**COALITION EXHIBIT 'B'**

## Backflow Prevention Devices

**1. EPA chapter on air gaps and backflow prevention** -which is attached to the testimony as **Coalition Exhibit 'D'**, has many diagrams illustrating difference between an air gap and an in-line check valve or chemigation valve. This is available online at: http://water.epa.gov/infrastructure/drinkingwater/pws/crossconnectioncontrol/upload/2003_04_09_crossconnection_chapter04.pdf

**2. EPA presentation of backflow prevention options with some price ranges**: Capital Costs - The primary factor affecting cost of a given type of backflow prevention device is the size of the pipe for which it is designed. The following will also contribute to the total cost for installing a backflow preventer: system design (including consultation as to which products are appropriate); on-site delivery; installation and retrofit; maintenance; and inspection, testing, and surveying. Costs for individual backflow preventers or backflow preventer systems will vary depending on the product brand and vendor. However, some general prices are provided below. These prices are capital costs for the backflow preventer and do not include installation or service costs.

> Costs for double check assemblies range from $100 for a ?-inch diameter unit to $2,000 for 8-inch diameter units. Larger sizes could be $10,000 or more.
>
> Costs for reduced pressure principle assemblies range from $180 for a ?-inch diameter unit to $3,000 for 8-inch diameter units. Larger sizes can be $12,000 or more.
>
> Costs for vacuum breakers range from $10 for a hose bib to $400 dollars for a 2-inch pressure vacuum breaker.
>
> Costs for air gap drains will be site-specific, and will depend on the size of the pipe and the area in which it is located. If re-pumping is required, the capital and operating costs will most likely be higher than for all other devices.

Operation and Maintenance Costs - As discussed above, backflow prevention devices must be tested on a periodic basis. Testing must be conducted by a trained and certified technician. Testing time for an individual backflow prevention device will vary with the size of the device and its accessibility. Typically, testing time can range from half an hour for a small, easily accessible device to several hours for larger units located in areas that are not easily accessible. When these requirements are extrapolated to include testing for each backflow prevention device within a system, costs for a backflow prevention testing program can be considerable.
http://cfpub.epa.gov/safewater/watersecurity/guide/productguide.cfm?page=backflowpreventiondevice

**3. Other types of air gap devices -** Used to funnel minor relief valve discharges due to line pressure fluctuations and/or minor check valve fouling into a drainage system.
http://www.cashacme.com/prod_backflow_air_gap.php

4. **Reduced Pressure (RP) Principle Assembly (two check valve systems)**
    a. **Video on how to field test the RPZ**
    http://www.youtube.com/watch?v=5cJif6OyYic

**b. Video showing how the backflow of contaminated liquid keeps first checkvalve open but the second check valve closes and discharge occurs**....note that this causes a discharge from the device that must be captured on the ground (video at 1:15 min). Depending on how much grit and other obstacles occur in the wastewater - the checkvalves may not seat correctly until they have been flushed significantly by the fresh water portion of the two flow system. Consider the pressure differential mechanism located below the two valves that causes the valves to open and close depending on incoming flow pressure from the fresh water side of the system - if gunk builds up on that seal as well, then the backflow preventer device may leak continuously during operation. At about 3.5 minutes, the animation shows how the rubber seals are replaced by completely diassembling the device. At about 5:00 minutes it demonstrates how to replace the diaphram in the pressure differential part of the device.
http://www.youtube.com/watch?v=pCtfmEox5Tc&feature=endscreen&NR=1

5. **Various check valve backflow preventer products and their spec sheets**
    a. CLAVAL two valve backflow preventer spec sheet showing pipe diameter and expected flow rates for various products available http://www.backflow-supply.com/backflowcd/pdffiles/Cla-Val/Reduced%20Pressure/CLAVAL%20RP-4.pdf
    b. WattsWater products 900 Series http://media.wattswater.com/0834246.pdf
    c. Video on how to do maintenance check on Watts Water 900 Series: http://www.youtube.com/watch?v=qox-tfZPvBk&feature=related

6. **relief valve discharging** - a photo of what the discharge might look like is on page 1 http://www.usc.edu/dept/fccchr/Crosstalks/Winter.2008.pdf

7. **Discussion of chemigation valves used for injecting chemicals into irrigation supply water** - which is attached to the testimony as **Coalition Exhibit 'C'--** is online at: http://www.ag.ndsu.edu/extension-aben/irrigation/chemigation

The equipment requirements for protection of the water source when chemigating have been incorporated into the North Dakota Century Code. The law specifically requires the following equipment:

1. An anti-siphon device on the main water line
2. A backflow device in the chemical line
3. A pressure sensor on the pressurized water line

4. An inspection port (to check the operation of the check valve)
5. An injection port downstream from the anti-siphon device
6. A chemical resistant injection pump
7. Interlock between the water pump and the injection pump.

Diagram from the North Dakota University website page on chemigating: