

BROWN WATER CONCERNS

Background, Actions and Solutions

Presentation to City Council

March 8, 2004

Department of Public Works

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WATER SYSTEM BACKGROUND

➤ Water Sources:

- Deep Wells (Piney Point Aquifer and Cheswold Aquifer)
- Water Treatment Plant (Columbia Aquifer)

➤ Current Treatment:

- Piney Point Aquifer – Chlorine
- Cheswold Aquifer – Chlorine and Fluoride
- Columbia Aquifer – Ozone, Activated Carbon, Lime, Chlorine, Fluoride

WHY CHLORINATION?

- An administrative order received from the state directed the City to begin disinfection of the system through chlorination.
- The order was signed by the City on December 8, 2000.
- The order resulted from several violations of the Total Coliform Rule.
- The last violation occurred in October of 2001 while undergoing provisions for the introduction of chlorination.

WHY CHLORINATION?

- The order to add chlorine to the city's system supported the results of a 1991 Disinfection Study. This study was prepared in anticipation of the order, due to the increasing size of the system.
- Since chlorination began there have been no violations of the Total Coliform Rule. Chlorination of the drinking water supply has provided an improved product from a Public Health standpoint.

CHLORINATION RESULTS


- System-wide continuous chlorination began on Monday, September 30, 2002. The capital cost of implementation was \$75,000 excluding in-house labor.
- The introduction of chlorine has played a key role in the development of the aesthetic concerns of the water system.
- Brown water complaints started being received in early December of 2002.

INITIAL ANALYSIS

Chlorine addition caused a breakdown of the rust layer on the inside of the unlined cast iron pipe system. Changes in velocity and flow within the water system created plumes of brown water that were in turn distributed throughout the system.



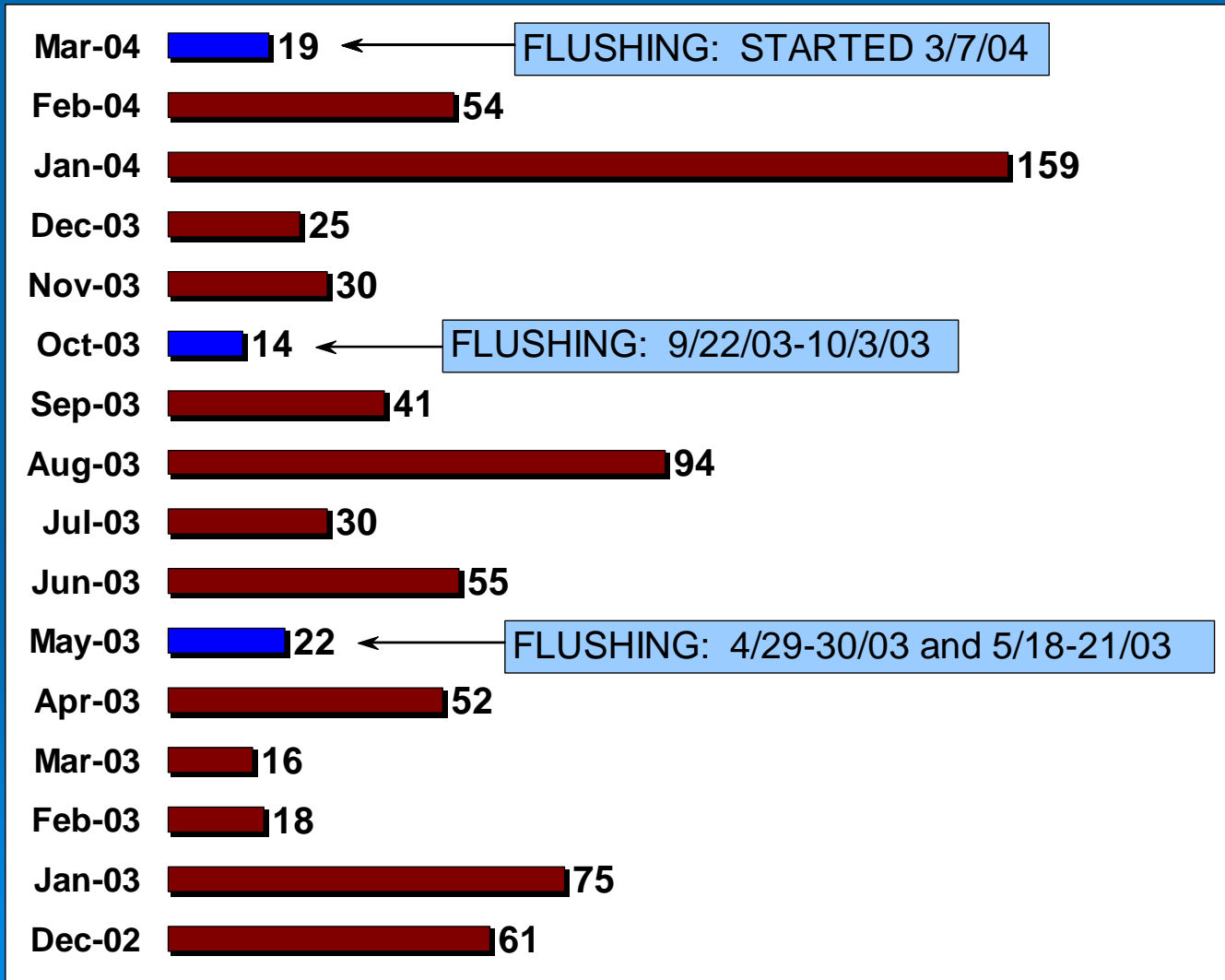
APPROACH: MONITORING

- All complaints received by the Public Works Office have been logged and evaluated.
 - Variations in system demand and operations have been tracked in an attempt to develop reasonable correlations.
 - Logs have been used to track complaints and system effects.
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APPROACH: FLUSHING

- In response to the brown water concerns, the City began a flushing program to remove the brown water from the system.
- April 2003 – east side and Rte. 13 corridor
- May 2003 – downtown, Rte. 8 and Rte. 13 corridors
- September 2003 – complete system
- January 2004 – delayed due to weather, rescheduled for March 2004

FLUSHING EFFECTS



APPROACH: MASTER PLAN

- The City has entered into an engineering services agreement with Whitman, Requardt & Associates to develop an updated Water Master Plan. This update includes a computerized hydraulic model of the water distribution system. This project was planned and budgeted for prior to December 2002.
- The Master Plan will aid in addressing these concerns because it will:
 - Map and predict the flow of water through the system
 - Model and predict the impact of the well facilities and treatment plant
 - Calculate water age
 - Identify necessary system improvements to improve flow across the system.

APPROACH: IMPROVEMENTS

- As the cast iron sections of the system appear to be a key player in the development of aesthetic problems with the water system, general capital improvements for the system have been proposed and budgeted for to begin with FY-2005.
- Capital improvements are to include replacing or relining portions of the cast iron sections of the system.

RUMORS AND FACTS

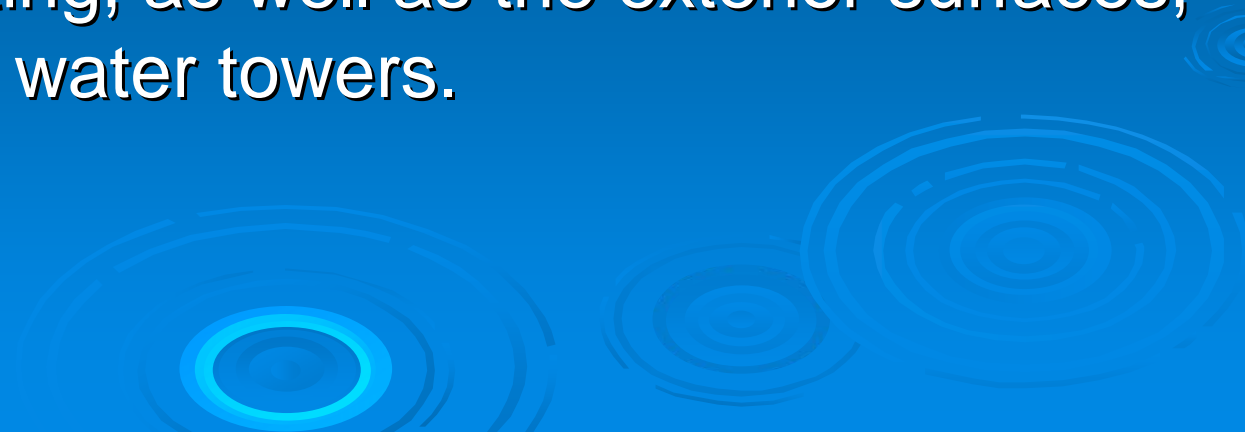
RUMOR #1: The system is being over-chlorinated.

