RHODE ISLAND DIVISION OF PLANNING

Legislative Task Force

Meeting #10

Thursday, June 19, 2014
8:00 – 10:00 AM

Rhode Island's Builders Association Conference room
450 Veterans Memorial Parkway, #301, East Providence, RI

Agenda

8:00 Welcome and Overview of Agenda– *Kevin Flynn, DOP*

8:05 Subject Topics and Technical Presentations:

A. Literature Review Continued:
   1. Summary of Wetland Buffer Reports & Manuals
      - Year 2000 Plus reports - *Carol Murphy, DEM & Tom Kutcher, LTF member*
      - General reference reports – *James Boyd, LTF member*

   2. Summary of OWTS Buffer Reports & Manuals – *Russell Chateauneuf, LTF member*

B. Questions & Task Force Discussion – (*All) - moderated by Kevin Flynn, DOP*

9:50 Next Steps– *Nancy Hess, DOP*
A. July 17 meeting- LTF questions for Maryland guest speakers?

10:00 Adjourn

Draft notes for Legislative Task Force Meeting June 19, 2014
Selected Reports and Manuals
Carolyn Murphy, DEM Freshwater Wetlands Program

Excerpts regarding buffers and flood protection:

"Vegetated buffers also have value for flood control, and have been employed for this purpose. They control flooding by reducing flow velocity, allowing absorption and storage of water in soils, and by moving water from surface to subsurface watercourses. Vegetated buffers also mitigate property destruction by maintaining some undeveloped land along waterways and keeping developed or developing areas back from floodwaters, storm surges, and extreme high tides."
Source: Desbonnet et al. URI GSO

"Wetlands serve as temporary floodwater storage areas. A buffer zone adjacent to a wetland contributes to the wetland's effectiveness in storing floodwaters. A buffer will intercept precipitation and stormwater runoff, promoting infiltration and reducing direct surface flow to the wetland. A vegetated buffer may also help to preserve the storage capacity of the wetland by stabilizing adjacent slopes and capturing sediment that would otherwise flow into the wetland. In some settings, buffers themselves temporarily store floodwaters that overflow from the adjacent wetland or watercourse."
Source: Murphy and Golet. URI NRS

"Riparian buffers have been reported to have a major mitigating effect on flooding by increasing infiltration. These buffers reduce the velocity of surface runoff, and the slower velocity allows for more infiltration because it increases residence time. Riparian buffers also do not have impervious cover so more infiltration is possible. Infiltration reduces flooding because ground water moves slower than runoff, and it is discharged over a longer period of time. The reduction of velocity not only reduces flooding, but also reduces erosion."
Source: Lichtin, N. URI CE NEMO

Selected New England Reports continued
Chase, V., L. Deming, F. Latawiec. 1997 Buffers for wetlands and surface waters: A guidebook for New Hampshire Municipalities. Audubon Society of New Hampshire. - Factors for wildlife: location, land uses, edge effects, vegetation, width. - Factors for water quality protection: soils, topography, vegetation, land uses, season, width. - Recommended standard width buffers that "balance" protection with needs of property owners. Recommended 100 feet "as a reasonable minimum buffer width under most circumstances." Describes benefits for water quality and for wildlife, and cases where more than 100 feet is appropriate at water supply sources, sensitive wetlands, species specific needs, designated wetlands.
Vermont Agency of Natural Resources. 2005 Riparian Buffers and Corridors Technical Papers. Waterbury, Vermont. - Riparian buffers provide for river/stream channel stability by: flood attenuation, reduced effects of storm events, bank and shoreline stabilization, ice damage control, and

maintenance of channel morphology. Discusses channel evolution processes.
- Discusses control of exotic plant species because riparian buffers may be susceptible to invasions at/near transportation corridors and at flood prone areas. Disturbed buffers are vulnerable to invasive species.

Murphy, B.D. Undated. Position statement Utilization of 100 foot buffer zones to protect riparian areas in Connecticut. Inland Fisheries Division, Connecticut
- The paper provides support for adoption of a 100 foot buffer zone as a minimum setback at CT's perennial streams.
- Sediment control and nutrient removal: literature suggests that 100 foot riparian buffers will assist, however effectiveness will vary according to site conditions and may not be complete.
- Temperature control: greater than 80 feet buffer width for temperature maintenance.
- Large woody debris: literature supports 100 foot buffer zone.
- Food supply: less than 100 feet were ineffective for protection of invertebrate populations. Greater than 100 feet equivalent to unclogged streams. "...fish growth and survival may be directly impacted along streams with inadequate sized riparian buffers."
- Streamflow maintenance: the literature has not documented buffer widths.

Selected Reports Since 2000

Fischer, R.A. and J.C. Fischenich. 2000
Design recommendations for riparian corridors and vegetated buffer strips. EMRRP Technical Notes Collection. ERDC TN-EMRRP-SR-24. U.S. Army Research and Development Center. Vicksburg, Mississippi
- From the viewpoint of buffer restoration and management, more than protection.
- Acknowledges that there are few examples where buffer studies or criteria merge water quality and habitat interests.
- The authors do cite numerous studies (from 1974 to 1999) recommending minimum buffer widths for the categories of 1) Water quality; 2) Vegetation, reptiles and amphibians, mammals, fish, and invertebrates; ad 3) Birds.
- **See attached Table 4 General Riparian Buffer Strip Width Guidelines**
- The authors summarize that "in all cases" buffers wider than 10m (33 ft) should be provided for multiple objectives. Widths wider than 100m (328 ft) are needed for habitat values and corridors.

Environmental Law Institute. 2003
Conservation thresholds for land use planners. Environmental Law Institute. Washington, D.C.
- "As with other conservation thresholds, the scientific literature does not support an ideal buffer width applicable in all circumstances." Their survey found "recommended buffer widths ranging from one meter (1m) up to 1600 meters, with 75% of the values extending up to 100 meters."
- At a minimum, a riparian buffer should encompass " the stream channel and the portion of the terrestrial landscape from the high water mark towards the upland where vegetation may be influenced by elevated water tables or flooding, and by the ability of

2

soils to hold water" (Naiman et al. 1993).

- "Based on the majority of scientific findings, land use practitioners should plan for buffer strips that are a minimum of 25 meters in width to provide nutrient and pollutant removal; a minimum of 30 meters to provide temperature and microclimate regulation and sediment removal; a minimum of 50 meters to provide detrital input and bank stabilization; and over 100 meters to provide for wildlife habitat functions. To provide water quality and wildlife protection, buffers of at least 100 meters are recommended."
- **See attached Figure 4. Recommended minimum riparian buffers.**
- "To ensure that buffers function adequately, all major sources of disturbance and contamination should be excluded from the buffer zone, including dams, stream channelization, water diversions and extraction, heavy construction, impervious surfaces, logging roads, forest clear cutting mining, septic tank drain fields, agriculture and livestock, waste disposal sites, and application of pesticides and fertilizers. (Wenger 1999, Pringle 2001)"
- "Another consideration is the level of legal protection afforded to the area. Whether the buffer is in preservation status or protected under a conservation easement that allows for some level of activity, for example, will also determine its ability to provide desired functions".

Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, T. Granger, S. Stanley, and E. Stockdale. 2005. Wetlands in Washington State - Volume 1: A Synthesis of the Science. Appendix 8C. Guidance on Width of Buffers and Ratios for Compensatory Mitigation. Wash. State Department of Ecology. Publication #05-06-006. Olympia, WA.

- **See attached excerpts from Appendix 8C.**

3

buffer requirements for enhanced protection and should be clearly identified in the buffer regulations. The values recommended represent the distance from the edge of a resource (e.g., stream bank, not the centerline).

