ILLINOIS COMMUNITY WATER SUPPLY NAP REQUIREMENTS

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BEFORE YOU FALL ASLEEP

- NAP is not what you all do when you come listen to me speak

- NAP is an abbreviation for Nitrification Action Plan

BRIEF REVIEW OF THE "NEW" REGULATORY REQUIREMENT

- Illinois EPA **proposal** to the Illinois Pollution Control Board in August **2017,** following outreach throughout 2016.
  - **Adoption by the IPCB July 25, 2019.**

SECTION 604.140 NITRIFICATION ACTION PLAN

Any community water supply distributing water without a free chlorine residual must create a Nitrification Action Plan (NAP). The NAP must:

a) contain a plan for monitoring total ammonia-N, free ammonia-N, nitrite-N, nitrate-N, monochloramine residual, dichloramine residual, and total chlorine residual;

b) contain system specific levels of the chemicals in subsection (a) when action must be taken;

c) contain specific corrective actions to be taken if the levels in subsection (b) are exceeded; and

d) be maintained on site and made available to the Agency, upon request.

WHY DID THE IPCB AGREE THAT THIS IS NEEDED?

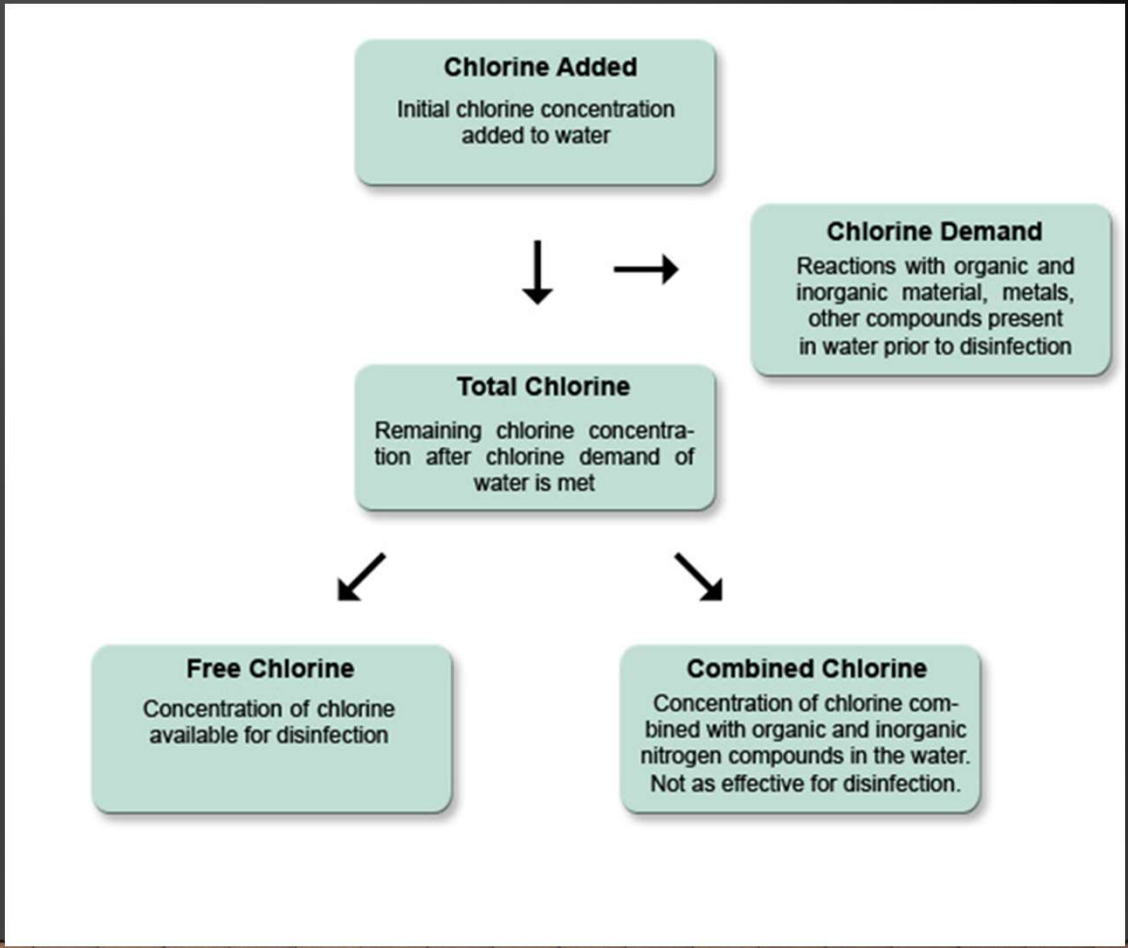
- Water systems around the state historically have not adequately controlled their chlorination practices resulting in health protection risks
  - Low (or no) residual disinfectants in stored and distributed water due to chlorination practices
    - Improperly balanced chlorine/ammonia ratios leaving water plants
    - Nitrification in Distribution System
      - Water age
        - Lack of mixing in tanks
        - Dead end mains

