drinking Water Criteria Document for Chloramines*.¹
- The criteria document for monochloramine provides a complete summary of health and other data considered in establishing a monochloramine standard.
- EPA periodically updates the monochloramine "criteria document."

**EPA's monochloramine standard² is set at a level where no human health effects are expected to occur.**
- Data from animal and human studies provide information on the health effects of monochloramine.
- EPA reviews and considers new research results as they become available.³
- EPA's standard for monochloramine takes data gaps and uncertainty into account by building safety factors into the regulatory standard.

**EPA reviewed historical data in its evaluation of monochloramine.**
- Monochloramine has been in use as a drinking water disinfectant since the 1930's.⁴
- Decades of use in the US, Canada, and Great Britain shows monochloramine is an effective secondary drinking water disinfectant.
- Denver, Philadelphia, and other large cities have used monochloramine as part of their water treatment process for years.

Additional Supporting Information:
2. The Maximum Residual Disinfectant Level Goal (MRDLG) for chloramines is 4 parts per million (ppm).
3. See the Contaminant Candidate List online at [http://www.epa.gov/OGWDW/ccl/ccl3.html](http://www.epa.gov/OGWDW/ccl/ccl3.html) for contaminants EPA proposes to review. EPA scientists review regulations of disinfectants and disinfection byproducts every six years. For information on six year review visit: [http://epa.gov/safewater/review.html](http://epa.gov/safewater/review.html)
4. Cleveland, OH, Springfield, IL, and Lansing, MI were among the first cities to use monochloramine in 1929 (see Chapter 1 of *The Quest for Pure Water Vol II*, AWWA, 1981).
15) Why does ERA believe enough research has been conducted to approve the use of monochloramine as a drinking water disinfectant?

**EPA uses risk assessment methods to evaluate the safety of drinking water disinfectants.**
- EPA's *Drinking Water Criteria Document for Chloramines* provides the detailed risk assessment process followed in setting the standard for monochloramine.
- EPA’s risk assessment process included a review of available research and historical data.
- EPA’s risk assessment process focused on health outcomes scientists consider most critical.

**EPA’s regulations account for uncertainties in the risk assessment by applying uncertainty factors.**
- Risk assessments of monochloramine contain substantial uncertainties regarding potentially harmful disinfection byproducts.
- Federal laws require EPA to act to protect human health even when there is incomplete information.
- Regulators must weigh the public health benefits of disinfection against the risks of the harmful disinfection byproducts.

**Research and experience indicate monochloramine is safe at levels used to treat drinking water.**
- Research indicates monochloramine produces lower levels of regulated disinfection byproducts which may be harmful.
- Monochloramine use may reduce the potential cancer risk from chlorinated byproducts.
- EPA continues to encourage research on the safety of monochloramine as a drinking water disinfectant.

**Additional Supporting Information:**
2. The chloramine limit was set in the Stage 1 DBP Rule. This rule is available at [http://www.epa.gov/safewater/disinfection/index.html](http://www.epa.gov/safewater/disinfection/index.html). In addition, EPA has enforceable regulations to limit occurrence of disinfection byproducts in drinking water for a group of four total trihalomethanes (TTHMs) (chloroform, bromodichloromethane (BDCM), dibromochloromethane (DBCM), and bromoform), a group of five haloacetic acids (HAAs) (monochloroacetic acid (MCA), dichloroacetic acid (DCA), trichloroacetic acid (TCA), monobromoacetic acid (MBA), and dibromoacetic acid (DBA)), and the individual byproducts chlorite and bromate. The maximum contaminant levels for these disinfection byproducts are: TTHMs (0.080 mg/L), HAAs (0.060 mg/L), chlorite (1.0 mg/L), bromate (0.010 mg/L). See Stage 2 Disinfection Byproducts Rule (71 FR 388, January 4, 2006) for more information on disinfection byproducts and discussion of uncertainties, [http://www.epa.gov/fedrgstr/EPA-WATER/2006/January/Day-04/w03.pdf](http://www.epa.gov/fedrgstr/EPA-WATER/2006/January/Day-04/w03.pdf).
3. For additional information regarding how uncertainty factors (also known as safety factors) are applied to risk assessments to provide a wide margin of safety see: [http://epa.gov/risk/dose-response.htm](http://epa.gov/risk/dose-response.htm).

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16) Why does EPA believe monochloramine is safe and appropriate to use?

*Research and experience indicate monochloramine use at regulated levels is a safe means for disinfecting drinking water.*

- Research indicates monochloramine produces lower levels of regulated disinfection byproducts compared to chlorine.
- Decades of use in the U.S., Canada, and Great Britain shows monochloramine is a safe and effective secondary drinking water disinfectant.\(^1\)
- EPA continues researching the safety of monochloramine and other drinking water disinfectants.

**EPA used accepted risk assessment methods to evaluate the safety of monochloramine.**

- EPA's risk assessment process included a review of available research and historical data.
- EPA's *Drinking Water Criteria Document for Chloramines*\(^2\) provides the detailed risk assessment process the Agency followed in setting the standard for monochloramine.
- EPA's risk assessment process focused on health outcomes scientists considered most critical.

**EPA's regulatory standard for chloramines provides a wide margin of safety\(^4\) to offset uncertainties in risk assessments.**

- Risk assessments of monochloramine contain uncertainties regarding potentially harmful disinfection byproducts.
- Federal laws require EPA to take action to protect human health even when there is incomplete information.
- EPA regulatory officials must weigh the public health benefits of disinfection against the uncertain risks of the harmful disinfection byproducts.

**Additional Supporting Information:**

1. Secondary disinfection is also known as using a disinfectant residual
2. The chloramine limit was set in the Stage 1 DBP Rule. This rule is available at [http://www.epa.gov/safewater/disinfection/index.html](http://www.epa.gov/safewater/disinfection/index.html). In addition, EPA has enforceable regulations to limit occurrence of disinfection byproducts in drinking water for a group of four total trihalomethanes (TTHMs) (chloroform, bromodichloromethane (BDCM), dibromochloromethane (DBCM), and bromofrom), a group of five haloacetic acids (HAA5) (monochloroacetic acid (MCA), dichloroacetic acid (DCA), trichloroacetic acid (TCA), monobromoacetic acid (MBA), and dibromoacetic acid (DBA)), and the individual byproducts chlorite and bromate. The maximum contaminant levels for these disinfection byproducts are: TTHMs (0.080 mg/L), HAA5 (0.080 mg/L), chlorite (1.0 mg/L), bromate (0.010 mg/L). See Stage 2 Disinfection Byproducts Rule (71 FR 3881, January 4, 2006) for more information on disinfection byproducts and discussion of uncertainties, [http://www.epa.gov/fedrgstr/EPA-WATER/2006/January/Day-04/w03.pdf](http://www.epa.gov/fedrgstr/EPA-WATER/2006/January/Day-04/w03.pdf).
4. For additional information regarding how uncertainty factors are applied to risk assessments to provide a wide margin of safety see: [http://epa.gov/kest/doce-response.htm](http://epa.gov/kest/doce-response.htm).
17) What does EPA see as the advantages of using monochloramine?

Using monochloramine allows utilities to meet new EPA drinking water regulations.

- Water utilities are required to comply with EPA’s new drinking water regulations to reduce disinfection byproducts.
- Water utilities are assessing whether to switch to monochloramine use as a way to meet new EPA drinking water regulations.
- To meet the new EPA regulations, a subset of utilities has decided to use monochloramine as a secondary disinfectant.

Water treated with monochloramine contains reduced levels of regulated disinfection byproducts compared to water treated with chlorine.

- Monochloramine produces lower concentrations of regulated disinfection byproducts because it is less reactive than chlorine with natural organic matter.
- The formation of disinfection byproducts is influenced by source water type and the type of disinfection used.
- The formation of disinfection byproducts can vary daily with the amount of natural organic matter in the water, temperature, rainfall, distance from the treatment plant, and other factors.

Monochloramine is a practical and effective secondary disinfectant.

- The use of monochloramine is often more affordable and requires less new equipment than alternatives, especially if a water utility is already using chlorine.
- Monochloramine helps protect drinking water quality as it moves through pipes.
- Several large cities such as Denver and Philadelphia have used monochloramine successfully as part of their water treatment process for decades.