Table 3-1 Recommended Minimum Buffer Widths. (Adapted from Environmental Law Institute, 2003)

Function	Range of Riparian Buffer Widths		Minimum Recommended Buffer Width
	Environmental Law Institute (2003)	*Fischer and Fischneich (2000)*	
Stream Stabilization	30-170 ft	30-65 ft	50 ft[1]
Water Quality Protection	15-300 ft (remove nutrients)[2] 10-400 ft (remove sediment)	15-100 ft	100 ft[3]
Flood Attenuation	65-500 ft	65-500 ft	FEMA 100-year floodplain plus an additional 25 ft[4]
Riparian/Wildlife Habitat	10 ft-1 mile	100 ft-0.3 mile	300 ft[5]
Protection of Cold Water Fisheries	>100 ft (5 studies) 50-200 ft (1 study)	--	150 ft[6]

1. Larger buffers may be necessary based on steep slopes and highly erodible soils.
2. Different buffer designs should be considered for protection of different resources (coastal vs. inland).
3. Larger buffers may be necessary based on land use, resource goals, slope, and soils.
4. Additional buffer recommended to compensate for variability in flood model results at a site level and due to a changing climate.
5. Larger buffers may be necessary based on species and vegetation.
6. Larger buffers are necessary as the impervious cover in the watershed exceeds 8%.

In developed areas, as stormwater runoff flows over impervious surfaces such as asphalt and concrete, it increases in temperature before reaching a stream or other water body. Water temperatures are also increased due to shallow ponds and impoundments along a watercourse as well as fewer trees along streams to shade the water. Since warm water can hold less dissolved oxygen than cold water, this "thermal pollution" further reduces oxygen levels in suburban and urban streams. As described in the RI Stormwater Manual, temperature changes can severely disrupt certain aquatic species, such as trout and stoneflies, which can survive only within a narrow temperature range.

4

Table 4. General Riparian Buffer Strip Width Guidelines

Function	Description	Recommended Width[1]
Water Quality Protection	Buffers, especially dense grassy or herbaceous buffers on gradual slopes, intercept overland runoff, trap sediments, remove pollutants, and promote ground water recharge. For low to moderate slopes, most filtering occurs within the first 10 m, but greater widths are necessary for steeper slopes, buffers comprised of mainly shrubs and trees, where soils have low permeability, or where NPSP loads are particularly high.	5 to 30 m
Riparian Habitat	Buffers, particularly diverse stands of shrubs and trees, provide food and shelter for a wide variety of riparian and aquatic wildlife.	30 to 500 m +
Stream Stabilization	Riparian vegetation moderates soil moisture conditions in stream banks, and roots provide tensile strength to the soil matrix, enhancing bank stability. Good erosion control may only require that the width of the bank be protected, unless there is active bank erosion, which will require a wider buffer. Excessive bank erosion may require additional bioengineering techniques (see Allen and Leach 1997).	10 to 20 m
Flood Attenuation	Riparian buffers promote floodplain storage due to backwater effects, they intercept overland flow and increase travel time, resulting in reduced flood peaks.	20 to 150 m
Detrital Input	Leaves, twigs and branches that fall from riparian forest canopies into the stream are an important source of nutrients and habitat.	3 to 10 m

[1]Synopsis of values reported in the literature, a few wildlife species require much wider riparian corridors.

5

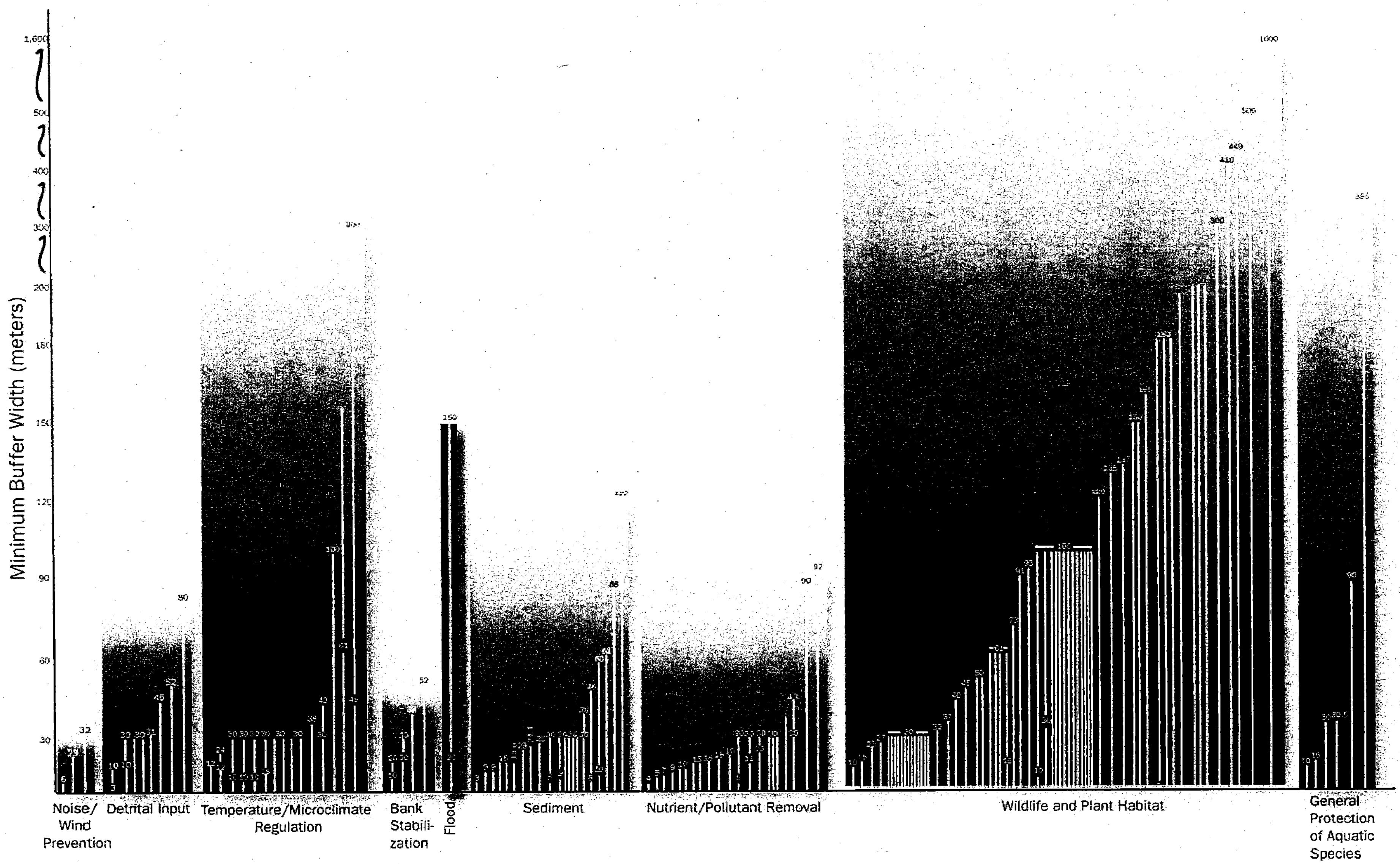


Figure 4. Recommended minimum riparian buffers (in meters) from each side of a water body (e.g. stream bank) needed to prevent noise/wind damage; provide detrital input; moderate temperature/microclimate; stabilize banks; provide flood attenuation; control sediment; reduce nutrients/pollutants; and provide wildlife habitat functions and general protection of aquatic systems in the United States, as cited in the scientific literature. Numbers represent the recommended minimum buffer widths; two numbers along one line indicate a recommended range (*see* Appendix D for specific findings). Lines extend from zero to the recommended buffer widths to indicate the span of habitat needed for protection.

