WVRWA Comments on WV Water Quality Standards:

WVDEP's Triennial Review for 2017 includes a review of **Stream Flow, Depth and Distance from Water Supplies**, as per WV Legislature. WVRWA wishes to submit the following comments, and ask some questions related to flow, depth and distance. Other issues that should be considered as Water Quality Criteria that would be protective of public water supplies are **Ammonia, Bromide, Corrosivity**, and a reasonably prompt, specific time required for **Spill Reporting**.

Stream Flow: Flow is currently included in WV's WQSs as low flow (7Q10). An alternative low flow (Harmonic Mean Flow) has been suggested in the past. Both of these flow rates have been recently estimated by WVDEP for any location in the state, and are available via one of its online mapping applications at http://tagis.dep.wv.gov/streamflow/.

The TAGIS website provides these and other flows (in cubic feet per second or CFS) for watersheds at locations chosen by the user, as well as the area (in Square Miles or SM) of the watershed upstream of the chosen location. It is often useful, when comparing flows to water quality, or comparing flow from one watershed to another, to normalize a watershed's flow to its area, as CFS/SM (or CFSM, as it is customarily abbreviated).

Flows of varying amounts will carry varying concentrations of constituents, and travel downstream at varying velocities. CFSM plotted against water quality concentrations can simplify comparisons of datasets from one time frame to another, or from one watershed to another. CFSM can also be used in flow velocity equations. WVDEP should explore expressing flow as CFSM, in relation to water quality as well as time of travel.