Additional Supporting Information:
1. See question 11 for additional ways utilities could comply.
4. Secondary disinfection is also known as using a disinfectant residual.
18) What does EPA see as the disadvantages of using monochloramine?

Water utilities will need to work closely with local and state regulatory agencies to determine if monochloramine is appropriate for their utility.

- The appropriateness of monochloramine use varies with water types and among water utilities.¹
- The appropriateness of monochloramine use varies with the amount of organic matter in the source water, temperature, rainfall, distance from the treatment plant, and other factors.
- EPA guidance is available to help states and water utilities make informed decisions as to whether monochloramine use is appropriate.²

Gaps in research on how monochloramine affects water need to be filled.

- There are few studies on how monochloramine affects human health.
- There are few studies on the disinfection byproducts that form when monochloramine reacts with natural organic matter in water.
- Compared to chlorine, water treated with monochloramine may contain higher concentrations of unregulated disinfection byproducts.¹

Utilities will need to monitor water quality³ for problems that may arise related to monochloramine use.

- Utilities will need to monitor for lead and other regulated contaminants from metal corrosion that may be caused by monochloramine use.²
- Water utilities that add substances to control metal corrosion will need to comply with all relevant regulations related to these substances.
- Water utilities using monochloramine will need to monitor and control for additional nitrites or nitrates in accordance with EPA guidance.³

Additional Supporting Information:

1. Use of monochloramine with source waters with high bromide, high iodide or high total organic matter may lead to bromo-, iodo-, and nitrosamine disinfection byproduct formation which are unregulated. EPA scientists are currently studying the unregulated disinfection byproducts that form in water treated with monochloramine. See Question 7 for additional information about disinfection byproducts.

2. Changes in water chemistry, such as the addition of monochloramine can make water more corrosive which may lead to pipe corrosion and increased levels of lead or other contaminants in the water. However, utilities can test water for corrosiveness and make changes to the water treatment process to address this problem. EPA requires that systems monitor lead and copper levels in the distribution system under the Lead and Copper Rule. Monitoring for other water quality issues are discussed in guidance manuals. Guidance manuals are available at: http://www.epa.gov/safewater/disinfection/stage2/compliance.html. Hard copies are available by ordering publications through EPA's Water Resource Center (phone: 202-566-1729). EPA's simultaneous compliance manual can be found at: http://www.epa.gov/OGWDW/disinfection/stage2/pdfs/qaide_st2_pws_simultaneous_compliance.pdf. Other guidance is available through the American Water Works Association (http://www.awwa.org) and the American Water Works Research Foundation (http://www.awwarf.org). Excessive levels of nitrate can be especially harmful to infants; additional health effect information can be found at: http://www.epa.gov/ogwdw/contaminants/dw_contamfs/nitrates.html.

3. See question 27 for more information on water quality charges and monochloramine.

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19) What is EPA’s current focus regarding chloramines research? What other ongoing research is EPA aware of?

The current focus of EPA monochloramine research is on disinfectant byproduct formation as well as how disinfectants affect water chemistry.

- EPA supports research on the unregulated disinfection byproducts formed in drinking water.
- EPA supports research on lead release and nitrate formation that can occur when disinfectants such as monochloramine are used.
- Natural organic matter removal technologies that can reduce byproduct formation are a priority for future EPA supported research.

Results from past and ongoing research indicate monochloramine use at regulated levels is a safe means for disinfecting drinking water.

- Several large cities such as Denver and Philadelphia have used monochloramine successfully as part of their water treatment processes for decades.
- Research shows that monochloramine produces fewer potentially harmful regulated disinfection byproducts than chlorine.
- EPA reviews and considers new research results as they become available.

Many organizations support research on the safety of monochloramine use.

- Academic institutions and water industry groups conduct research on monochloramine use.
- CDC has investigated community concerns related to monochloramine use.
- EPA will continue to work with other organizations on research related to the safe use of monochloramine.

Additional Supporting Information:
2. Compared to chlorine, water treated with monochloramines may contain different unregulated disinfection byproducts than chlorinated water. There are few studies on health effects of unregulated disinfection byproducts. For example, TTHMs and HAAs (see question 6 for more information) typically occur at higher levels than other known and unknown disinfection byproducts. The presence of TTHMs and HAAs is representative of the occurrence of many other chlorinated disinfection byproducts; thus, a reduction in TTHMs and HAAs generally indicates a reduction of other types of disinfectant byproducts. Information on one unregulated byproduct associated with chloramination, NDMA, can be found at [http://www.epa.gov/fto/download/contaminantfocus/epa542f07006.pdf](http://www.epa.gov/fto/download/contaminantfocus/epa542f07006.pdf). Also see question 9 and 23.
3. See the Contaminant Candidate List online at [http://www.epa.gov/OGWDW/ccl/ccl3.html](http://www.epa.gov/OGWDW/ccl/ccl3.html) for contaminants EPA proposes to review. EPA scientists review regulations of disinfection byproducts every six years. [http://epa.gov/safewater/review.html](http://epa.gov/safewater/review.html). EPA is currently monitoring for several unregulated disinfectant byproducts (NDEA, NDMA, NDPA, NPYR). More information can be found at [http://www.epa.gov/safewater/ucmr/index.html](http://www.epa.gov/safewater/ucmr/index.html). American Water Works Association Research Foundation (AwwaRF) is an example of a group that conducts water industry research. Information on AwwaRF projects can be found at [http://www.awwarf.org/](http://www.awwarf.org/).

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20) Is it safe to drink and cook with chloraminated water?

**Chloraminated water that meets EPA regulatory standards is safe to use for drinking and cooking.**
- EPA's *Drinking Water Criteria Document for Chloramines* provides the detailed risk assessment process followed in setting the standard for monochloramine.¹
- Health authorities recognize that some people may have chemical sensitivities and some people may have a chemical sensitivity to monochloramine.²
- People who have health concerns about monochloramine use should consult their physicians.

**EPA regulations limit chloramines³ use to levels where no adverse health effects are anticipated.¹**
- EPA's *Drinking Water Criteria Document for Chloramines* provides the detailed risk assessment process followed in setting the standard for monochloramine.¹
- EPA's risk assessment process included a review of available research and historical data.
- EPA's risk assessment process focused on health outcomes scientists consider most critical.

**Special populations, such as people with weak immune systems, should check with their physicians before consuming any type of drinking water.**
- Special populations with potentially weak immune systems include transplant patients and people with AIDS.
- People with weak immune systems can be more susceptible than others to harmful organisms in water.⁴
- People who have weakened immune systems should consult with their physicians regarding any type of drinking water they consume, including bottled water.⁵

Additional Supporting Information:
2. EPA is not aware of any studies regarding monochloramine chemical sensitivity. CDC investigated reports of monochloramine and health effects in Vermont but they were unable to draw any conclusions from the investigation.
3. The chloramines limit was set in the Stage 1 DBP Rule. This rule is available at [http://www.epa.gov/safewater/disinfection/index.html](http://www.epa.gov/safewater/disinfection/index.html). In addition, EPA has enforceable regulations to limit occurrence of disinfection byproducts in drinking water for a group of four total trihalomethanes (TTHMs) (chloroform, bromodichloromethane (BDCM), dibromochloromethane (DBCM), and bromoform), a group of five haloacetic acids (HAA5) (monochloroacetic acid (MCA), dichloroacetic acid (DCA), trichloroacetic acid (TCA), monobromoacetic acid (MBA), and dibromoacetic acid (DBA)), and the individual byproducts chlorite and bromate. The maximum contaminant levels for these disinfection byproducts are: TTHMs (0.080 mg/L), HAA5 (0.060 mg/L), chlorite (1.0 mg/L), bromate (0.010 mg/L). See Stage 2 Disinfection Byproducts Rule (71 FR 386, January 4, 2009) for more information on disinfection byproducts and discussion of uncertainties, [http://www.epa.gov/fedreg/EPAPA-WATER/2006/January-Day-04/w03.pdf](http://www.epa.gov/fedreg/EPAPA-WATER/2006/January-Day-04/w03.pdf).
4. Potentially harmful organisms include disease-causing bacteria, viruses, and protozoa. Chlorination and chloramination are not effective at inactivating *Cryptosporidium*.
5. More information regarding drinking water for those with weak immune systems is available at: [http://www.epa.gov/ogdw/crypt.html](http://www.epa.gov/ogdw/crypt.html).
21) Can I shower in or use a humidifier with chloraminated water?