SORRY, WHY DO WE CHLORINATE?

- The Multiple Barrier Concept to Protecting the Public Water Supply
  - Source water protection
  - Treatment
  - Distribution system integrity and
  - **Disinfection**

SUBPART G: DISINFECTION

- Disinfection for inactivation of pathogens
  - Done within treatment plant.
- Maintaining a chlorine residual in the distribution system



SUBPART G CONTINUED:

- Section 604.725 Residual Chlorine

  a) A minimum free chlorine residual of 0.5 mg/L or a minimum combined chlorine residual of 1.0 mg/L must be maintained in all active parts of the distribution system at all times.

  b) Community water supplies must monitor chlorine residual to determine the amount and type of residuals existing at different points in the distribution system.

  c) Community water supplies must not mix water sources with free chlorine and combined chlorine residual.

SO, I'LL JUST USE FREE CHLORINE AND THEN I DON'T HAVE TO HAVE A NAP

- Most water supplies deal with "some" level of raw water ammonia
  - SURFACE WATER SOURCES
    - Always background concentrations present – Usually <0.5 mg/L (Unless rain)
  - GROUNDWATER SOURCES
    - AMMONIA LEVELS VARY WIDELY – Commonly <1.0 mg/L;
      - **BUT CAN BE >5.0 mg/L in some aquifers (e.g., the Mahomet)**
  - Purchase Water Systems
    - AMMONIA LEVELS dependent on what the wholesaler sends!

NEED TO BE ABLE TO PROVE TO IEPA YOU CONSISTENTLY MAINTAIN FREE, OTHERWISE….

- Do the math
  - Overcome competition for chlorine and other reactions.
  - Generally, chlorine reactions follow this sequence: 1) Iron, Hydrogen Sulfide, etc.; 2) free ammonia; 3) monochloramine and dichloramine. To establish a free chlorine residual, need to overcome:
    - Manganese at 1.3 times Mn concentration,
    - Iron at 0.64 times Fe concentration,
    - Sulfide at 2.2 times H_2S concentration,
    - Ammonia times at 7.6 times NH_4 concentration
    - (and don't forget possible TOC interaction to form DBPs).

PROVING IT, CONTINUED

- Rule of Thumb (**Properly** using a DPD test method, test free and total chlorine) -
  - If your results indicate that the free chlorine value is greater than 80% of the total chlorine value, you have likely achieved a true free residual.
  - If the free value is less than 80%, you are likely getting a false indication of free residual (caused by testing interference).Confirm with analytical testing
- When necessary (e.g., have TOC or H_2S) conduct additional demand test
  - Have seen Hach Method 10223 utilizing DPD reagents to confirm the math above

DON'T FORGET YOU CAN'T OVERFEED CHLORINE!

- Maximum NSF chlorine feed = 30 mg/l for gas and 10 mg/l for Sodium Hypochlorite (80 mg/l for 12.5%).
- This feed rate includes the sum of all points of application (pre, in process and post) and is based upon contaminants present when the gas or solution is made by the manufacturer.
  - In round numbers, if using sodium hypochlorite anything over 1.3 mg/l of free ammonia in the source water and chloramine formation is needed. Likewise, if using gas Cl2 anything over 3.9 mg/l of free ammonia in the source water and chloramine formation is needed.
  - **Experience in IL is that, with other competition for Cl_2, if you have more than than 1.0 or 3.0 mg/l free ammonia (for hypo and gas respectively) you won't be able to consistently use free chlorine.**

OK, SO I CHLORAMINATE & HAVE TO HAVE A NAP, WHERE DO I START?