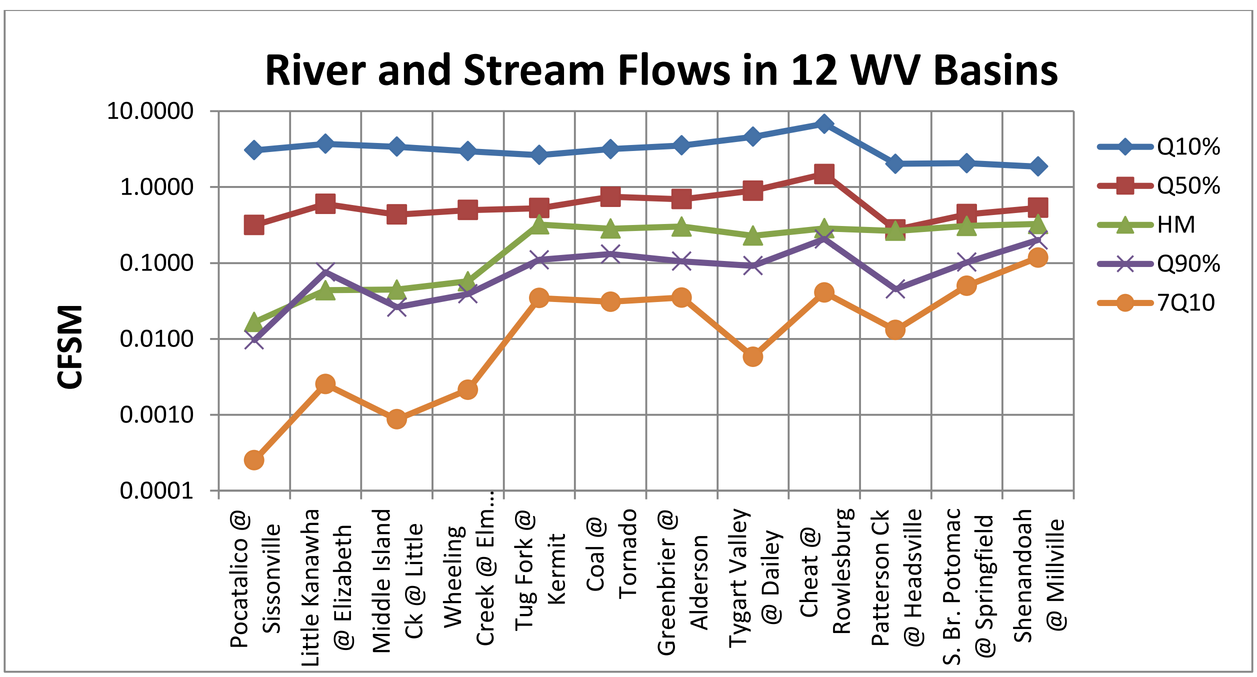

Figure 1 **Flows in WV watershed, in CFSM (Cubic Ft / Sec / Sq Mi)**

Figure 1 is a comparison of twelve watersheds (at USGS stream gage locations) in CFSM using the WVDEP's 7Q10 and Harmonic Mean (HM) values and areas, as well as the 90th Percentile (Q90%) low flow, 50th Percentile (Q50%), and 10th Percentile (Q10%) low flows from the USGS. (The highest flow here, Q10% low flow, is the same as the 90th % high flow used by WVBPH and WVDEP in delineating the Source Water Protection ZCCs and ZPCs.) Note, WVDEP's HM approximates Q90% in the four western watersheds, but HM is nearly constant elsewhere. Perhaps an error in WVDEP's HM calculation could account for this near constancy.

Low flows are certainly important when selecting a reliable Source of Drinking Water. The second graph below (Figure 2) has the 7Q10 and Q90% flows for these same 12 watersheds expressed as Gallons per Day per Sq Mi. Note that even in the Pocatalico Watershed, each square mile would provide on average 163 GPD during the driest week per decade. As the WV Water Quality Standards define public water supplies as including sources for single households, it is worth noting that even at 163 GPD/SM conditions a small headwater stream or aquifer area could supply a single household, without water storage.

To compensate for low flows, homeowners as well as community water supplies can and do benefit from water stored in aquifers or behind dams, etc. For example, the Putnam PSD serves a population of nearly 22,000 from a watershed of only 10 SM, with a 7Q10 of only 1653 GPD (based on the CFSM value for nearby Pocatalico River). The PSD is able to weather serious droughts by storing more than a six month supply in a reservoir which was constructed in a small nearby watershed, which is less than ½ SM in size.

During low flow conditions, small areas can and do serve as Source Water Areas for even sizeable public water supplies in West Virginia. Therefore, all the waters of the state should continue to be defined as Drinking Water Use, except where there is a site-specific exemption.