**Chloraminated water that meets EPA standards is safe to use for showering.**
- Showering with chloraminated water poses little risk because monochloramine does not easily enter the air.
- Trichloramine, a chemical related to monochloramine and often found in swimming pools, enters the air more easily and has been linked to breathing problems.
- Trichloramine may form more easily in swimming pools because of higher levels of chlorine as well as ammonia from bodily fluids which are often found in swimming pools.

**Chloraminated water that meets EPA standards is safe for use in humidifiers.**
- The use of chloraminated water in humidifiers poses little risk because monochloramine does not easily enter the air.
- EPA is not aware of any studies that investigate the use of disinfected water in humidifiers.
- It is important to follow manufacturer's instructions regarding proper maintenance and operation of your humidifier.

**EPA considered a wide range of household uses in establishing regulatory limits for chloramines in water.**
- EPA considered all available research in establishing regulatory limits for chloramines in water.
- EPA considered historical data in establishing regulatory limits for chloramines in water.
- EPA's regulatory standard for chloramines provides a wide margin of safety to offset uncertainties in risk assessments.

**Additional Supporting Information:**
1. Trichloramine formation does not usually occur under normal drinking water treatment conditions. However, if the pH is lowered below 4.4 or the chlorine to ammonia-nitrogen ratio becomes greater than 7.6:1, then trichloramine can form. Trichloramine formation can occur at a pH between 7 and 8 if the chloramine to ammonia-nitrogen ratio is increased to 15:1. Source: *Optimizing Chloramine Treatment, 2nd Edition*, AwwaRF, 2004.
2. Problems with trichloramine have been most-often associated with indoor swimming pools and are known to cause a strong chlorine-type odor. Trichloramine can be controlled in indoor swimming pools with proper pool maintenance and ventilation. For more information see: [http://www.cdc.gov/healthywater/irritants.htm](http://www.cdc.gov/healthywater/irritants.htm).
3. More information on EPA's standard setting process may be found at: [http://www.epa.gov/OGWDW/standard/setting.html](http://www.epa.gov/OGWDW/standard/setting.html).
4. For additional information regarding how uncertainty factors (also known as safety factors) are applied to risk assessments to provide a wide margin of safety see: [http://epa.gov/risk/dose-response.htm](http://epa.gov/risk/dose-response.htm).
22) Can chloraminated or chlorinated water be used for dialysis or in an aquarium?

**Chloraminated or chlorinated water may need additional treatment if used for specialized purposes.**
- Water utilities typically provide health care agencies and organizations with information about their disinfection processes.
- Water utilities typically provide consumers with information about disinfection processes.
- Water utilities consult with regulatory authorities about major changes in their water treatment processes.

**Chlorine and monochloramine must be removed prior to use in kidney dialysis machines.**
- Special precautions are needed when using chlorinated or chloraminated water in dialysis machines because the treated water comes into direct contact with blood.
- Dialysis patients should consult with their physicians if they have concerns about chlorinated or chloraminated water.
- Dialysis patients can safely drink chlorinated or chloraminated water.

**Chlorine and monochloramine must be neutralized or removed if used in aquariums.**
- Chlorine and monochloramine can be harmful to fish because it directly enters their bloodstream through the gills.
- Chlorine and monochloramine can also prevent the growth of beneficial bacteria that are necessary for healthy fish tanks.
- Chlorinated and chloraminated water can be safely used in aquariums by using products readily available from aquarium supply stores.

Additional Supporting Information:
2. Dialysis patients with severely compromised immune systems should consult with their physician before consuming any type of water.
Does monochloramine cause cancer?

EPA believes water disinfected with monochloramine that meets regulatory standards poses no known or anticipated adverse health effects, including cancer.

- Most of the research on the cancer risk of monochloramine comes from animal studies using mice and rats.\(^1\)
- EPA believes available data support the use of monochloramine to protect public health.
- EPA's regulatory standard for chloramines provides a wide margin of safety\(^2\) to offset uncertainties in risk assessments.

**Monochloramine use may reduce bladder cancer risk compared to chlorine use.**

- Several studies have shown lower rates of bladder cancer in communities served by systems that use monochloramine as a secondary disinfectant compared to systems that use chlorine.\(^3\)
- Compared to chlorine, water treated with monochloramine may contain higher concentrations of unregulated disinfection byproducts but the cancer risk is unknown.\(^4\)
- EPA continues to support research on the safety of monochloramine.

**Monochloramine use produces lower levels of regulated disinfection byproducts which are linked to cancer.**

- Regulated disinfection byproducts are produced in lower amounts when monochloramine is used.
- Regulated disinfection byproducts serve as indicators\(^5\) of other types of byproducts that may also be reduced as a result of using monochloramine.
- Compared to chlorine, water treated with monochloramine may contain higher concentrations of unregulated disinfection byproducts.\(^6\)

Additional Supporting Information:
1. More information on these studies can be found at EPA IRIS (Integrated Risk Information System) [http://www.epa.gov/ncea/iris/subst/0644.htm](http://www.epa.gov/ncea/iris/subst/0644.htm), in the Stage 2 DBPR (71 FR 388, January 4, 2006), or the Criteria Document for Chloramines ([http://www.epa.gov/ncea/pdfs/water/chloramine/dwchloramine.pdf](http://www.epa.gov/ncea/pdfs/water/chloramine/dwchloramine.pdf)).
2. For additional information regarding how uncertainty factors (also known as safety factors) are applied to risk assessments to provide a wide margin of safety see: [http://epa.gov/risk/dose-response.htm](http://epa.gov/risk/dose-response.htm)
3. EPA is currently researching unregulated disinfectant byproducts that can form from monochloramine use. Compared to chlorine, water treated with monochloramine may contain different unregulated disinfection byproducts than chlorinated water. There are few studies on health effects of unregulated disinfection byproducts. However, additional information on NDMA, an unregulated byproduct, can be found at: [http://www.epa.gov/ttn/downloads/contaminantfocus/epa542/07006.pdf](http://www.epa.gov/ttn/downloads/contaminantfocus/epa542/07006.pdf) Also see question 9 and 19.
4. TTHMs and HAAs (see question 6 for more information) typically occur at higher levels than other known and unknown disinfectant byproducts. The presence of TTHMs and HAAs is representative of the occurrence of many other chlorinated disinfectant byproducts; thus, a reduction in TTHMs and HAAs generally indicates a reduction of other types of disinfectant byproducts.

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24) Does monochloramine cause skin problems?

EPA believes water disinfected with monochloramine that meets regulatory standards has no known or anticipated adverse health effects, including skin problems.

- Isolated cases of skin problems due to exposure to chloramines have been reported.¹
- Monochloramine has not been shown to be a cause or contributor to reported skin problems.
- CDC's investigation² of reports of monochloramine-related skin problems associated with drinking water use was unable to draw any conclusions about monochloramine and health effects.

Trichloramine, a chemical related to monochloramine that often forms in swimming pools, has been linked to skin problems.

- Trichloramine forms in swimming pools when chlorine reacts with ammonia from bodily fluids.
- Skin problems traceable to disinfected water are typically related to swimming pool use.³
- EPA continues to study and review research on disinfectants used in swimming pools.

People who believe their skin problems are related to monochloramine should consult with their doctors.

- Skin problems are a common health issue, and it is often difficult to trace their causes.
- People who have skin problems should inform their doctors if they have been in a swimming pool.
- CDC's investigation² of reports of monochloramine-related skin problems associated with drinking water use was unable to draw any conclusions about monochloramine and health effects.