- Start with the end in mind. Your GOAL is to Limit nitrification by:
  - Controling chloramination process;
    - Maintain monochloramine residual above 1.5 mg/L, AWWA M-56
  - Increasing flushing (directional flushing with scouring velocity);
  - Decreasing dead-ends in distribution system (looping mains and auto-flushers);
  - Managing stored water;
  - Use of alternative disinfectants (e.g., chlorine dioxide), pH adjustment and biocides (jury still out).

ADDITIONAL THINGS TO CONSIDER ABOUT NITRIFIERS

Considerations:		
Nitrifiers WILL develop especially in the presence of:	Opportunistic and WILL develop anywhere and everywhere:	Must DECREASE water age wherever and whenever possible:
High Ammonia	Raw Water Lines	Frequent Flushing
pH > 7	Aerator/Reaction Basin	Remove Tuberculation in Pipes
Warmer Temperatures	Clarifiers/Cones – Sludge Blanket	Water Storage Management
Sufficient Alkalinity, Oxygen and Nutrients	Filters/Softeners	De-Stratify Towers Deep Cycle Towers
	Storage Tanks	Reduce Excess Stored Water
	Distribution Piping	

WHAT I AM GETTING AT

- Make your plan of action fit what makes sense in your system
- When you monitoring indicates you have a concern, let it substantiate the actions you will take (those described in the previous two slides)
  - For example, your mono and total chlorine monitoring indicates that the two tests are farther apart than normal, your actions might look like the following:
    - Conduct additional monitoring (if it confirms your initial testing)
      - Flush areas of concern (e.g., deadends) (if you still have a problem)
        - Evaluate stored water (if you determine this is your problem)
          - Take necessary actions to reduce water age in tower

GET STARTED BY

- Beginning Nitrification Action Plan Monitoring (likely will have to buy some testing equipment)
  - Conduct regulatory required monitoring
  - For example, measure free and total ammonia along with nitrite and nitrate in the distribution system to confirm the level of nitrification that is occurring (also check pH).
  - What does this monitoring tell you?
    - In distribution, increase free Ammonia-N indicates monochloramine residual is being decayed and ammonia is being release.
    - If total Ammonia-N is decreasing, it is likely being "eaten" by Ammonia-Oxidizing Bacteria (nitrification is occurring).
    - Measuring total chlorine along with monochloramine will indicated the decay of mono to di prior to reverting to ammonia. Lowered pH will also indicated decay of mono.

START FORMULATING YOUR PLAN

- Use available resources:
  - IRWA Homepage: http://www.ilrwa.org/
    - For VA/ERP and **NAP: http://www.ilrwa.org/Downloads.htm**
    - For Building flushing (reopening) directions (1st box on page): http://www.ilrwa.org/index.htm
    - For Illinois EPA Drinking Water Watch: http://water.epa.state.il.us/dww/
  - For Illinois EPA Sample Collector Handbook NAP Chapter:
    - **https://www2.illinois.gov/epa/topics/compliance-enforcement/drinking-water/Documents/NAP-Handbook-final.pdf**
  - For Subtitle F: Public Water Supplies, Chapter I Pollution Control Board:
    - https://pcb.illinois.gov/SLR/IPCBandIEPAEnvironmentalRegulationsTitle35
  - 2018, Julie Sievers, Iowa DNR Presentation:
    - http://www.iowaruralwater.org/presentations/2018/IRWA-AmmoniaChlorine2018.pdf

NAP EXCERPTS FROM IRWA TEMPLATE

			Yellow Flag			Red Flag	
Site	Parameter	Goal	Trigger	Actions		Trigger	Actions
Entry Point	Total Cl			1)Verify Results 2)Check & Adjust → Until Returned to Normal			1)Verify Results 2)Check & adjust dose →Until return to normal
	Monochloramine						
	Dichloramine						
	Total NH3-N						
	Free NH3-N						
Ave. Water Age							
	Total Cl						
	Monochloramine						
	Dichloramine						
	Total NH3-N	A	B				
	Free NH3-N						