Appendix 8-C- Guidance on Widths of Buffers…Western Washington Wetland Rating System

- Proposal for guidance on width of buffers linked to the *Washington State Wetland Rating System for Western Washington* - Revised - 2004
- Systems would:
    - o Standardize a system that classifies wetlands in 4 categories; I - IV
    - o Set widths of buffers are based on wetland category & adjacent land uses
    - o Land uses are classified into 3 categories based on threat of impacts to adjacent wetlands: low, moderate and high
- Buffers are defined as the uplands adjacent to an aquatic resource that can through various physical, chemical, and biological processes reduce impacts to wetlands from adjacent land uses.
- Widths of the buffer are measured along the horizontal plane.
- Three alternatives which increase in complexity;

❖ Widths of buffers ranged from 25 to 300 feet

Alternative 1: width based only on wetland category

Category of Wetland	Widths of Buffers
IV	50 ft
III	150 ft
II	300 ft
I	300 ft

Alternative 2: widths based upon wetland category and the intensity of impacts from proposed land use.

Category of Wetland	Land Use with Low Impact *	Land Use with Moderate Impact *	Land Use with High Impact*
IV	25 ft	40 ft	50 ft
III	75 ft	110 ft	150 ft
II	150 ft	225 ft	300 ft
I	150 ft	225 ft	300 ft

Level of Impact from Proposed Change in Land Use	Types of Land Use Based on Common Zoning Designations *
High	• Commercial • Urban • Industrial • Institutional • Retail sales • Residential (more than 1 unit/acre) • Conversion to high-intensity agriculture (dairies, nurseries, greenhouses, growing and harvesting crops requiring annual tilling and raising and maintaining animals, etc.) • High-intensity recreation (golf courses, ball fields, etc.) • Hobby farms
Moderate	• Residential (1 unit/acre or less) • Moderate-intensity open space (parks with biking, jogging, etc.) • Conversion to moderate-intensity agriculture (orchards, hay fields, etc.) • Paved trails • Building of logging roads • Utility corridor or right-of-way shared by several utilities and including access/maintenance road
Low	• Forestry (cutting of trees only) • Low-intensity open space (hiking, bird-watching, preservation of natural resources, etc.) • Unpaved trails • Utility corridor without a maintenance road and little or no vegetation management.

Alternative 3: Width based upon wetland category, intensity of impacts, and wetland functions or special character.

Category 1: wetlands scoring 70 more points)

Wetland Characteristics	Buffer Widths by Impact of Proposed Land Use (Apply most protective if more than one criterion is met)	Other Measures Recommended for Protection
Natural Heritage Wetlands	Low - 125 ft Moderate – 190 ft High – 250 ft	No additional surface discharges to wetland or its tributaries No septic systems within 300 ft of wetland Restore degraded parts of buffer
Bogs	Low - 125 ft Moderate – 190 ft High – 250 ft	No additional surface discharges to wetland or its tributaries Restore degraded parts of buffer
Forested	Buffer width to be based on score for habitat functions or water quality functions	If forested wetland scores high for habitat, need to maintain connections to other habitat areas Restore degraded parts of buffer
Estuarine	Low - 100 ft Moderate – 150 ft High – 200 ft	No recommendations at this time[3]
Wetlands in Coastal Lagoons	Low - 100 ft Moderate – 150 ft High – 200 ft	No recommendations at this time[3]
High level of function for habitat (score for habitat 29 - 36 points)	Low – 150 ft Moderate – 225 ft High – 300 ft	Maintain connections to other habitat areas Restore degraded parts of buffer
Moderate level of function for habitat (score for habitat 20 - 28 points)	Low – 75 ft Moderate – 110 ft High – 150 ft	No recommendations at this time[3]
High level of function for water quality improvement (24 – 32 points) and low for habitat (less than 20 points)	Low – 50 ft Moderate – 75 ft High – 100 ft	No additional surface discharges of untreated runoff
Not meeting any of the above characteristics	Low – 50 ft Moderate – 75 ft High – 100 ft	No recommendations at this time[3]

Category II: wetlands scoring 51-69 points

Wetland Characteristics	**Buffer Widths by Impact of Proposed Land Use** (Apply most protective if more than one criterion is met.)	**Other Measures Recommended for Protection**
High level of function for habitat (score for habitat 29 - 36 points)	Low - 150 ft Moderate – 225 ft High – 300 ft*	Maintain connections to other habitat areas
Moderate level of function for habitat (score for habitat 20 - 28 points)	Low - 75 ft Moderate – 110 ft High – 150 ft	No recommendations at this time[2]
High level of function for water quality improvement and low for habitat (score for water quality 24 - 32 points; habitat less than 20 points)	Low - 50 ft Moderate – 75 ft High – 100 ft	No additional surface discharges of untreated runoff
Estuarine	Low - 75 ft Moderate – 110 ft High – 150 ft	No recommendations at this time[2]
Interdunal	Low - 75 ft Moderate – 110 ft High – 150 ft	No recommendations at this time[2]
Not meeting above characteristics	Low - 50 ft Moderate – 75 ft High – 100 ft	No recommendations at this time[2]

Category III: wetlands scoring 30-50 points

Wetland Characteristics	Buffer Widths by Impact of Proposed Land Use	Other Measures Recommended for Protection
Moderate level of function for habitat (score for habitat 20 - 28 points)	Low - 75 ft Moderate – 110 ft High – 150 ft	No recommendations at this time[1]
Not meeting above characteristic	Low - 40 ft Moderate – 60 ft High – 80 ft	No recommendations at this time[1]

Category IV: wetlands scoring less than 30 points

Wetland Characteristics	Buffer Widths by Impact of Proposed Land Use	Other Measures Recommended for Protection
Score for all 3 basic functions is less than 30 points	Low - 25 ft Moderate – 40 ft High – 50 ft	No recommendations at this time[1]

Literature review notes for Wetland and OWTS Legislative Task Force

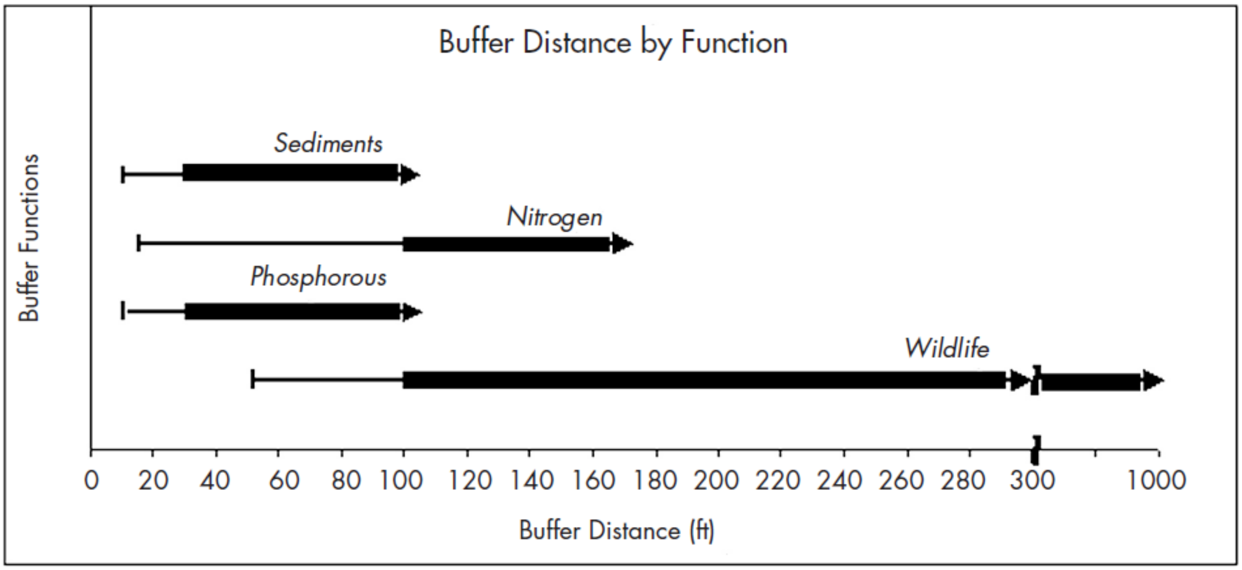
Tom Kutcher

Nichols, S. S., McElfish Jr, J. M., & Kihslinger, R. L. (2008). Planner's guide to wetland buffers for local governments. Environmental Law Institute, Washington, DC. 21 pp. plus appendices.

This report investigates municipal ordinances addressing wetlands buffers and the underlying science, under the assumption and assertion that local governments are better suited to authorize wetland buffer regulations than state or federal agencies. The authors reason that local governments are more concerned with broader implications of wetland regulation for their communities. While much of the report covers the elements of local ordinances, many points are relative to the Task Force. The report is based on 50 wetland buffer ordinances and "several hundred" scientific studies, although only 48 papers were cited. Scientific review of buffer literature was conducted and summarized as below. Refer to Figure 1 for the numbers.

- **Water Quality** is affected not just width of buffer, but also by flow pattern, vegetation type, percent slope, soil type, surrounding land use, pollutant type, and precipitation patterns. Buffer width effectiveness is therefore highly variable. For consistent protection, wider buffers are necessary.
- **Wildlife Habitat** is also affected by buffer width, but is highly variable by species. Upland area surrounding wetlands is considered core habitat for wetland-dependent amphibians and reptiles.
- Outlines some approaches to setting buffer widths including
    - Fixed non-disturbance width
    - Non-disturbance width plus additional regulated area of scrutiny
    - Non-disturbance width plus setback
    - Matrix-based (see Fig. 2)

Figure 1



*Effective buffer distance for water quality and wildlife protection functions. The thin arrow represents the range of potentially effective buffer distances for each function as suggested in the science literature. The thick bar represents the buffer distances that may **most** effectively accomplish each function (30 - > 100 feet for sediment and phosphorous removal; 100 - > 160 feet for nitrogen removal; and 100 - >300 feet for wildife protection. Depending on the species and the habitat characteristics, effective buffer distances for wildlife protection may be either small or large.*

Figure 2

The water quality calculation includes differing buffers based on wetland type (A-E) and whether there is a surface water outlet from the wetland.

Water Quality Buffers						
Land Use Intensity	Wetland Category					
	Wetland Outlet	A	B	C	D	E
Low	Yes	40 ft	35 ft	30 ft	25 ft	20 ft
	No	75 ft	50 ft	40 ft	35 ft	25 ft
Moderate	Yes	90 ft	65 ft	55 ft	45 ft	30 ft
	No	105 ft	90 ft	75 ft	60 ft	40 ft
High	Yes	125 ft	110 ft	90 ft	65 ft	40 ft
	No	175 ft	150 ft	125 ft	90 ft	50 ft

The water quality value is then adjusted for slope:

Slope Adjustment	
Slope Gradient	Additional Buffer Multiplier
5-14%	1.3
15-40%	1.4
>40%	1.5

This matrix approach is more complex than a single number, but can better reflect scientific understanding, particularly with diverse wetland types and land use conditions in a locality. With appropriate public outreach and technical support, a matrix-driven buffer can gain public support and achieve good results.

Hruby, T. (2013). Update on wetland buffers: the state of the science, final report. Washington State Department of Ecology Publication #13-06-11.

This report is based on a national literature search using relevant keywords to identify the most up-to-date and best available science on wetland buffer functions. Main conclusions of the research are as follow.

Pollutants

- The function of buffers in flood attenuation has still not been well-studied
- Buffers protect water quality by infiltrating surface water
- Buffers remove pollutants from groundwater via soil and root interactions
- Buffers may become saturated with pollutants and lose effectiveness over time
- Buffer width, slope, infiltration rate, rugosity, adjacent LU, vegetation type, vegetation density and spacing, and flow convergence are all important characteristics for pollution removal
- Coarse sediments may be removed by narrow buffers (16-66 feet)
- Finer sediments are better removed by wider buffers (66 to 328 feet)
- Trapping of sediments is tied to pollutant removal
- Buffer width accounts for 35-60% of buffer effectiveness for water pollution
- Wider buffers are more reliably effective (Fig. 3)

Wildlife

- Buffers considered core habitat for many species (and this core habitat needs a buffer)
- Undisturbed uplands between wetlands are important for species
- Effective buffer for wildlife is very complex and depends on width, vegetation type, etc. per species
- Mean minimum core habitat for herps from literature ranges from 117m to 205m depending on species
- Protecting upland habitats is necessary for the sustained survival of amphibians
- Many bird and mammal species rely on wetland buffers and require huge buffers to maintain populations
- Recent documents recommend buffers exceeding 300 feet (Fig. 4)
- Protecting wildlife will protect other functions