Additional Supporting Information:
1. Reported skin problems, such as eczema, due to chloramines are primarily associated with dermal antiseptic contact in occupational/hospital settings. The "Drinking Water Criteria Document for Chloramines" can be found at [http://www.epa.gov/ncea/pdfs/water/chloramine/dwchloramine.pdf](http://www.epa.gov/ncea/pdfs/water/chloramine/dwchloramine.pdf), ECAO-CIN-D002, March, 1994 and it includes more information on isolated health effects incidents. See question 1 for a discussion of the different types of chloramines.
2. CDC and EPA conducted a preliminary investigation of reports of monochloramine-related skin problems associated with drinking water. The investigation consisted of a questionnaire filled out by [the people who had complained of health problems](http://www.cdc.gov/mmwr/pdf/rr/rr5110.pdf), The information collected can be used to help design future epidemiologic studies.
   - CDC’s trip report can be found at: [http://www.cdc.gov/mmwr/pdf/rr/rr5110.pdf](http://www.cdc.gov/mmwr/pdf/rr/rr5110.pdf)
3. Improper pool maintenance can often lead to trichloramine formation. Some examples include: [http://www.cdc.gov/mmwr/pdf/rr/rr5110.pdf](http://www.cdc.gov/mmwr/pdf/rr/rr5110.pdf) and [http://www.cdc.gov/mmwr/PDF/mm5636.pdf](http://www.cdc.gov/mmwr/PDF/mm5636.pdf).
25) Do chloramines cause breathing problems?

**EPA believes water disinfected with monochloramine that meets regulatory standards has no known or anticipated adverse health effects, including breathing problems.**

- Monochloramine does not enter the air easily and therefore would be difficult to inhale.
- CDC's investigation of reports of monochloramine-related breathing problems associated with drinking water use was unable to draw any conclusions about monochloramine and health effects.
- Breathing problems associated with trichloramine and indoor swimming pools have been reported.

**Trichloramine**, a chemical related to monochloramine and often found in swimming pools, has been linked to breathing problems.

- Trichloramine forms in swimming pools when chlorine reacts with ammonia from bodily fluids.
- Breathing problems traceable to disinfected water are typically related to swimming pool use.
- EPA continues review research related to the use of disinfectants used in swimming pools.

**People who believe their breathing problems are related to monochloramine should consult with their doctors.**

- The causes of breathing problems are often difficult to determine.
- People who have breathing problems should inform their doctors if they have spent time in or around a swimming pool.
- CDC's investigation of reports of monochloramine-related breathing problems associated with drinking water use was unable to draw any conclusions about monochloramine and health effects.

Additional Supporting Information:

1. CDC and EPA conducted a preliminary investigation of reports of monochloramine-related respiratory problems associated with drinking water. The investigation consisted of a questionnaire filled out by complainants. The information collected can be used to help design future epidemiologic studies. CDC's trip report can be found at: [http://healthvermont.gov/enviro/water/documents/CDC_Chloramines_report_011608.pdf](http://healthvermont.gov/enviro/water/documents/CDC_Chloramines_report_011608.pdf).

2. Reported breathing problems due to chloramines are primarily related to inhalation of household chemicals (mixing ammonia and bleach cleaning products), indoor swimming pool air, or industrial exposure. See question 1 for further information about different types of chloramines.

3. Trichloramine formation does not usually occur under normal drinking water treatment conditions. However, if the pH is lowered below 4.4 or the chlorine to ammonia-nitrogen ratio becomes greater than 7.6:1, then trichloramine can form. Trichloramine formation can occur at a pH between 7 and 8 if the chloramine to ammonia-nitrogen ratio is increased to 15:1. Source: *Optimizing Chloramine Treatment, 2nd* Edition, AwwaRF, 2004.


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26) Does monochloramine cause digestive problems?

EPA believes water disinfected with monochloramine that meets regulatory standards has no known or anticipated adverse health effects, including digestive problems.

- EPA’s regulatory standard for monochloramine is based primarily on risk assessments focused on drinking water.
- EPA’s standard for monochloramine is set at a level where no digestive problems are expected to occur.
- EPA’s regulatory standard for monochloramine provides a wide margin of safety to offset uncertainties in risk assessments.

An important characteristic of monochloramine is any amount ingested quickly leaves the body.

- Monochloramine is broken down by saliva.
- Monochloramine is neutralized by stomach acid.
- Monochloramine leaves the body through human waste.

People who believe their digestive problems are related to monochloramine should consult with their doctors.

- The causes of digestive problems are often difficult to determine.
- People who have digestive problems should inform their doctors about what they have drunk or eaten and about any unusual exposures to chemicals.
- CDC’s investigation of reports of monochloramine-related digestive problems associated with drinking water use was unable to draw any conclusions about monochloramine and health effects.

Additional Supporting Information:
1. CDC and EPA conducted a preliminary investigation of reports of monochloramine-related digestive problems associated with drinking water. The investigation consisted of a questionnaire filled out by complainants. The information collected can be used to help design future epidemiologic studies. CDC’s trip report can be found at: http://healthvermont.gov/enviro/water/documents/CDC_Chloramines_report_011608.pdf.
27) Does monochloramine change water chemistry? Does monochloramine change lead levels?

Water chemistry can be changed by many factors, including the use of monochloramine.

- Water chemistry can be changed by many factors including temperature, rainfall, weather conditions and monochloramine use.
- Levels of lead in water may change due to changes in water chemistry from monochloramine use.
- Levels of nitrite and nitrate in water may change due to changes in water chemistry from monochloramine use.

Water utilities typically monitor for problems caused by changes in water chemistry from monochloramine use.

- The presence of natural organic matter in water may change the water chemistry.
- Water utilities monitor for changes in water chemistry at water treatment facilities.
- Water utilities typically monitor for changes in water chemistry as the water moves through pipes.

Water utilities may need to adjust their treatment processes for problems caused by changes in water chemistry from monochloramine use:

- Water utilities may need to adjust their treatment processes to reduce levels of lead to meet EPA regulations.
- Water utilities may need to adjust their treatment processes to reduce levels of nitrates and nitrites.
- EPA provides guidance for water utilities on problems that can arise from changes in water chemistry.

Additional Supporting Information:
1. Changes in water chemistry, such as the addition of monochloramine, can make water more corrosive which may lead to pipe corrosion and increased levels of lead or other contaminants in the water. However, utilities can test water for corrosiveness and make changes to the water treatment process to address this problem (see footnote 4 below).
2. Excessive levels of nitrate can be especially harmful to infants; additional health effect information can be found at:
   http://www.epa.gov/opwdw/contaminants/dw_contamns/nitrates.html. The ammonia which is added to the water to make monochloramine, or which naturally occurs in some waters, can be converted by naturally occurring bacteria to form nitrates and nitrites, which are contaminants regulated by EPA at the treatment plant. Excessive nitrate/nitrites (nitrification) in the distribution system can also cause bacterial regrowth. For more information about nitrification see:
   For more information about biofilm see:
   Nitrate/nitrite control is discussed in EPA's simultaneous compliance manual which can be found at:
3. Natural organic material is a complex mixture of compounds formed as a result of the breakdown of animal and plant material in the environment; Source:

Deliberative draft – do not cite or distribute
4. EPA guidance to utilities on addressing corrosion issues is available at:
http://yosemite.epa.gov/water/owrcCatalog.nsf/065ca07e299b464685256ce50075c11a/1b761cd04a477d6085256b0600723e621OpenDocument.
28) Can my doctor tell if my health problems are caused by monochloramine or any disinfectant in drinking water?

A doctor would have difficulty making a direct link between a health problem and monochloramine or any disinfectant in drinking water.

- People are exposed to many chemicals and other irritants in their daily lives and their sensitivity to these agents vary.
- EPA's drinking water regulations limit the use of chloramines to levels where no adverse health effects are anticipated.
- EPA's regulatory standard for chloramines in drinking water provides a wide margin of safety to offset uncertainties in risk assessments.

EPA believes drinking water disinfected with monochloramine that meets regulatory standards poses no known or anticipated adverse health problems.

- Isolated cases of health problems thought to be related to drinking water have been reported and were investigated by CDC.¹
- Trichloramine, a chemical that may be formed in swimming pools², has been linked to skin irritation and breathing problems.
- CDC's investigation¹ of reports of monochloramine-related breathing problems related to drinking water was unable to draw any conclusions about monochloramine and health effects.

Contact your doctor if you think you have a health problem related to drinking water use.

