Riparian & Karst Buffers: Effective Water Quality Protection
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Editor's note: The following essay is the fourteenth in a five-year series on water resources stewardship in the Cowpasture River Watershed, sponsored by the Cowpasture River Preservation Association and published by The Recorder. The goal of the series is to create awareness among students, citizens and officials of the critical need to protect our surface and ground-water resources, and to stimulate interest in progressive stewardship.

WILLIAMSVILLE – Riparian and karst buffers are arguably the single best conservation practice for protecting surface and ground water quality.

Both riparian (stream-side) and karst (permeable carbonate rock) buffer areas serve multiple purposes including: reducing erosion, filtering sedimentation, filtering pollutants or contaminants, cooling streams, moderating temperature swings, and providing wildlife habitat and travel corridors. Science-based variable factors in buffer design and implementation include: soil characteristics and erodibility, slope gradient or percent, slope length or distance, vegetative cover and condition, and the nature of the pollutant or contaminant. In karst terrain however, the scientific and technical challenges are complicated because four more variable factors come into play: (a) how deep does surface and then ground water infiltrate karst formations, (b) what direction does the karst ground water flow, (c) how far does the karst ground water move horizontally, and (d) do any private or public wells draw upon these karst waters or do they resurge as karst springs?

Evaluation of Water Pollution Impacts – The Atlantic Coast Pipeline (ACP) has apparently chosen not to assess the environmental impacts of pollutants including soil and rock, bacteria-laden debris, industrial solvents and oils, and industrial hazardous materials upon: (a) surface rivers and streams, (b) ground water aquifers, (c) karst springs and seeps, (d) wetlands and bogs, and (e) aquatic wildlife and plants. The ACP Resource Report No. 2 – Water Use and Quality, furthermore, is substantively devoid of environmental impact assessments, analyses, evaluations, appraisals or predictions. Instead, the Natural Resources Group (NRG) leap-frogs to dumbed-down and rule-of-thumb buffer distances that blatantly ignore any recognition whatsoever of the scientific basis for designing, building and maintaining riparian or karst buffer areas. Most likely, the ACP/NRG excuse for this oversight is the guidance provided by the Federal Energy Regulatory Commission (FERC) which appears sound asleep at the throttle and perfectly happy for the ACP/NRG to apply archaic and out-dated rules-of-thumb fixes.

FERC Rule-based Decision Making – The Federal Energy Regulatory Commission is promulgating dumbed-down and Neanderthal-like rule-based decision-making for riparian and karst terrain buffers. As an illustration, the FERC recommends a rule-based vulnerability measure for drinking water supplies stating, *"Identify by milepost all drinking water supply wells, including private, community, municipal/public wells, and springs within 150 feet of any area that would be disturbed by construction."* (See: FERC, page 3-27). However, Dr. Neven Kresic, Ph.D. in Geology, Professor of Groundwater Dynamics at the University of Belgrade, Senior Fulbright Scholar at the U.S. Geological Survey and arguably the world's leading authority on water in karst terrain states, *"Sometimes, with the best intentions, various government agencies...create guidance documents...on karst vulnerabilities that are confusing at best...misleading and potentially harmful. [A] typical example is a recommended minimum distance for which there should be concerns regarding certain practices; if such distance is*

greater than the rule of thumb, the concern somehow disappears [and] then there is no concern. Whatever the karst-related concern may be, it is best to perform a site-specific assessment and not rely on some rules of thumb..." (See: Kresic, page 556). There is no scientific basis whatsoever for the following FERC-promulgated rules of thumb:

- Determining the location of public and private water supply wells or springs within 150 feet of construction.
- Restricting hazardous materials storage, equipment refueling or parking within 100 feet of karst terrain features, wetlands or waterbodies; within 200 feet of private water supply wells; or within 400 feet of public water supply wells.
- Conducting pre- and post-construction tests of water quality and quantity for wells within 150 feet of the construction area.