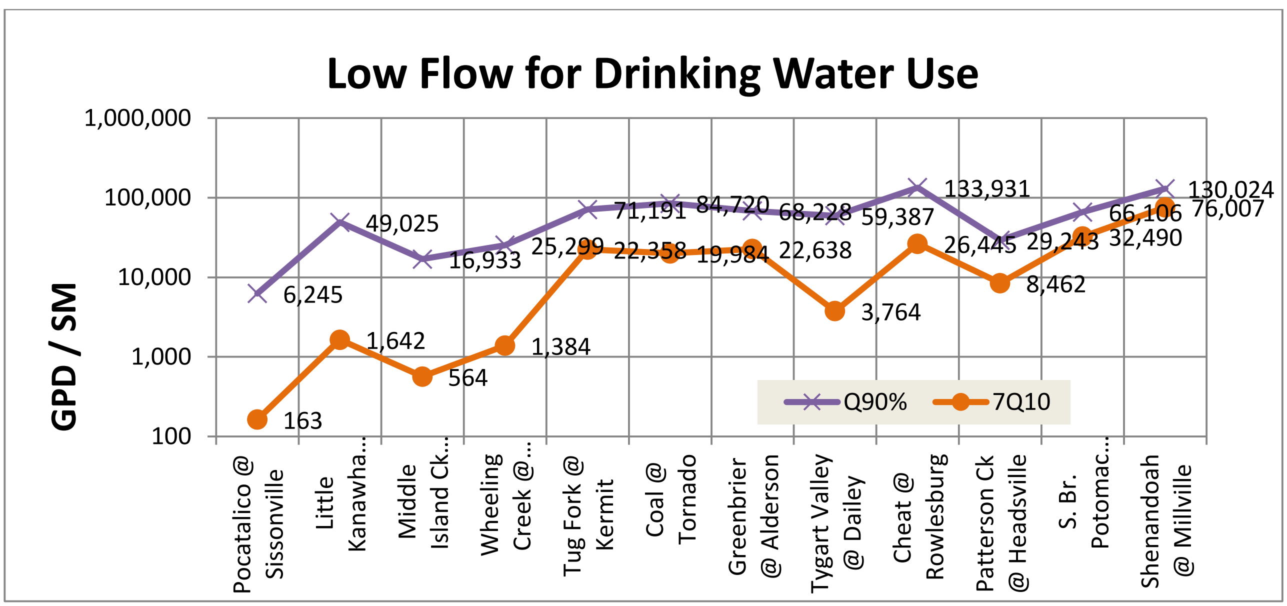

Figure 2 **Low Flows for Drinking Water Use (Gal / Day / Sq Mi)**

Distance to Water Supplies: WVDEP has another useful mapping application for determining the distance to the next downstream intake in West Virginia. http://tagis.dep.wv.gov/pswicheck. This mapping tool should supplant the list of public water supplies and their source water, found in Appendix B in the state's Water Quality Standards. Appendix B is decades out of date, and everyone should be able to access this information online where it can be updated as it changes.

This TAGIS mapping tool does not include the distance to public groundwater supplies, nor does it include private water wells. WVBPH no doubt provides mapping of public water wells to WVDEP, so the mapping application could be updated to include those. The locations of private wells could be approximated from the 911 address mapping, by assuming wells are in proximity to those dwellings which are located outside public water supply service areas. Mapping of water utility service areas should be available from the Water Development Office.

Distances to most water supplies on the land's surface can be readily mapped, or at least estimated in this way. Some areas will be somewhat complicated, as in karst and mined terrains, where streams of water flow under-ground and where some mine pools serve as sources of public water supplies.

Distances underground also include vertical distances. At what depth is the bottom of a Source Water Protection Area? Is it the lower most "fresh water" zone in an aquifer? Because stream flow during low flow conditions is due to groundwater discharge to streambeds, how deep should the surface water protection zone go below a streambed? Because riverbank wells induce infiltration of surface water, what distance upstream should a protection zone extend for a riverbank supply?

Distances to public water supplies need to be based on more than a straight line measure from point A to point B. The importance of the distances must include a recognition of flow pathways, as some nearby waters are not used while some distant waters are, and a recognition that surface waters become ground waters and vice versa.

Depth of Water: Water quality in a reservoir, stream or water well varies with depth. Where does a water quality standard for drinking water use apply, near the surface where samples may often be collected, or at the depth of an intake in a reservoir or stream or water well, or wherever source water may most likely come from (both above and below intakes), or all of the above? The question of depth should be explored, and addressed in the Triennial Review.

Spill Reporting: The Water Quality Standards include a Narrative Standard, whereby it is a violation to cause waters of the state to be unfit for drinking water use. Violations of the Narrative Standard are not limited to discharges from point and non-point sources. Many violations of the Narrative Standard are the result of spills, which may temporarily contaminate a source of drinking water. Promptly notifying a downstream water supply that a spill may soon arrive at its intake is of utmost importance to minimizing the impact of these types of violations of the Water Quality Standards.

The Narrative Standard should therefore be amended to include a reasonably prompt time criteria (i.e 2 hours) for responsible parties to warn any imperiled downstream surface water supplies when spills that may degrade their drinking water use have occurred. Knowing which public supply is downstream of any facility, or segment of a pipeline, railroad or highway has been simplified by WVDEP's Distance to Water Supplies mapping tool. A Spill Reporting requirement added to the Water Quality Standards should include a link to this tool. Responsible parties should be advised by WVDEP to use this tool in developing their Spill Response Plans for their facilities, pipelines, railroads and highways.

Ammonia: A Water Quality Criteria of 1 mg/l for Ammonia for drinking water use has been adopted by ORSANCO. The reason for the criteria is higher concentrations of Ammonia may interfere with the disinfection process of a public water supply. This ORSANCO Water Quality Criteria is in effect at the water supply intakes on the Ohio River. West Virginia should adopt the Ammonia criteria all our water intakes, and consider whether the criteria should also apply to drinking water sources beyond the intakes.