- It is important for your doctor to know where and how you believe you were exposed to chloramines (e.g., via drinking water or a swimming pool).³
- Health problems are typically highly diverse in origin, making it difficult for doctors to specify exact causes.
- Your doctor should discuss health problems he/she believes may be related to chloramines in drinking water with the local health department.

Additional Supporting Information:
1. CDC and EPA conducted a preliminary investigation of reports of monochloramine-related health problems associated with drinking water. The investigation consisted of a questionnaire filled out by complainants. The information collected can be used to help design future epidemiologic studies.
3. See question 1 for a discussion of the different types of chloramines.
29) How can I remove monochloramine from my drinking water?

**EPA believes that drinking water disinfected with monochloramine that meets regulatory standards is safe to use and it does not need to be removed.**
- EPA drinking water regulations limit monochloramine use to levels where no adverse health effects are anticipated.
- Water utilities must test drinking water regularly to make sure it is within EPA regulatory limits.
- EPA's regulatory standard for monochloramine in drinking water provides a wide margin of safety to offset uncertainties in risk assessments.

**Monochloramine can be more difficult to remove from drinking water than chlorine.**
- Boiling water does not remove monochloramine from drinking water.
- Letting water sit at room temperature does not remove monochloramine from drinking water.
- Reverse osmosis filters\(^2\) will not remove monochloramine from drinking water.

**Commercial products are available that indicate they remove monochloramine from drinking water.**
- Commercial products that remove monochloramine from drinking water often contain certifications describing their effectiveness.\(^2\)
- Some home treatment systems and water filters\(^2\) will remove monochloramine.\(^2\)
- EPA does not test or certify home treatment systems or filters\(^2\) that remove monochloramine from drinking water.

**Additional Supporting Information:**
1. See question 14 for information on how EPA evaluated safety of monochloramine use as a drinking water disinfectant.
2. More information on certified devices for removing monochloramine is available at [www.nsf.org](http://www.nsf.org) and [www.wqa.org](http://www.wqa.org). To be certified, devices must demonstrate at least an 83% chloramines reduction over the entire service cycle of the filter.
3. See question 22 for information regarding removing monochloramine for aquarium use.
Audrey, Mike, Jonathan, and Darren,

I met with OW yesterday and for the most part they were okay with incorporating our "major" comments. They did however ask me to go back and shorten Question 19, message 1 and revise Question 27.

In a nutshell, the changes are:
- Making the bullets shorter for Question 19.
- Adding "other contaminants" in addition to lead
- Discussing biofilm activity and nitrification (instead of just saying nitrate and nitrite)
- Not using either "water chemistry" or "water quality" but instead "water properties"

Take a look at what I have done and let me know if you are okay with these two final draft messages. Are you able to "live with" this text? I think they are a decent compromise. Anyhow, OW is trying to wrap this activity up and wants any final comments from me on these two questions by tomorrow.

suggested revisions for question 19.doc  suggested revisions for 27.doc

For reference, here are the previous versions Audrey and I worked on that OW wanted us to change:
Thanks,
Nicole

Nicole Shao
US EPA, ORD-Office of Science Policy
1200 Pennsylvania Avenue, NW (8104R)
Washington, DC 20460
(202) 564-6779
I: 19) What is EPA's current focus regarding chloramines research? What other ongoing research is EPA aware of?

The current focus of EPA chloramine research is on disinfectant effectiveness, disinfectant effects on water properties, and disinfection byproduct formation.

- **Evaluating the effectiveness of disinfectants, including monochloramine, is a focus for EPA's chloramines research.**
- **Research is targeted at understanding the various effects that may be caused by disinfectant use.**
- **EPA supports research on evaluating potential treatment technologies that can reduce effects sometimes caused by disinfectant use.**

Results from past and ongoing research indicate monochloramine use at regulated levels is a safe means for disinfecting drinking water.

- Several large cities such as Denver and Philadelphia have used monochloramine successfully as part of their water treatment process for decades.
- **Research shows that monochloramine produces fewer potentially harmful regulated disinfection byproducts than chlorine.**
- **EPA reviews and considers new research results as they become available.**

Many organizations support research on the safety of monochloramine use.

- Academic institutions and water industry groups conduct research on monochloramine use.
- CDC has investigated community concerns related to monochloramine use.
- **EPA will continue to work with other organizations on research related to the safe use of monochloramine.**

Additional Supporting Information:

2. **Research includes studying the effectiveness of chloramines at controlling potentially harmful organisms under different source water and treatment options. See question 3 for more information on potentially harmful organisms.**
3. **Efforts include improving the understanding of the various effects that may be caused by the use of disinfectant(s) or mixed disinfectants on water properties, such as the formation of disinfection byproducts, the release of contaminants, including lead, into water, and biofilm activity, including nitrification and the resulting nitrite and nitrate formation.** See question 27 for additional information on contaminant release, biofilms, and nitrification.
4. **Compared to chlorine, water treated with monochloramine may contain different unregulated disinfection byproducts than chlorinated water. There are few studies on health effects of unregulated disinfection byproducts. For example, TTHMs and HAAs (see question 6 for more information) typically occur at higher levels than other known and unknown disinfection byproducts. The presence of TTHMs and HAAs is representative of the occurrence of many other chlorinated disinfection byproducts; thus, a reduction in TTHMs and HAAs generally indicates a reduction of other types of disinfectant byproducts. Information on one unregulated byproduct associated with chloramination, NDMA, can be found at [http://www.epa.gov/ics/download/contaminantfocus/epsa54207006.pdf](http://www.epa.gov/ics/download/contaminantfocus/epsa54207006.pdf). Also see question 9 and 23.**
5. **See the Contaminant Candidate List online at [http://www.epa.gov/OGW/DW/ccl/cd3.html](http://www.epa.gov/OGW/DW/ccl/cd3.html) for contaminants EPA proposes to review. EPA scientists review regulations of disinfection byproducts every six years. ([http://epa.gov/safewater/review.html](http://epa.gov/safewater/review.html)). EPA is currently monitoring for several unregulated disinfectant byproducts (NDEA, NDMA, NDPA, NPYR). More information can be found at [http://www.epa.gov/safewater/ucmr/index.html](http://www.epa.gov/safewater/ucmr/index.html).**
American Water Works Association Research Foundation (AwwaRF) is an example of a group that conducts water industry research. Information on AwwaRF projects can be found at [http://www.awwaRF.org/](http://www.awwaRF.org/).

27) Does monochloramine change water properties? Does monochloramine use contribute to the release of lead or other contaminants into drinking water?

Water properties can be changed by many factors, including the use of monochloramine.

- The chemical, physical, and biological properties of water may be changed by many factors.
- Levels of lead or other contaminants in water may change due to changes in water properties from monochloramine use.
- Biofilm activity, including nitrification and the resulting nitrite and nitrate formation in water may change due to changes in water properties from monochloramine use.

Water utilities typically monitor for problems caused by changes in water properties from monochloramine use.

- The presence of natural organic matter in water may change the water properties.
- Water utilities monitor for changes in water properties at water treatment facilities.
- Water utilities typically monitor for changes in water properties as the water moves through pipes.

Water utilities may need to adjust their treatment processes for problems caused by changes in water properties from monochloramine use.

- Water utilities may need to adjust their treatment processes to reduce levels of lead or other regulated contaminants to meet EPA regulations.
- Water utilities may need to adjust their treatment processes to reduce biofilm activity, including nitrification and the resulting nitrite and nitrate formation.
- EPA provides guidance for water utilities on problems that can arise from changes in water properties.

Additional Supporting Information:

1. Examples of chemical properties include pH and alkalinity. Examples of physical properties include taste and odor, and examples of biological properties include biofilm formation and nitrification. See footnote 3 below for more information on biofilms and nitrification. Factors that may influence water properties include temperature, rainfall, weather conditions, and the use of disinfectants, including monochloramine.

2. Changes in water properties can occur when disinfectants such as monochloramine are added to water. These changes can make water more corrosive which may lead to pipe corrosion and increased levels of lead or other contaminants in the water. However, utilities can test water for corrosiveness and make changes to the water treatment process to address this problem (see footnote 5 below).