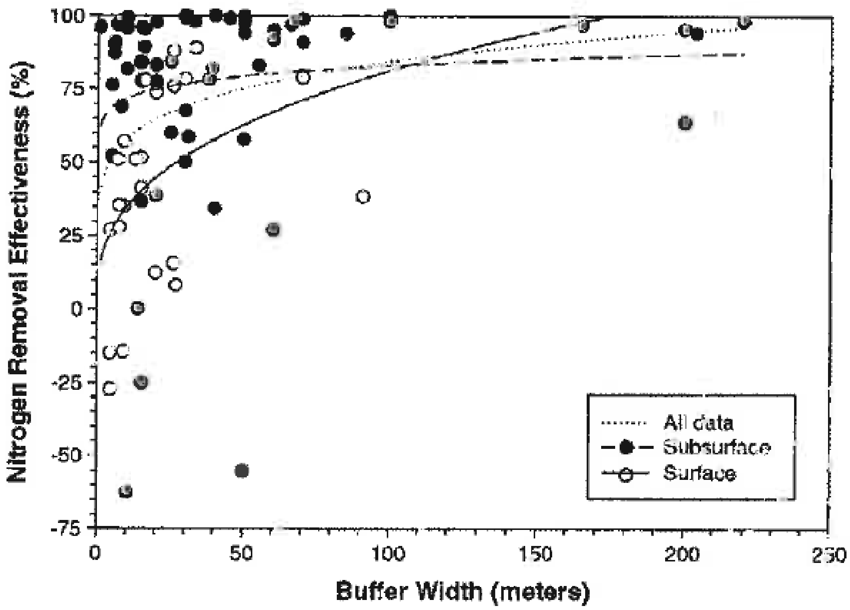


Figure 3. Graphic from meta-analysis by Mayer et al. 2007

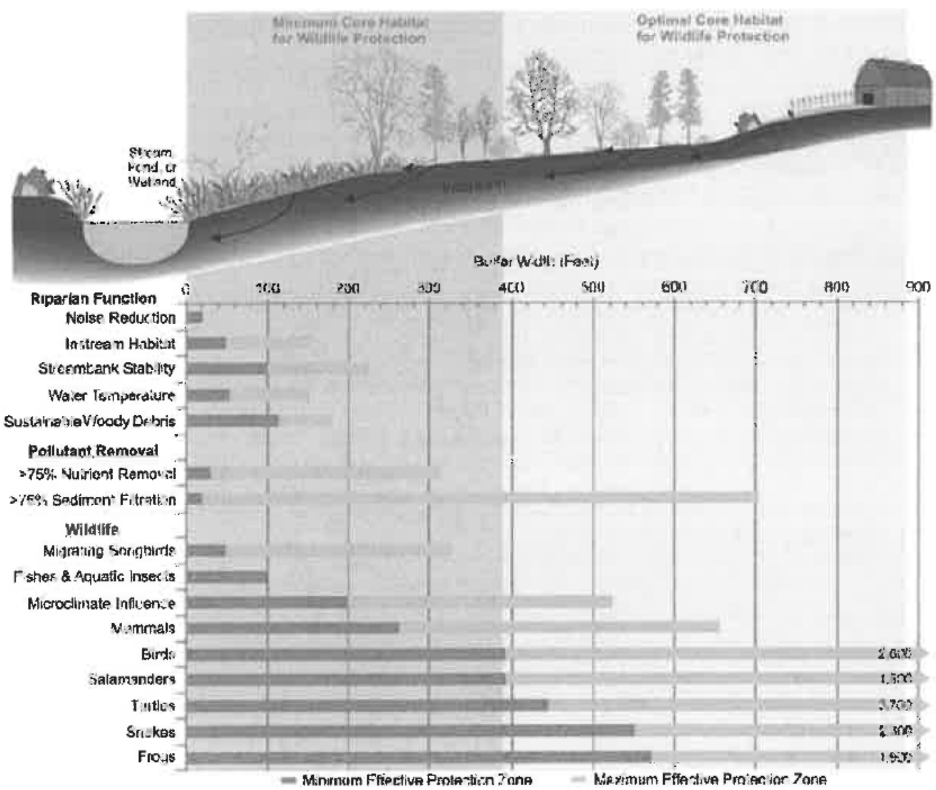


Figure 4.

Woods Hole Group (2007). Nitrogen attenuation in wetlands: a literature review, bibliography with abstracts and annotations. Final Report Prepared for Massachusetts DEP, Lakeville, MA

This report summarized the latest literature regarding Nitrogen attenuation capacity of wetlands. Much of the information was not relevant to the group. However, the following information on forested buffers is relevant.

- Forested uplands retain substantial nitrogen (N)
- Forested uplands, particularly NLE mature forests, can become N saturated
- N saturated uplands can leach N to groundwater
- Vegetation type does not drive N removal; % carbon, LU history, water table dynamics, roots, and organic matter are primary contributors
- Riparian wetland soils can denitrify NO3 from groundwater
- Microbial community is an important factor

Bentrup, G. 2008. Conservation Buffers—Design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS–109. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 110pp.

This report focuses on the functions of wetland buffers and their applications in municipal planning. The report is not a synthesis of current science per se and, in fact, does not cite any references; however, the authors claim it is based on a synthesis of the latest and best available science of the time. While the report contains an abundance of useful information for planning, much of it is intended for site and situation-specific planning and is not directly applicable to regulations. The functions of buffers are offered in a table (Table 1). Other relevant information is as follows.

- Buffers are most effective around low order streams
- Buffers are most effective closer to the source of pollution
- Wider buffers are needed where flow is concentrated (i.e. valleys)
- Buffers are more effective on flatter slopes
- Narrow buffers remove coarse sediments more effectively than fine sediments
- Buffers can reduce pathogens, nitrogen, phosphorus from surface and groundwater, but the mechanisms are complex and vary with pollutant
- Buffer width tools are recommended for determining buffer width based on soils, slope, pollution type and other factors
- Gets into ecological implications, such as patch ecology and habitat corridors for wildlife
- Corridor width recommendations are shown in Figure 5

Table 1

Issue and Objectives	Buffer Functions
Water Quality	
Reduce erosion and runoff of sediment, nutrients, and other potential pollutants Remove pollutants from water runoff and wind	Slow water runoff and enhance infiltration Trap pollutants in surface runoff Trap pollutants in subsurface flow Stabilize soil Reduce bank erosion
Biodiversity	
Enhance terrestrial habitat Enhance aquatic habitat	Increase habitat area Protect sensitive habitats Restore connectivity Increase access to resources Shade stream to maintain temperature
Productive Soils	
Reduce soil erosion Increase soil productivity	Reduce water runoff energy Reduce wind energy Stabilize soil Improve soil quality Remove soil pollutants
Economic Opportunities	
Provide income sources Increase economic diversity Increase economic value	Produce marketable products Reduce energy consumption Increase property values Provide alternative energy sources Provide ecosystem services
Protection and Safety	
Protect from wind or snow Increase biological control of pests Protect from flood waters Create a safe enviroment	Reduce wind energy Modify microclimate Enhance habitat for predators of pests Reduce flood water levels and erosion Reduce hazards
Aesthetics and Visual Quality	
Enhance visual quality Control noise levels Control air pollutants and odor	Enhance visual interest Screen undesirable views Screen undesirable noise Filter air pollutants and odors Separate human activities
Outdoor Recreation	
Promote nature-based recreation Use buffers as recreational trails	Increase natural area Protect natural areas Protect soil and plant resources Provide a corridor for movement Enhance recreational experience

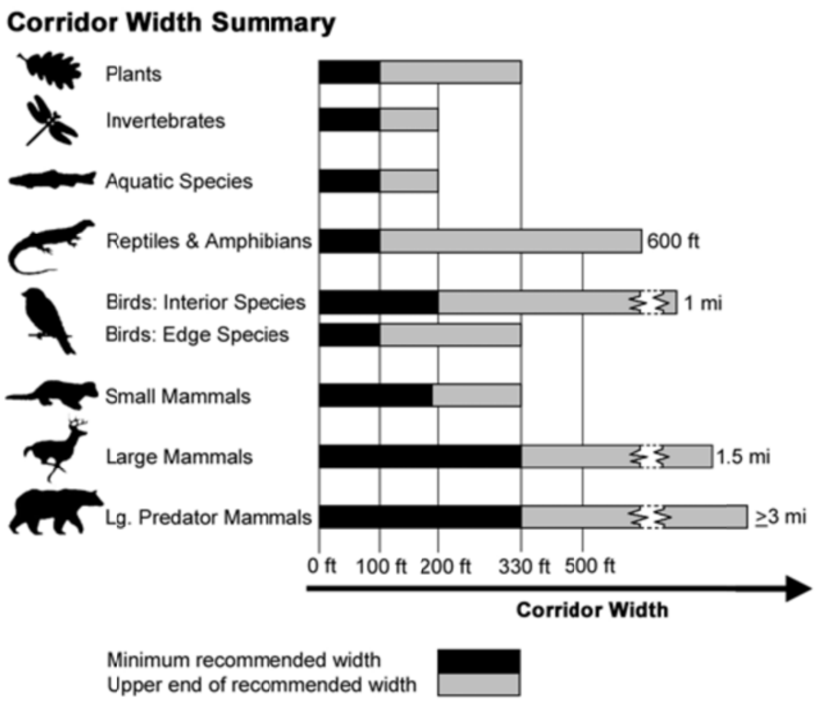

Corridor Width Summary
Plants
Invertebrates
Aquatic Species
Reptiles & Amphibians
600 ft
Birds: Interior Species
1 mi
Birds: Edge Species
Small Mammals
Large Mammals
1.5 mi
Lg. Predator Mammals
≥3 mi
0 ft
100 ft
200 ft
330 ft
500 ft
Corridor Width
Minimum recommended width
Upper end of recommended width