Bromide: Bromide ions react with disinfectants commonly used in public water supplies, creating brominated disinfection byproducts. When chlorine is used, a significant fraction of the bromide ions present in the source water may become incorporated into the disinfection byproducts, causing a significant increase in their mass (how they are regulated) and in their toxicity (why they are regulated). For example, the disinfection byproducts, known as Trihalomethanes are regulated in drinking water supplies at a concentration of 80 ug/l. A Bromide Criteria of 50 ug/l may be appropriate, to prevent creation of excessive Triahalomethanes and other types of disinfection byproducts. A Bromide Criteria of 50ug/l would be the same concentration adopted by CALFED, a large public water supply in central California, and for the protection of Birmingham, Alabama's drinking water.

Bromide concentrations in the West Virginia's waters may be locally elevated due to: 1) wastewater from the oil and gas industry ("produced water", or "natural brine") which comes from the geologic reservoirs which also produce oil and gas), 2) concentrated bromide solutions known as "Clear Brine Fluids" used by the oil and gas industry, 3) coal preparation plants and coal-fired power plants which use bromide salts to scrub mercury from coal as it's burned, 4) spills of bromide salts or brines being transported by truck, rail or barge. It is worth noting that the most commonly used bromide salts, such as Calcium Bromide, used by both the oil and gas and coal industries, are not included on any Federal list of chemicals which must be reported when spilled.

Corrosivity: Good quality drinking water depends on good quality source water. For public water supplies, it also depends on what happens in the treatment plant, the distribution systems, and the plumbing all the way to a faucet. Populations may become poisoned when some of the protections we depend on fail, causing for example lead poisoning from water supplies in Flint, Michigan and elsewhere.

In Flint, Michigan it has been reported the failures included switching to a corrosive source of water (the Flint River), using a different coagulant that made the water even more corrosive, and trying to save money by choosing not to use corrosion control chemicals. We should all try to learn from Flint's story.

The portion of the Flint story that is most relevant to our Water Quality Standards is this: What makes the Flint River corrosive, and should we consider protecting our public water supplies from being exposed to corrosive waters?

In West Virginia, our Bureau for Public Health uses the Langelier Index to measure corrosivity. This index uses a complex equation of water temperature, pH, Alkalinity, and Calcium ion concentration to estimate whether the water is likely to form a protective coating on the interior surfaces of plumbing that may contain lead.

However, as studies at Flint and elsewhere have shown, there are other water quality parameters that may be important, as they interfere with the water's ability to form a protective coating in the pipes. Beyond the Langelier Index, two other corrosion indices use concentrations of Chloride and Sulfate ions. Common sources of Chloride in our waters are road salts and oil and gas wastewaters, while our waters tend to have elevated sulfates in areas of coal mining.

The Chloride to Sulfate Mass Ratio (CSMR) is a simple ratio of these two ions' concentrations (each usually reported in mg/l). A CSMR > 0.58 in water supplies going out to the public has been correlated with increased lead in water supplies, and CSMR < 0.58 has not.

Another corrosive index which includes these two ions is the Larson Index, which is the ratio of Chloride plus Sulfate to Alkalinity, with each parameter expressed in milliequivalents. A Larson Index < 0.2 is not corrosive, whereas numbers >0.2 increase from slightly corrosive to very corrosive.

In order to learn from Flint, perhaps we should look beyond the Langelier Index and rate our state's waters using other corrosive indices as well. WVDEP has collected decades of water quality data on our waters, maintains this data in a spreadsheet format, and could easily set up and run a variety of corrosion indices. The output of a computer run of corrosive indices for our state's waters could be mapped by TAGIS, included in Watershed Basin Reports and Source Water Protection Reports. Water quality data for private water wells could be run through the same corrosive indices, and the data provided to well owners by their county Health Departments.

Following review and discussion of corrosivity as a water quality parameter, WVDEP should consider which indices to adopt and what numeric criteria should be applied for corrosive indices.