3. High levels of nitrates/nitrites can be especially harmful to infants; additional health effect information can be found at: [http://www.epa.gov/ogwdw/contaminants/dw_contamfs/nitrates.html](http://www.epa.gov/ogwdw/contaminants/dw_contamfs/nitrates.html). The ammonia which is added to the water to make monochloramine, or which naturally occurs in some waters, can be converted by naturally occurring bacteria through a process called nitrification to form nitrates and nitrates, which are contaminants regulated by EPA at the treatment plant. For more information about nitrification see: [http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_nitrification.pdf](http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_nitrification.pdf). For more information about biofilm see question 2 or: [http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_biofilms.pdf](http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_biofilms.pdf). Nitrates/nitrites (nitrification) in the distribution system can also cause bacterial regrowth.
control is discussed in EPA's simultaneous compliance manual which can be found at: http://www.epa.gov/OGWDW/disinfection/stage2/pdfs/guide_st2_pwe_simultaneous_compliance.pdf. Other guidance is available through the American Water Works Association (http://www.awwa.org) and the American Water Works Research Foundation (http://www.awwarf.org).

4. Natural organic material is a complex mixture of compounds formed as a result of the breakdown of animal and plant material in the environment; Source: http://www.iwahq.org/templates/id_templates/layout_633184.aspx?ObjectID=661579.

5. EPA guidance to utilities on addressing corrosion issues is available at: http://yosemite.epa.gov/water/owrCatalog.nsf/0b5ca07e299b464865256ce50075c11a/1b761cd04a477d6085256b0600f23e62?OpenDocument.
19) What is EPA’s current focus regarding chloramines research? What other ongoing research is EPA aware of?

The current focus of EPA chloramines research is on determining disinfectant effectiveness, related effects on water quality, and disinfection byproduct formation.

- Determining disinfectant effectiveness, including evaluating the effectiveness of chloramines at controlling potentially harmful organisms under different source water and treatment options is a focus for EPA’s chloramines research.
- Research is targeted at improving understanding of the effects of disinfectants on water quality, emerging contaminants, and the disinfection byproducts that form as a result of individual or combined disinfection practices.
- EPA supports research on the release of contaminants, including lead, into drinking water, biofilm activity, including nitrification and the resulting nitrite and nitrate formation that can occur when disinfectants such as monochloramine are used.

Results from past and ongoing research indicate monochloramine use at regulated levels is a safe means for disinfecting drinking water.

- Several large cities such as Denver and Philadelphia have used monochloramine successfully as part of their water treatment process for decades.
- Research shows that monochloramine produces fewer potentially harmful regulated disinfection byproducts than chlorine.
- EPA reviews and considers new research results as they become available.

Many organizations support research on the safety of monochloramine use.

- Academic institutions and water industry groups conduct research on monochloramine use.
- CDC has investigated community concerns related to monochloramine use.
- EPA will continue to work with other organizations on research related to the safe use of monochloramine.

Additional Supporting Information:
2. Potentially harmful organisms include disease-causing bacteria, viruses, and protozoa. Chlorination and chloramination are not effective at inactivating Cryptosporidium. For information on alternative disinfectants and other oxidants visit: http://www.epa.gov/safewater/mbdp/mbdp.html#disinfect.
3. See questions 2 and 27 for additional information on contaminant release, biofilms, and nitrification.
4. Compared to chlorine, water treated with monochloramine may contain different unregulated disinfection byproducts than chlorinated water. There are few studies on health effects of unregulated disinfection byproducts. For example, TTHMs and HAAs (see question 6 for more information) typically occur at higher levels than other known and unknown disinfection byproducts. The presence of TTHMs and HAA5 is representative of the occurrence of many other chlorinated disinfection byproducts; thus, a reduction in TTHMs and HAA5 generally indicates a reduction of other types of disinfectant byproducts. Information on one unregulated byproduct associated with chloramination, NDMA, can be found at http://www.epa.gov/tio/download/contaminantfocus/epa542f07006.pdf Also see question 9 and 23.
5. See the Contaminant Candidate List online at [http://www.epa.gov/OGWDW/ccl/ccl3.html](http://www.epa.gov/OGWDW/ccl/ccl3.html) for contaminants EPA proposes to review. EPA scientists review regulations of disinfection byproducts every six years. ([http://epa.gov/safewater/review.html](http://epa.gov/safewater/review.html)). EPA is currently monitoring for several unregulated disinfectant byproducts (NDEA, NDMA, NDPA, NPYR). More information can be found at [http://www.epa.gov/safewater/ucmr/index.html](http://www.epa.gov/safewater/ucmr/index.html). American Water Works Association Research Foundation (AwwaRF) is an example of a group that conducts water industry research. Information on AwwaRF projects can be found at [http://www.awwarf.org/](http://www.awwarf.org/).

27) Does monochloramine use change water quality? Does monochloramine use contribute to the release of lead or other contaminants into drinking water?

Water quality can be changed by many factors, including the use of monochloramine.
- Water quality can be changed by many factors including temperature, rainfall, weather conditions and monochloramine use.
- Levels of lead or other contaminants in water may change due to changes in water quality\(^1\) from monochloramine use.
- Biofilm activity, including nitrification and the resulting nitrite and nitrate formation in water may change due to changes in water quality from monochloramine use.\(^2\)

Water utilities typically monitor for problems caused by changes in water quality from monochloramine use.
- The presence of natural organic matter\(^3\) in water may change the water quality.
- Water utilities monitor for changes in water quality at water treatment facilities.
- Water utilities typically monitor for changes in water quality as the water moves through pipes.

Water utilities may need to adjust their treatment processes for problems caused by changes in water quality from monochloramine use.\(^2\)
- Water utilities may need to adjust their treatment processes to reduce levels of lead or other regulated contaminants to meet EPA regulations.
- Water utilities may need to adjust their treatment processes to reduce biofilm activity, including nitrification and the resulting nitrite and nitrate formation.\(^2\)
- EPA provides guidance for water utilities on problems that can arise from changes in water quality.\(^4\)

Additional Supporting Information:
1. The addition of monochloramine can make water more corrosive which may lead to pipe corrosion and an increase in the release of lead or other contaminants into the water. However, utilities can test water for corrosiveness and make changes to the water treatment process to address this problem (see footnote 4 below).
2. High levels of nitrates/nitrites can be especially harmful to infants; additional health effect information can be found at: [http://www.epa.gov/ogwdw/contaminants/dw_contamfs/nitrates.html](http://www.epa.gov/ogwdw/contaminants/dw_contamfs/nitrates.html). The ammonia which is added to the water to make monochloramine, or which naturally occurs in some waters, can be converted by naturally occurring bacteria through a process called nitrification to form nitrites and nitrates, which are contaminants regulated by EPA at the treatment plant. For more information about nitrification see: [http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_nitrification.pdf](http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_nitrification.pdf) For more information about biofilms see question 2 or: [http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_biofilms.pdf](http://www.epa.gov/safewater/disinfection/tcr/pdfs/whitepaper_tcr_biofilms.pdf). Nitrate/nitrite control is discussed in EPA's simultaneous compliance manual which can be found at: [http://www.epa.gov/OGWDW/disinfection/stage2/pdfs/guide_st2_pws_simultaneous-compliance.pdf](http://www.epa.gov/OGWDW/disinfection/stage2/pdfs/guide_st2_pws_simultaneous-compliance.pdf). Other guidance is available through the American Water Works Association ([http://www.awwa.org](http://www.awwa.org)) and the American Water Works Research Foundation ([http://www.awwarf.org](http://www.awwarf.org)).
4. EPA guidance to utilities on addressing corrosion issues is available at: http://yosemite.epa.gov/water/owrcCatalog.nsf/065ca07e299b464685256ce50075c11a/1b761cd04a477d6085256b0600723e62!OpenDocument.
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**Processing**

**Comments**

E-mails from 3/23/09 are already in the release file. 4/8/09 e-mail is about message maps, but not specifically about chloramine health effects.

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Crystal,

After my second e-mail announcement, I've still only heard affirmative responses from two scientists. I don't think there is enough interest to proceed with the information session. Would your office be alright with not having one? Let me know how you would like to proceed.