FACT: Free chlorine residuals within the system may not be less than 0.3 mg/L nor more than 4 mg/L. Maintaining a residual greater than necessary is not an effective use of resources. The current dosing rates at the deep wells and the water treatment plant are between 0.8 mg/L and 3.5 mg/L. The current monthly average residual in the system is 0.6 mg/L.

RUMORS AND FACTS

RUMOR #2: The water towers are the source.

FACT: The water towers are one of the most highly maintained elements of the system. The City is under contract for maintenance and visual inspections to be performed every year. Routine maintenance and painting are performed on the interior coating, as well as the exterior surfaces, of all six (6) water towers.



RUMORS AND FACTS

RUMOR #3: This problem has been ongoing for at least two years.

FACT: Complaints began in December 2002. To date the problem has occurred during a 15 month period.

RUMORS AND FACTS


RUMOR #4: Chlorination was implemented all at once instead of being phased in.

FACT: Prior to September 30, 2002, chlorination was occurring at the Long Point Road Water Treatment Plant only. During the week of September 30, 2002, chlorination was implemented at the deep wells over a week long period. Chlorination began with a low dosing rate which was gradually increased until the required residual was achieved.

RUMORS AND FACTS

RUMOR #5: The raw water supply has a high iron (Fe) concentration.

FACT: Raw water samples were taken at 11 of the 16 entry points into the system. Iron levels were less than 0.050 mg/L at all entry points.

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RUMORS AND FACTS

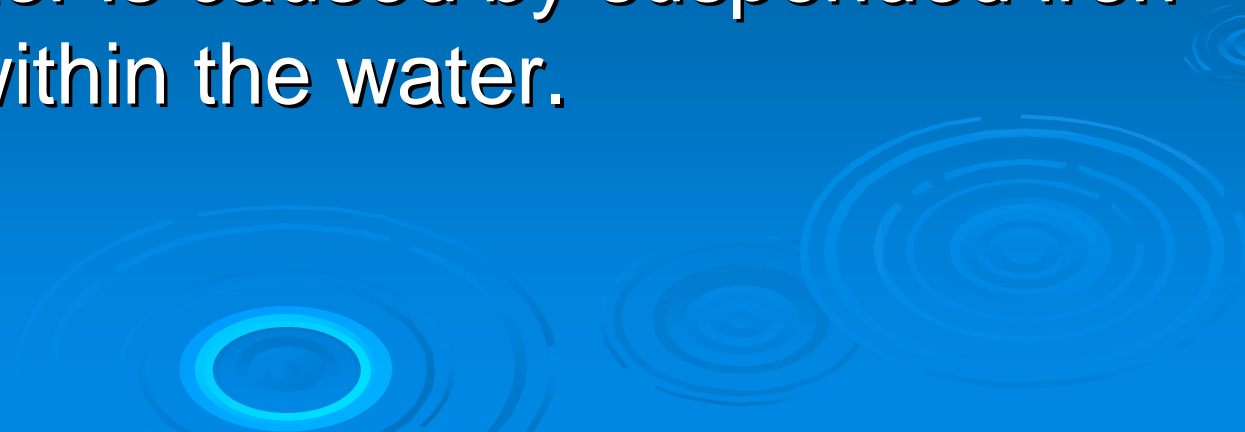
RUMOR #6: The City has commissioned a \$109,000 study to analyze the brown water issue.

FACT: The City of Dover has entered into a engineering services agreement with Whitman, Requardt & Associates to prepare a new Water Master Plan. This plan focuses on the physical attributes of the system as well as the creation of a computerized hydraulic model of the system. It will not review water chemistry or the effects of disinfection.

RUMORS AND FACTS

RUMOR #7: Good microbes are being killed by the chlorine, resulting in the brown water.