Figure 5

DRAFT – Freshwater Wetlands & OWTS Legislative Task Force

James Boyd, CRMC Coastal Policy Analyst

<u>Literature Review</u>

Final Report – Assessing Forest Buffer Functions after Five Years – Maryland DNR 2010

- Quantitative assessment of riparian forest buffer functions at 34 sites abutting tributary streams within three Chesapeake Bay watersheds from 2000-2008
- Buffers were newly planted with trees (seedlings) and averaged over 100 feet in width located in mostly small rural sub-watersheds ranging from 38 to 19,000 acres in drainage area (average size is 2756 acres)
- Impervious cover within the drainage areas was mostly 2-11% of watershed area with an average of 5% impervious cover, but ranged up to 66%
- Tree survival in restored riparian forest buffers was 80% in the 1st year with losses continuing at up to 12%/year and stabilizing in the 5th year at 50%
- Understory richness increased significantly from 165 to 276 species during the study period, a 67% increase

<u>Key Points</u>

- The State of Maryland has planted over 1300 linear miles of riparian forest buffers since 1996 to help restore the Chesapeake Bay and tributaries
- Forest buffers are an essential tool for meeting water quality and habitat goals
- Timely riparian restoration and development of expected ecological functions depend on sufficient site preparation, matching species to site conditions, and actively managing good growing conditions around planted trees for at least 3-5 years is required to gain water quality benefits
- Growth rate and tree density affect the speed of development of functions
- Instream water quality monitoring adjacent to buffers showed a reduction of 1mg/L nitrate (not significant) and a decline of phosphate from 0.13mg/L to 0.05 mg/L (significant) between 2001 and 2008
- Nitrate and phosphorus generally showed improved trends, but widespread variability resulted in insignificant reductions for nitrate
- Develop policies to support long-term retention (>20 years) of restored buffers to obtain nutrient reduction goals

Notes for Legislative Task Force Meeting on June 19, 2014
Literature Review relating to OWTS and Wetland Buffers
R. Chateauneuf

Context:

- Literature reviews conducted by Lorraine Joubert and Russ Chateauneuf.

- All literature reviewed relates to water quality concerns, specifically those associated with nitrogen and phosphorus fate and transport.

- Current RIDEM OWTS setbacks are distances to the resource, not the buffer. In some cases, the setback is equal to the jurisdictional wetland (perimeter wetland). In other cases, the setback is less than the jurisdictional wetland (riverbanks). In such cases, the wetland impacts are reviewed and decided upon first through the wetland permit process. The wetland program does not generally review the WQ impact from the OWTS, giving deference to the OWTS rules and WQ rules.

- Wetland setbacks are primarily based on risk to public health as some treated wastewater typically enters the surface environment with the groundwater recharging the vegetated wetland or stream where contact with humans is possible.

- Systems over 5,000 GPD require a site specific review under RIDEM regulations.

- > 90% of the OWTSs serve single family homes.

Major Findings:

- Nutrients impact wetland habitat and WQ functions, but the effectiveness of buffers in removing nutrients is mixed.

- The majority (>80%) of nitrogen and phosphorus entering a septic tank is discharged into the ground.

- Nutrient treatment and removal in the subsurface is primarily related to site-specific factors including saturation of the soil beneath the leachfield, soil chemistry and biology, the flow path of the effluent, and the presence of riparian “sinks” along the flow path (Gold, A. J. and J.T. Sims. 2000). “Characterizing subsurface flow requires extensive (and expensive) field work” (Gold).

- In non-calcareous acidic soils common in Rhode Island, the majority of phosphorus is removed in the vadose zone below the leachfield; the remainder moves laterally away but more slowly than the movement of groundwater. Retardation factors of between 20 and 100 have been recorded. (Cesspools are poor treatment devices partly because there is often no vadose zone below.)

- Nitrogen is mostly converted to nitrate in the leachfield and moves laterally away from the system with groundwater.

- OWTS derived nitrogen impacts are a much more significant concern in Rhode Island than OWTS derived phosphorus impacts (excepting cesspools and failures).

- In the general, the literature does not recommend specific buffer distances based on WQ impacts to wetlands from OWTS. “There is no “magic” distance” (Gold).

- Nutrient impacts on water quality are the result of cumulative loadings from individual OWTS systems and other non-point pollution sources into a receiving waterbody and the ability of the waterbody to accommodate the loading and still meet water quality standards. (e.g. not exceed the TMDL established for that waterbody).

- OWTS technology solutions for added phosphorus are not readily available. Where residual P loadings are a concern, additional removal may be possible by improved soil categorization, soil improvement, and alternative leachfield design.

- OWTS technology solutions for partial nitrogen removal are readily available and are used extensively in Rhode Island, Cape Cod and Chesapeake Bay.

- Periodic monitoring of alternative systems and some compliance oversight is needed to ensure optimum performance (Barnstable County, Board of Health).

From Mayer, P.M., S.K. Reynolds Jr., M.D. McCutchen, and T.J. Canfield (2007), Meta-analysis of nitrogen removal in riparian buffers.

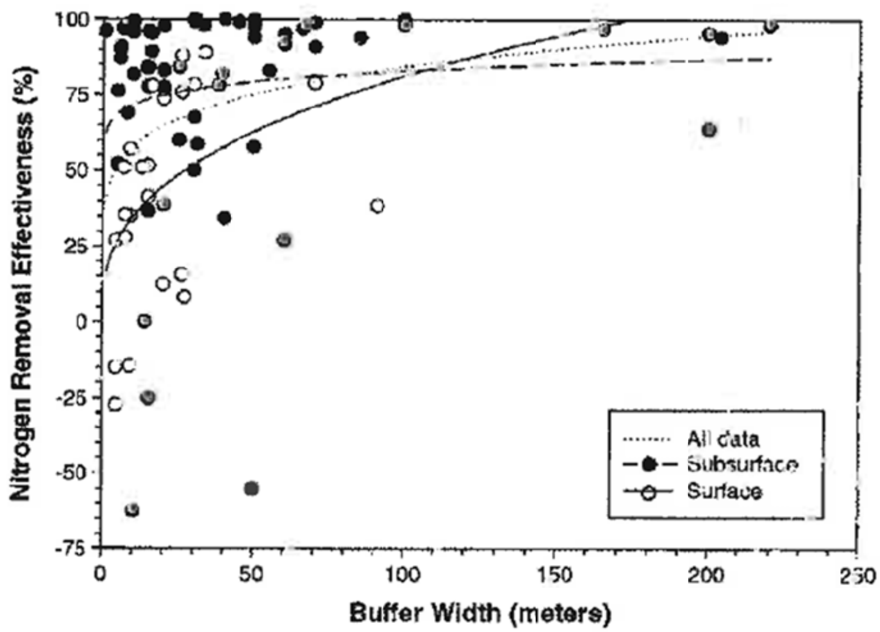


Figure 1: An example of the removal of nitrogen as a function of the width of the buffer based on data published for 89 individual measurements (figure is from 49).

From Zhang, X., X. Liu, M. Zhang, and R.A. Dahlgren, 2010. A review of vegetated buffers and meta-analysis of their mitigation efficacy in reducing nonpoint source pollution.

Buffer width alone explains only part of the effectiveness of buffers: (surface and groundwater sources)

- 37% sediments
- 60% pesticides
- 44% nitrogen
- 35% phosphorus

Slope, soil chemistry, soil structure, and vegetation type are <u>other</u> variables that correlate with removal efficiency.