Nicole

Nicole Shao
US EPA, ORD-Office of Science Policy
1200 Pennsylvania Avenue, NW (8104R)
Washington, DC 20460
(202) 564-6779

Crystal Rodgers-Jenkins

Hi Nicole, What's the latest? 04/08/2009 10:01:05 AM

From: Crystal Rodgers-Jenkins/DC/USEPA/US
To: Nicole Shao/DC/USEPA/US@EPA
Cc: Jeanna Briskin/DC/USEPA/US@EPA
Date: 04/08/2009 10:01 AM
Subject: Re: Q&As - checkn' in

Hi Nicole,
Hi Crystal,

Thank you for your voice message. I have forwarded below the e-mail that I sent to the ORD scientists on 3/23. It looks like I copied Jeanne on the message, but I did not copy you. Jeanne reviewed the draft version of this e-mail before I sent it. You are correct that we did ask the scientists about their interest in an information session on the Q&As. I had asked for any responses by last Friday, but I did not receive any. Yesterday I sent out a follow-up e-mail. I have heard back from two scientists regarding interest in such a training. I hope that I will hear from more individuals over the next few days. I think we will need a few more people to express interest before scheduling the information session. As I mentioned in one of my previous e-mails to Jeanne, I would like to consider the possibility of having a member of the ORD Communications Staff come to the information session and briefly provide some information on the current ORD communications approach, as well as other internal tools available to ORD when responding to the public and/or media. Examples of other internal tools include assistance with determining interview questions in advance and serving as moderator during an interview.

I will get back to both you and Jeanne once I hear back from more of the scientists.

Nicole

Nicole Shao
US EPA, ORD-Office of Science Policy
1200 Pennsylvania Avenue, NW (8104R)
Washington, DC 20460
(202) 564-6779

--- Forwarded by Nicole Shao/DC/USEPA/US on 04/01/2009 08:42 AM ---

From: Nicole Shao/DC/USEPA/US
To: Crystal Rodgers-Jenkins/DC/USEPA/US@EPA
Cc: Jeanne Briskin/DC/USEPA/US@EPA
Date: 04/01/2009 11:45 AM
Subject: Q&As Voice mail

Hi Crystal, Thank you for your voice message. I...
ORD Colleagues,

I am forwarding you an e-mail I received today from the Office of Water (OW) announcing the availability of the URL to the finalized copy of the chloramines message maps (hereafter referred to as Q&As). This URL is: http://www.epa.gov/safewater/disinfection/chloramine/.

Both the Office of Water (OW) and I thank you for contributing your expertise to this important effort over the past year. OW carefully considered all of your comments as the Q&As were being developed. I worked very closely with OW to address your comments and ensure that the Q&As would be scientifically and technically correct, while meeting the goal of presenting the information in a way that would be easy for the general public to understand. To help address ORD workgroup recommendations for including more scientific details in this communication tool, we have added a new section in the final Q&As entitled, "Additional Supporting Information," that includes links to documents and resources that can be used to gain additional technical information on each of the topics.

OW is aware that research on drinking water disinfectants is constantly evolving, and expects to periodically evaluate and possibly update the questions and answers about chloramines when new information becomes available.

If you would be interested in attending an information session via teleconference on this collaboratively-developed communication tool, please send me an e-mail no later than Friday, March 27th. The information session would likely include time for OW to answer any questions you might have about the Q&As, as well as a brief discussion on how the Q&As can be used to help us better communicate with the public and/or media.

Please do not hesitate to contact me if you have any questions or comments.

Nicole Shao
US EPA, ORD-Office of Science Policy
1200 Pennsylvania Avenue, NW (8104R)
Washington, DC 20460
(202) 564-6779

--- Forwarded by Nicole Shao/DC/USEPA/US on 03/23/2009 11:43 AM ---

Chloramine Message Maps

Anthony Meadows, Blake Atkins, Bruce Kiselica, Charlene Denys, Chris Thomas, Corine Li, Debra Forman, Diane Sanelli, Jack Rychecky, Jacqueline Clark, Jane Downing, Janet Kuefler, Karen Mcguire, Larry Wright, Marie Jennings, Mary Mindrup, Robert Smoliski, Stallings Howell, Stephen Hogye, Thomas Poy, Victoria Binetti, Walter Andrews, Nicole Shao
The Office of Water, along with input from the Office of Research and Development (ORD), the Office of General Counsel (OGC), and the EPA regions, has created detailed questions and answers (Q&As) in response to public concerns and frequently asked questions about use of chloramine as a secondary disinfectant in drinking water. The goal of these Q&As is to provide the best informed EPA answers to the public about the benefits and risks of monochloramine while at the same time stressing the necessity of adequate pathogen control to assure protection of public health. The website to view the Chloramine Q&As is:
http://www.epa.gov/safewater/disinfection/chloramine/

We are releasing these Q&As in order to assist EPA regions, state environmental and public health offices, and water suppliers to respond to public. The Q&As were designed using a specific risk communication format (message maps) aimed at targeting the general public. Each question is answered by 3 key responses, written at approximately a 6th grade level. Each key response is supported by three more detailed pieces of information at a 12th grade level. There is an Additional Supporting Information section in the footnotes that includes links to documents and resources that provide additional technical information. For more information on message maps, see http://www.epa.gov/NHSRC/news/news040207.html

We worked closely together, and with a highly qualified risk communication expert, Dr. Vince Covello, to develop specific language that is both understandable and accurate. Dr. Covello recommends that we adhere closely to the wording in the Q&As rather than attempt to rephrase the responses. Sometimes subtle word changes are perceived (rightly or wrongly) as conveying different information than the specific text provided.

These Q and As provide an opportunity for us to communicate our best understanding about chloramines in a way that is understandable to the general public. We plan to hold an information session in the near future to answer any questions you may have about this new risk communication tool and how best to use it when speaking with the public or the media.

We very much appreciate the input of many technical experts in ORD who worked closely with us to assure that the simple language we required is also accurate and up to date. Thanks also to the representatives of the Regions who helped us make sure that the very technical information we needed to convey is understandable and responds to the questions they frequently receive.

We hope you find these Q&As helpful and timely, and look forward to discussing with you how to best communicate about chloramines in drinking water.

Jeanne Briskin, Chief
Standards and Risk Reduction Branch
OGWDW/OW
202-564-4583 (phone)
202-564-3760 (fax)

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SRRB/SRMD/OGWDW/OW
1201 Constitution Ave NW
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Washington DC 20460

Address for US Mail
US EPA
1200 Pennsylvania Avenue
4607M
Washington, DC 20460
Hi Crystal,

Thank you for your voice message. I have forwarded below the e-mail that I sent to the ORD scientists on 3/23. It looks like I copied Jeanne on the message, but I did not copy you. Jeanne reviewed the draft version of this e-mail before I sent it. You are correct that we did ask the scientists about their interest in an information session on the Q&As. I had asked for any responses by last Friday, but I did not receive any. Yesterday I sent out a follow-up e-mail. I have heard back from two scientists regarding interest in such a training. I hope that I will hear from more individuals over the next few days. I think we will need a few more people to express interest before scheduling the information session. As I mentioned in one of my previous e-mails to Jeanne, I would like to consider the possibility of having a member of the ORD Communications Staff come to the information session and briefly provide some information on the current ORD communications approach, as well as other internal tools available to ORD when responding to the public and/or media. Examples of other internal tools include assistance with determining interview questions in advance and serving as moderator during an interview.

I will get back to both you and Jeanne once I hear back from more of the scientists.

Nicole

Nicole Shao
US EPA, ORD-Office of Science Policy
1200 Pennsylvania Avenue, NW (8104R)
ORD Colleagues,

I am forwarding you an e-mail I received today from the Office of Water (OW) announcing the availability of the URL to the finalized copy of the chloramines message maps (hereafter referred to as Q&As). This URL is: [http://www.epa.gov/safewater/disinfection/chloramine/](http://www.epa.gov/safewater/disinfection/chloramine/).

Both the Office of Water (OW) and I thank you for contributing your expertise to this important effort over the past year. OW carefully considered all of your comments as the Q&As were being developed. I worked very closely with OW to address your comments and ensure that the Q&As would be scientifically and technically correct, while meeting the goal of presenting the information in a way that would be easy for the general public to understand. To help address ORD workgroup recommendations for including more scientific details in this communication tool, we have added a new section in the final Q&As entitled, “Additional Supporting Information,” that includes links to documents and resources that can be used to gain additional technical information on each of the topics.