Purposes or Functions of Buffer Areas – Ecologists have recognized for more than 25 years that riparian and karst terrain feature buffer areas are the single most effective conservation strategy for protecting water quality. Riparian and karst buffer areas protect surface and ground water quality by filtering debris, sedimentation, nutrients and contaminants. Buffer areas promote stream bank stabilization, reduce erosion and provide food and habitat for aquatic wildlife. Riparian and karst terrain buffer areas intercept overland stormwater flow, increase water travel time and reduce peak floods. And buffer areas with mature trees also reduce water temperatures, enhance cold water habitat, and supply organic nutrients. What the Federal Energy Regulatory Commission should be doing but it is not doing, and what the Atlantic Coast Pipeline should be doing but it is studiously avoiding is to apply the best possible science in the design, construction and maintenance of riparian and karst buffers.

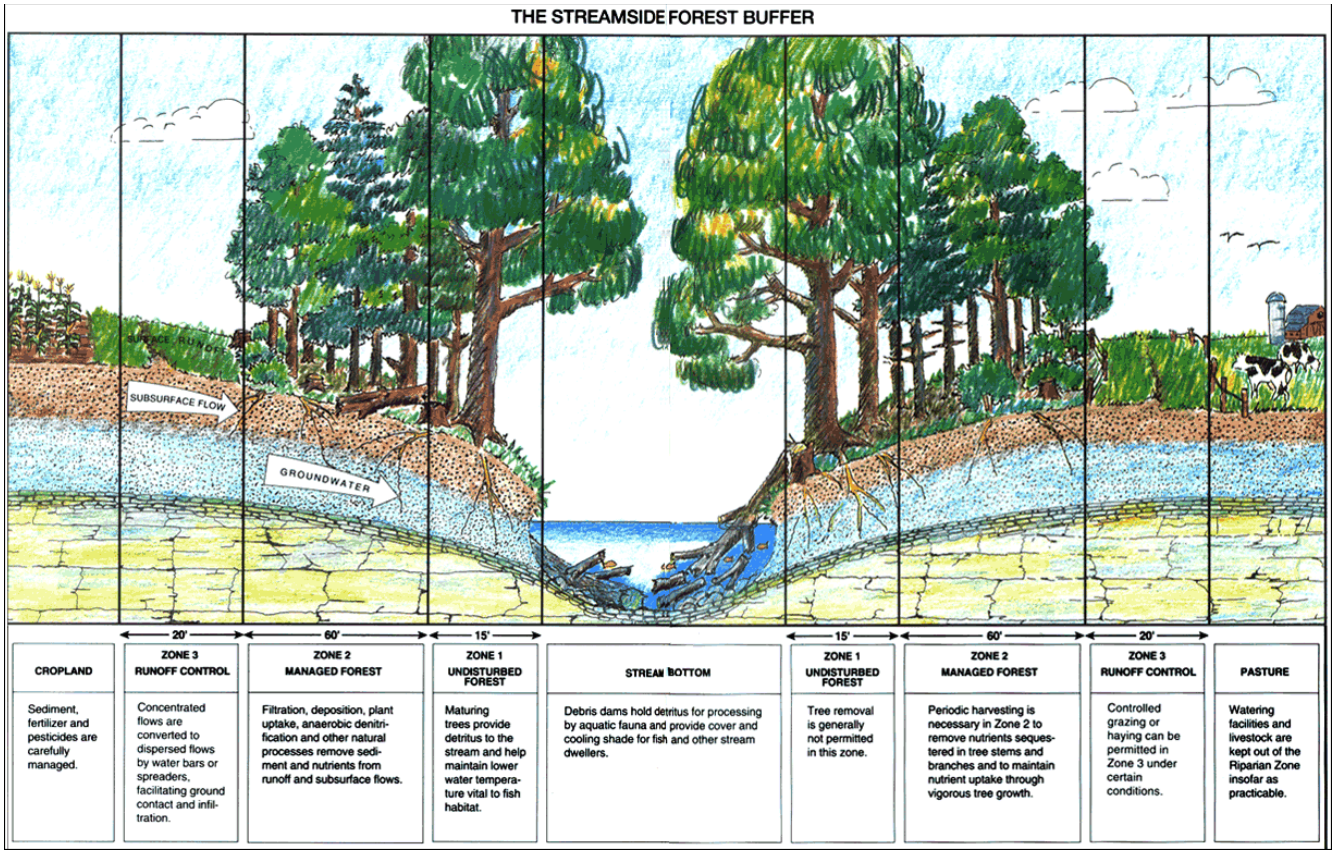
- Dozens of science-based studies illuminate the observation that stormwater Best Management Practices (BMPs) absolutely will not mitigate the risks and exposures to water quality from industrial-scale development nor permit the rehabilitation of a site to its pre-construction and natural status.

- Buffer strip width recommendations to protect surface water intakes, based upon research conducted by the New Jersey Agricultural Experiment Station at Rutgers University in 1989, vary from 50 feet (1% slope in mature forest with heavy ground cover and a hay meadow) to 775 feet (15% slope in areas with little vegetation and untilled alluvial fans). Science consistently indicates that steeper slopes above 15% become progressively more problematical and further, 30% slopes or greater create an almost impossible challenge.

- The effectiveness of riparian and karst terrain feature buffers is determined to a significant degree by the percent slope or gradient. As the slope increases from 10% the challenge becomes progressively greater. Additionally, the length of a slope influences effectiveness.

- The vegetative cover type(s) determine the effectiveness of riparian and karst terrain buffer areas. Well established grasslands are particularly effective in trapping sediment. Forest root systems are particularly effective in stabilizing banks and absorbing nutrients. Shrub cover falls roughly in between. The optimal approach is a mix of vegetative types in two or three zones.

- The effectiveness of riparian and karst terrain feature buffer areas are determined to a meaningful degree by the site-specific soil type. Moderately and highly erodible soils are less effective as buffer areas. Clay-based soils do not readily absorb water.
- The proximity of a waterbody or karst terrain feature to the location of a water pollution hotspot and the nature of contaminants in these hotspots influences the environmental risks and exposures, and the effectiveness of a buffer area.
- The three-zone riparian buffer system, arguably the most rigorous approach to effective buffer design, was originally developed as a stratagem for protecting the Chesapeake Bay. Note however that the three-zone riparian buffer system was not designed to handle the extraordinary challenges created by industrial scale linear developments in rugged mountainous terrain. See the illustration below.



Source – Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers. Note that "The Streamside Forest Buffer" illustration above is appropriate for slopes of perhaps 1% to 5%, however, steeper slopes require much wider buffer areas with 775 feet or more being appropriate for a 15% slope.

Recommended Conservation Actions – The Atlantic Coast Pipeline, LLC has apparently chosen not to adapt state-of-the practice know-how in establishing riparian and karst buffer areas. Therefore,

citizens of the Cowpasture River Valley of Virginia and the general public along the Atlantic Coast Pipeline route should figuratively speaking hold the FERC Commissioner's bare feet to the fire of enlightened public opinion and insist upon the best possible science-based standards of riparian and karst buffer design, construction and maintenance. More specifically:

- Establish karst and riparian buffer width distances based upon science and with six variable factors taken into account including: soil characteristics and erodibility, slope gradient or percent, slope length or distance, vegetative cover and condition, karst sinkhole depth and direction, plus a three-zone buffer design or schema.
- Absolutely do not rely solely upon cookbook stormwater "Best Management Practices (BMPs)" and particularly BMPs promugated by the Federal Energy Regulatory Commission, to effectively mitigate the risks and exposures to ground and surface water quality from industrial-scale development nor to rehabilitate a site to its pre-construction and natural status.
- The optimal approach must be to combine science-based riparian and karst buffer areas along with the most environmentally-friendly possible "Best Management Practices".

Let the mountains ring!!!

Technical References –

FERC Office of Energy Projects, Guidance Manual for Environmental Report Preparation (Washington, DC: Federal Energy Regulatory Commission, 2002), 150 pages.

Neven Kresic, Water in Karst: Management, Vulnerability, and Restoration (New York, New York: McGraw-Hill Professional, 2012), 736 pages.

Paleone, Roxanne S. and Albert H. Todd (editors), Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers (Annapolis, Maryland: USDA Forest Service, NA-TP-02-07, Revised June 1998), Approximately 300 pages.