Moreover, there is great variability on the effectiveness of buffers for nutrient removal; the R^2 of the data is often less than 0.7, the generally accepted value of a good fit, if not far less in most cases.

Phosphorus

Addy, K.L., A.J. Gold, P.M. Groffman, P.A. Jacinthe. 1999. Groundwater nitrate removal in forested and mowed riparian buffer zones. J. of Environ. Qual. 28:962-970.

Etnier, C., D. Braun, A. Grenier, A. Macrellis, R. J. Miles, and T. C. White. 2005. Micro-Scale Evaluation of Phosphorus Management: Alternative Wastewater Systems Evaluation. Project No. WU-HT-03-22. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by Stone Environmental, Inc., Montpelier, VT.

Gold, A. J. and J.T. Sims. 2000. Risk Based Decision Making for On-site Wastewater Treatment. U.S.EPA/EPRI. pp. 114-146

Gold, A.J., P.M. Groffman, K. Addy, D.Q. Kellogg, M. Stolt, and A.E. Rosenblatt. 2001. Landscape attributes as controls on ground water nitrate removal capacity of riparian zones. J. of the American Water Resources Association. 37:1457-1464.

Harmon, J., W.D. Robertson, J.A. Cherry, and L. Zanni, 1996, Impacts on a Sand Aquifer from an Old Septic System: Nitrate and Phosphate, Vol. 34, No.61—GROUND WATER—November –December - 1996

Lusk, Mary, Gurpal S. Toor, and Tom Obreza, Onsite Sewage Treatment and Disposal Systems: Phosphorus, University of Florida, IFAS Extension

Robertson, W.D., 2008, Irreversible Phosphorus Sorption in Septic System Plumes?, Vol. 46, No. 1—GROUND WATER—January–February 2008

Robertson, W.D., S.L. Schiff, and C.J. Ptacek, 1998. Review of Phosphate Mobility\ty and Persistence in 10 Septic System Plumes, Vol. 36, No. 6 Ground Water, November-December, 1998

Hruby, Thomas, 2013. Update on Wetland Buffers: State of the Science, Washington State Department of Ecology

Effectiveness of a buffer on removal phosphorus depends on many factors including:

- Soil Type (sorbents, redox state, pH)
- Degree of saturation on soil particles
- Slope of the land
- Type of plants present and how managed

- Amount of phosphorus generated by the surroundings
- Flow path of groundwater and its interaction with iron, aluminum oxides, or other minerals that react with dissolved phosphorus

Nitrogen

Gold, A. J. and J.T. Sims. 2000. Risk Based Decision Making for On-site Wastewater Treatment. U.S.EPA/EPRI. pp. 114-146

Oakely, S.M., A. J. Gold and A. J. Oczkowski. 2010. Nitrogen Control through Decentralized Wastewater Treatment: Process Performance and Alternative Management Strategies. Ecological Engineering. doi:10.1016/j.ecoleng.2010.04.030

Schipper, L., A.J. Gold and E. Davidson. 2010. Managing Denitrification in Human Dominated Landscapes. Ecological Engineering. 36:1503-1506.

Kellogg, D.Q., A.J. Gold, S. Cox, K. Addy, and P.V. August. 2010. A geospatial approach for assessing denitrification sinks within lower-order catchments. Ecological Engineering 36: 1596-1606.

Barnstable County Board of Health. http://www.barnstablecountyhealth.org/ia-systems/information-center/data-and-statistics/ (accessed 5/2014)

Hruby, Thomas, 2013. Update on Wetland Buffers: State of the Science, Washington State Department of Ecology

> Removal of nitrogen in groundwater flowing through buffers does not appear to be related to buffer width, while removal of nitrogen from surface water was only partially related to the width of the buffer. The reduction of nitrate in groundwater flowing through a buffer has been attributed to denitrification, uptake by vegetation as a function of its density, and immobilization by micro-organisms.
>
> The relative removal of nitrate in a buffer is reduced as the concentration of nitrate in the incoming water is increased. (In one study of 14 sites, nitrate removal dropped to 0% when the concentration of nitrate was above 20 mg/l.)

Contrarily, modelling at the watershed scale supports the view that20m (66ft) is a sufficient buffer for nitrate removal. But other studies indicate that coarse soils in the buffer, the presence of seeps, and the specific site flow path are other factors that need to be taken into account.

Wetland Habitat and Nutrients

Sheldon, Dyanne, Tom Hruby, Patricia Johnson, Kim Harper, Andy Mcmillan, Teri Granger, Stephen Stanley, Erick Stockdale, 2005. Wetlands in Washington State Volume 1: A Synthesis of the Science (Together with the 2013 update by Hruby, this document is a comprehensive literature review and an excellent resource on the topic of wetlands and wetland buffers.)

Increases in nutrients may have the beneficial function of slowing flood flows by thickening of plant growth and increasing numbers of some invertebrate species but may also have many negative impacts including lowering water quality, changing the chemistry of bogs, and decreasing species richness, where fewer species dominate and invasives may thrive. Nutrient loads from agricultural applications have been studied and have shown impacts on amphibians, water-birds, and other wildlife.

Andrew T. Der
1000 Fell Street, #428, Baltimore, Maryland 21231
Telephone: 410 491 2808
Email: AndrewTDer@comcast.net

PROFESSIONAL SUMMARY

As a regionally recognized environmental practitioner and leader for the last 30 years, served as a government regulatory official and subsequently environmental consultant and manager providing regulatory, technical and scientific expertise for public and private sector clients with a commitment to provide the most equitable and sustainable solutions to complex projects and goals. Critical deliverables include assessment, feasibility studies, and regulatory compliance. In private practice as of 2001 as associate and director of environmental services for two prominent civil engineering firms as well as a sole-proprietor consultant and project developer. Previously completed 17 years of service with Maryland government as an environmental manager successfully leading major new initiatives to regulate and restore water resources. Accomplishments include awards, profitable growth, appointment to industry commissions and committees, expert testimony, presenter at industry and continuing education seminars, media interviews, and publishing numerous magazine articles and technical features.

RELAVENT EXPERIENCE

Principal and Environmental Consultant, Andrew T. Der & Associates, LLC, Maryland, 1998 to Present

Provide consulting services to government and private client base in resource assessment and feasibility studies including watershed, wetland, forest, and NEPA analyses; stormwater management; environmental site design; and water quality and NPDES monitoring to assure sustainable and project goals. Expertise includes regulatory compliance, biomonitoring, bioengineering, remedial design, wetland and stream mitigation, fisheries, and evaluation of proposed alternatives including watershed restoration plans. Determine the appropriate resource management practices and design criteria which minimize and mitigate potential impacts to assure consistency with local, State and federal environmental laws, regulations and policies. Evaluate the environmental, economic and social aspects of proposed alternatives and practices including determination of appropriate construction techniques.