OW is aware that research on drinking water disinfectants is constantly evolving, and expects to periodically evaluate and possibly update the questions and answers about chloramines when new information becomes available.

If you would be interested in attending an information session via teleconference on this collaboratively-developed communication tool, please send me an e-mail no later than Friday, March 27*. The information session would likely include time for OW to answer any questions you might have about the Q&As, as well as a brief discussion on how the Q&As can be used to help us better communicate with the public and/or media.

Please do not hesitate to contact me if you have any questions or comments.

Nicole Shao
US EPA, ORD-Office of Science Policy
1200 Pennsylvania Avenue, NW (8104R)
Washington, DC 20460
(202) 564-6779

--- Forwarded by Nicole Shao/DC/USEPA/US on 03/23/2009 11:43 AM ---
Chloramine Message Maps

Anthony Meadows, Blake Atkins, Bruce Kiselica, Charlene Denys, Chris Thomas, Corine Li, Debra Forman, Diane Sanelli, Jack Rychecky, Jacqueline Clark, Jane Downing, Janet Kuefler, Karen Mcguire, Larry Wright, Marie Jennings, Mary Mindrup, Robert Smolski, Stallings Howell, Stephen Hogye, Thomas Poy, Victoria Binetti, Walter Andrews, Nicole Shao

Jeanne Briskin 03/23/2009 11:39 AM

The Office of Water, along with input from the Office of Research and Development (ORD), the Office of General Counsel (OGC), and the EPA regions, has created detailed questions and answers (Q&As) in response to public concerns and frequently asked questions about use of chloramine as a secondary disinfectant in drinking water. The goal of these Q&As is to provide the best informed EPA answers to the public about the benefits and risks of monochloramine while at the same time stressing the necessity of adequate pathogen control to assure protection of public health. The website to view the Chloramine Q&As is: http://www.epa.gov/safewater/disinfection/chloramine/

We are releasing these Q&As in order to assist EPA regions, state environmental and public health offices, and water suppliers to respond to public. The Q&As were designed using a specific risk communication format (message maps) aimed at targeting the general public. Each question is answered by 3 key responses, written at approximately a 6th grade level. Each key response is supported by three more detailed pieces of information at a 12th grade level. There is an Additional Supporting Information section in the footnotes that includes links to documents and resources that provide additional technical information. For more information on message maps, see http://www.epa.gov/NHSRC/news/news040207.html

We worked closely together, and with a highly qualified risk communication expert, Dr. Vince Covello, to develop specific language that is both understandable and accurate. Dr. Covello recommends that we adhere closely to the wording in the Q&As rather than attempt to rephrase the responses. Sometimes subtle word changes are perceived (rightly or wrongly) as conveying different information than the specific text provided.

These Q and As provide an opportunity for us to communicate our best understanding about chloramines in a way that is understandable to the general public. We plan to hold an information session in the near future to answer any questions you may have about this new risk communication tool and how best to use it when speaking with the public or the media...

We very much appreciate the input of many technical experts in ORD who worked closely with us to assure that the simple language we required is also accurate and up to date. Thanks also to the representatives of the Regions who helped us make sure that the very technical
information we needed to convey is understandable and responds to the questions they frequently receive.

We hope you find these Q&As helpful and timely, and look forward to discussing with you how to best communicate about chloramines in drinking water.

Jeanne Briskin, Chief
Standards and Risk Reduction Branch
OGWDW/OW
202-564-4583 (phone)
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Dear Crystal,

Thank you for the opportunity to review the July 28, 2008 version of the message maps. Attached are my comments on maps 1-12 for your consideration. I am still working on writing up my comments on maps 13-30. I will send them to you as soon as I can.

Nicole Shao
US EPA, ORD-Office of Science Policy
1200 Pennsylvania Avenue, NW (B104R)
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Nicole Shao Comments on Message Maps 1-12 (July 28, 2008 Version)

Specific Comments

Question 1
KM 3. "The EPA regulates the use of chloramines." If you want to include the word "safe" since Covello suggested it, I suggest incorporating it instead into one of the supporting information bullets instead of the key message. For example, "Drinking water treated with chloramines that meets EPA's health standards is safe to use."

Question 5
KM 3. Suggest replacing "is often" with "is sometimes." Especially because above we have stated that monochloramine use as a primary disinfectant is impractical for most.

Question 6
Footnote (*****) What reference will be used here? For my own edification, what factors are discussed in this reference?

Question 8
KM 2, bullet 3. Consider also including the factors "source water type" and "disinfectant used" like in Question 10 KM 2, bullet 2.

Question 9
KM 1, bullet 3. Same comment as for Question 8. Consider also including the factors "source water type" and "disinfectant used" like in Question 10 KM 2, bullet 2.

Question 11
Many times on this page the words "major options" or "major alternatives" are used. Suggest eliminating the word "major" throughout. It doesn't seem to add anything.

SI for KM 2. Per Friday's conversation with Covello, consider discussing difficulties with finding a skilled operator, operator training, and maintenance of special parts. Also discussed was installing filtration or biological filtration.

KM 3, bullet 3. Per Friday's conversation with Covello, this bullet should read something like, "EPA encourages using the full range of technologies available for reducing disinfection byproducts."

Question 12
In all three bullets for KM 1, the term "state and local authorities" is used. In Question 6, KM 3, bullets 1 and 2 the term "regulatory agencies" are used. Please check for consistency and revise as necessary in both locations.

KM 2, bullet 3. Per Friday's conversation with Covello, incorporate Trish's comment to delete the current bullet and copy the bullet from Question 13 KM2, bullet 2 here. We may want to
also say something here about how we develop guidance for use, not just that we work with state and local authorities when they ask for additional guidance.

**KM 3.** For increased accuracy, consider including the word "major" before the word changes.

**KM 3, bullet 2.** Consider adding the word "large" before the words "water utilities." I am not sure that small systems notify their customers of plans to use monochloramine. Please check.

**KM 3, bullet 3.** The term "local water authorities" is used here. Should this be "water utilities" to be consistent with the rest of the document? Please check.

**General Editorial Comments**

In the Additional Supporting Information section, some of the web links are underlined, while others are not. Please check for consistency.

*Cryptosporidium* should be capitalized and italicized. There are a few places in the document where this has not been done. Please check.

Suggest replacing the word "particular disinfection byproducts" with "certain disinfection byproducts" throughout.

**Specific Minor Editorial Comments**

**Question 2**

**KM 1, 3rd bullet.** Consider replacing "usually" with "typically."

Footnote (**). A semicolon is needed after the word "visit."

**Question 3**

The order of the website links for cholera and hepatitis should be switched so that they match the order in KM2, bullet 1 above (typhoid fever, hepatitis, and cholera).

**Question 8**

**KM 1.** Suggest switching the words "two groups" and "two individual" to maintain consistency with the order of the text presented in footnotes (*) and (**) below.

**KM 2, bullet 2.** Suggest replacing the word "will" with the word "can."

Footnote (**). Trihalomethane should be "trihalomethanes." Also, there is an extra comma after DBCM that needs to be removed.

Footnote (***). This footnote points for the CCL3 website. Shouldn't it point to the 6-Year website? Please check.

**Question 9**

**KM 2, bullet 1.** For consistency with the rest of the document, suggest changing the word "types" to "groups."
Question 10
KM 3, bullet 3. The word "monochloramines" should be "monochloramine."

Question 11
KM 1, bullet 1. The comma at the end of the sentence should be a period.

KM 1, bullet 2. The "u" in ultraviolet does not need to be capitalized.

KM 1, bullet 3. The word "organic" needs to be added before the word "materials" and the word "disinfection" needs to be added before the word "byproducts." Also a footnote now needs to be added with the NOM definition.

Question 12
KM 2, bullet 2. "Compliing" should be "complying."

Footnote (*). A colon is needed twice, once after each "at."

Footnote (**). The semicolon after the word "Act" should be a comma. The word States should be capitalized. A period is needed at the end of the sentence.