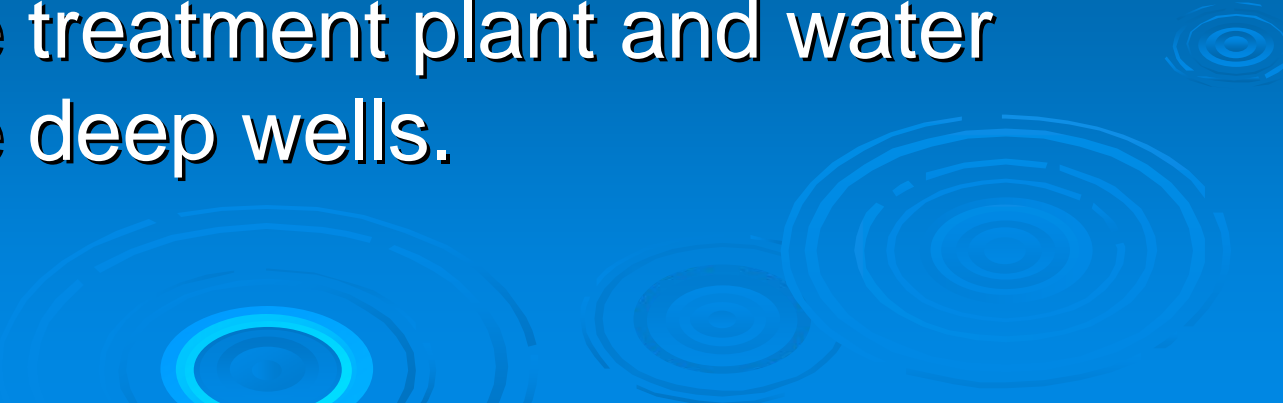
FACT: There is no indication that the brown water is a result of microbiology. The brown water is caused by suspended iron particles within the water.

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WHAT IS THE PROBLEM?

- Based upon available information and observations, iron particles are contained within the water which causes the brown water.
- Iron is covered under secondary drinking water standards for aesthetic value only.
- Based upon internal departmental conversations and discussions with a consulting firm, iron particles are being caused by the corrosion of the unlined cast iron pipes within the system.

WHAT IS THE PROBLEM?

- The water distribution system is a very delicate system which is extremely sensitive to changes in velocities, flow directions and water chemistry.
 - A corrosive environment has been created due to a pH differential between water leaving the treatment plant and water leaving the deep wells.
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WHAT IS THE PROBLEM?

- The corrosion problem created by waters with differing pH levels is intensified by the introduction of a free chlorine residual within the system.
- Conditions such as changes in flow direction or velocity cause iron particles created from corrosion to detach from the interior walls of the pipe and create plumes of brown water within the system.

PLAN OF ACTION

Items necessary to stabilize the water supply:

- 1) Flush the entire distribution system.
(Scheduled for 3/7/04 thru 3/10/04.)
- 2) Place the Long Point Road Water Treatment Plant (the Columbia Aquifer supply) off-line for routine maintenance for approximately 30 days.
- 3) Bring Well #2 back online to increase the stability of the flow direction throughout the system.
- 4) Develop an RFQ for water quality issues such as pH.


PLAN OF ACTION

- 5) When the Long Point Road Water Treatment Plant comes back online, increase the pH concentration to as close to 8.0 as possible to match the pH range of 7.8 – 8.4 from the Cheswold and Piney Point Aquifers. If the plant can maintain a pH of 8.0, extend the hours of operation of the plant to create a more uniform flow of water into the distribution system. Extended hours will necessitate the hiring of additional staff and/or contractors to move toward a 24/7 schedule.
- 6) Convert the water treatment plant to the baseline flow for additional stability once the pH level has been increased to 8.0. If the pH cannot be increased to 8.0 using hydrated lime, consider switching to sodium hydroxide which will provide more pH control but increase costs. Changing chemical usage will require the assistance of a consultant

PLAN OF ACTION

- 7) Use the SCADA system to develop a more stable flow scenario by managing the use of various deep well facilities.
- 8) Use results of the computerized hydraulic model to develop a unidirectional flushing program to be used several times per year.

PLAN OF ACTION

- 9) Pursue the replacement/relining of the unlined cast iron sections of the water distribution system.
 - 10) Determine whether or not a corrosion inhibitor will be necessary at each well head if pH stabilization does not eliminate corrosion of the interior of the pipe wall. This issue will require the assistance of a consultant.
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SECTION OF WATER MAIN



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