A NAP Includes:

1. A map and list of NAP sample sites representing all sources, entry points, and average and high water age sites within the distribution system;
2. A sampling schedule;
3. Analytical methods and standard operating procedures (SOPs) for sample collection;
4. A table of goals, baselines, and triggers for chemical levels, including 'yellow alert' triggers for when water is slightly off-spec and 'red alert triggers for when nitrification is bad-based on historical data;
5. A list of actions to take in response to yellow or red triggers; and
6. Communication strategies that will allow your system to take needed actions in a timely manner

EXAMPLES OF WHAT THE MONITORING TELLS US

- Optimize your chloramination practices
  - Start with a 5 to 1 chlorine to Ammonia-N ratio.
  - Measure Monochloramine, Total Chlorine and Free Ammonia at the entry point and in the distribution system.
    - At the entry point to the distribution system
      - If Mono=Total and no free ammonia you have optimized.
      - If free ammonia is still present, increase chlorine feed (up to NSF limit) and remeasure.
      - If total higher than mono and no free ammonia, decrease chlorine feed and remeasure.
    - In the distribution system (assuming optimized disinfection)
      - Mono less than total and free ammonia present - mono degrading to di
      - Total residual drops when supplemental chlorine added with no free ammonia present – on the wrong side of the break point curve and need to cut back on chlorine feed rate
      - Ammonia present - After chloramines are formed, they begin to decay and release ammonia back into the water. As decay occurs, monochloramine is converting to dichloramine and then dichloramine begins to dissipate. As pH drops, the rate of dichloramine formation is more rapid and it lasts longer in the water. (may get taste and odor complaints at the point di becomes prevalent)

EXAMPLES CONTINUED

- Watch for nitrite and nitrate formation
  - Measure at the source, entry point and designated points in the distribution system
    - Important to determine if nitrification is occurring
- Optimize pH - Chloramines are more stable (long lasting) at higher pH and Nitrifying bacteria are generally less likely to form at higher pH (9.0+).
  - Measure pH at the entry point to the distribution system and in the distribution system
    - A decrease in pH could indicate the presence of nitirifiers
- Important note on nitrate and pH – U.S. EPA ORD has determined that the presence of nitrifiers and lowered pH can be a significant factor in corrosion control. The processes at work may cause LCR violations and health risks if left unchecked.

IN SUMMARY, YOU MAY HAVE A NITRIFICATION PROBLEM IF:

- The weather is hot, and the treated water has excess ammonia
- Your monitoring indicates:
  - Monochloramine levels are decreasing
  - Ammonia-N concentrations are going down. (Decrease in Ammonia-N … suggests that it is being "eaten" by nitrifying bacteria … converting it to Nitrite then to Nitrate.)
  - Nitrite/ntrate concentrations are increasing
  - You begin receiving taste and odor complaints because dichloramine concentrations are going up as mono decays
  - pH drops in the distribution system

SPECIAL SATELLITE NOTE:

- If supplemental disinfection becomes necessary at REMOTE CHEMICAL FEED LOCATIONS: Add Ammonia first, establish a SAMPLE POINT WELL DOWNSTREAM TO CHECK concentrations, THEN CHLORINE FEED, and another SAMPLE POINT WELL DOWNSTREAM TO CHECK effects.
  - If good monochloramine residual present:
    - TYPICALLY ADD AMMONIA FIRST – ADD upstream far enough to assure good mixing prior to next step.
    - Provide Sample Point to measure ACTUAL FREE AMMONIA in the water (make sure target free ammonia is present to hit target monochloramine residual).
    - ADD Chlorine to form monochloramine residual.
    - May require 15 to 60 seconds mixing and reaction time downstream of chlorine feed before adding sample point for CHLORINE ANALYZER, or grab samples.
      - If you have a little pump station – this means you have to tap the water main outside of the building, and run a line back into the building for proper sampling or to hook to an analyzer.

QUESTIONS?