- Act as primary permit liaison and expert between agencies, subcontractors, and clients to facilitate compliance.
- Manage and coordinate subcontractor work and deliverables.
- Obtain water resource permits for major capital improvement projects in sensitive environmental areas in suburban Washington, DC.
- Prepare deliberative guidance documents to demonstrate compliance criteria regarding the effectiveness of stream buffer setbacks and impervious surface limitations.
- Perform environmentally sensitive design of major new developments in the Chesapeake Bay watershed.
- Prepare continuing education seminars for Lorman Educational Services for industry professionals in areas of water quality, nonpoint source pollution control, compliance and wetland regulation.
- Participate in the development of new water quality, TMDL, NPDES, stormwater management, and forestry policy and regulations as a member of the Chesapeake Bay Program Citizens Advisory Committee, Maryland Patuxent River Commission, Montgomery County Forest Conservation Advisory Committee, and Maryland National Capital Building Industry Association Environmental Committee.
- Represented USA as environmental expert in Fulbright exchange program providing expertise and seminars for the Regional Environmental Center for Eastern Europe and the Central European University Environmental Studies Program.
- Invited presenter at International Water Association International Water Week , Amsterdam symposium on topic of wetlands and stormwater management.
- Invited presenter at the joint symposium of the Society of Wetland Scientists, Florida Association of Environmental Soil Scientists, and Southwest Chapter of the Florida Association of Environmental Professionals , Tampa on topic of wetlands and stormwater management.
- Invited presenter at National Association of Environmental Professionals , Tampa on topic of wetlands and stormwater management.
- Yearly International Water Association Panel Judge for World Water Monitoring Day competition.

Associate & Director of Environmental Services, Whitman Requardt & Associates, LLP, MD, 2009 to 2013

Managed and developed the firm's environmental services and technical personnel to promote growth in evolving multi-disciplines in life sciences and engineering. Provided full service capabilities to government agencies and developer client base in water and forest resource assessment, feasibility studies, and regulatory compliance specializing in privatization and sustainable development projects. Compliance measures include watershed analysis and restoration including wetlands, streams, forest, stormwater management; environmental site design; and water quality monitoring. Expertise includes permitting, monitoring, bioengineering, remedial design, mitigation, fisheries, and evaluation of proposed alternatives and restoration plans. Responded to government Requests for Proposals and managed the appropriate distribution of work and staffing including the assessment and inventory of on-site resources to assure environmentally compliant public works and land development projects that meet client goals. Determined the appropriate resource management practices and design criteria which minimize and mitigate potential impacts to assure consistency with local, State and federal environmental laws, regulations and policies.

- Prepared and executed responsive environmental service proposals including NEPA and EIS studies for complex and sensitive projects for Department of the Army, Maryland Transportation Authority (Red Line) and local governments.
- Acted as lead permitting specialist for largest private development client in Charles County, Maryland.
- Established protocol and procedures for interagency liaising and coordination regarding complex, large-scale and sensitive public projects.
- Established new and efficient internal environmental services including GIS level preliminary environmental constraints studies and in-house GPS survey of environmental constraints to reduce costs and timelines.
- Established and promoted a multi-disciplinary environmental team for the main office through training and providing multi-faceted one-stop-shop services for internal project managers as well as external client base.
- Implemented additional procedures for establishing budgets and procedures for managing scope of work regarding new environmental compliance requirements and methods.
- Provided expert testimony to Charles County Commissioners, Maryland on water quality regulation in regards to a new proposed Master Plan.
- Represented industry on regional environmental committees participating in policy development and application while keeping company current on cutting edge and changing criteria.

Associate and Director of Environmental Services, Loiederman Soltesz Associates, Inc, MD, 2001 to 2009

Provided full range of corporate environmental consulting services and expertise to the private and government land development, engineering and public works industries. Managed a multi-disciplinary team of environmental scientists, specialists and project managers for six regional offices throughout Maryland and Virginia. Represented the firm in all environmental matters including client services and marketing. Determined the appropriate distribution of work and resources, team hiring and establish and monitor budgets. Responsible for services such as the assessment and inventory of on-site resources including forests, streams, wetland and floodplain to assure environmentally compliant public works and land development projects. Determined the appropriate resource management practices and design criteria which minimize and mitigates potential impacts to assure consistency with local, State and federal environmental laws, regulations and policies. Obtained applicable environmental permits from federal, State and local regulatory agencies. Provided ongoing educational and seminar services in the environmental and water resource disciplines including expert testimony, continuing education and public outreach.

- Developed and increased company environmental services as in independent profit center from three to 11 persons.
- Developed new contemporary multi-disciplined environmental services protocols and skill sets in response to changing and evolving water resource regulation.
- Developed new water quality compliance monitoring services and protocols in response to new construction monitoring NPDES requirements.
- Recognition:
  - National Award for Smart Growth Achievement for Downtown Silver Spring, Maryland in the category of Overall Excellence nationwide, U. S. Environmental Protection Agency.
  - U. S. Green Building Council LEED for New Construction Gold certificate for Maryland project and Green Building finalist award from the National Association of Home Builders, National Green Building

Conference.

- Featured as the International Society for Ecological Restoration's web site's Top News Story recognizing Maryland-National Capital Building Industry Association environmental award.
- Ten merit awards from the Maryland-National Capital Building Industry Association for innovative and environmentally sensitive land development designs and Maryland Department of Natural Resources award demonstrating innovative water quality management and sustainable design.
- Award from Homebuilders Association of Maryland for Outstanding Committee Work in drafting of the Maryland Stormwater Management Act of 2007.
- Featured in the National Association of Home Builders online weekly newspaper regarding the topic of wetland regulation.
- Interviewed by National Public Radio regarding US Supreme Court decisions affecting wetlands.
- Provided testimony to the Montgomery County Council, Maryland regarding the technical merits of its newly issued NPDES permit and the technical merits of proposed impervious cap overlays.
- Invited faculty for Mid-Atlantic Wetlands Symposium, CLE International, on topic of Wetlands and Stormwater Management.

Natural Resources Planner, Chesapeake Bay Critical Areas Commission, Maryland, 2000 to 2001

Oversaw local government administration of the State's Chesapeake Bay Critical Area law. Advised local regulatory agencies and development companies on land use planning and project design criteria. Reviewed local development processes and ordinances including preparation of position papers and technical reports and monitoring of grant disbursements. Reviewed major projects to assist local authorities in the regulation of activities such as waterfront development, shore erosion control, dredging, and capital improvement projects. Made recommendations for the appropriate management and restoration practices and design criteria, which minimize and mitigate potential resource and water quality impacts to comply with mitigation requirements. Identified potential impacts to tidal waters and wetlands including resources of concern such as sensitive, threatened or commercially valuable species. Evaluated environmental, economic and social aspects of proposed rezoning, exception and variance requests. Managed public review and coordination processes including hearings to involve the interested public and nongovernmental organizations. Coordinated with other applicable State and federal agencies to assure compatibility of goals and objectives.

Maryland Department of the Environment (MDE), Maryland

Regional Chief, Wetland and Waterways Program, 1995 to 2000
Environmental Specialist 1992 to 1996
Natural Resources Biologist 1986 to 1992

Administered multi-disciplinary State and federal water resource regulatory programs requiring supervision of environmental specialists and water resources engineers. Determined the potential environmental effects of development and public works activities. Identified impacts to waterways, flood plains and wetlands including resources of concern such as sensitive, threatened or commercially valuable species. Determined the appropriate management practices and design criteria to minimize and mitigate potential resource and water quality impacts to assure consistency with NEPA, federal and State environmental laws, regulations and policies. Evaluated proposed alternatives and appropriate construction techniques. Participated in EA and EIS studies as well facilitating public/agency participation processes. Evaluated watershed improvement projects including the restoration of flood plain, stream and wetland systems and nonpoint source pollution management retrofit projects. Participated in the development of regulations, policy and guidance documents. Represented Department at public meetings, hearings, committees.

- Improved efficiency of the Nontidal Wetlands and Waterways Division's Southern Region by establishing more efficient project review procedures and commended by the Maryland Department of the Environment Secretary.
- Lead MDE project manager for largest Maryland new highway construction, Intercounty Connector. Appointed as MDE representative to Senior Technical Team, Maryland Department of Transportation.
- Lead project manager for major projects in sensitive area of suburban Washington, DC area such as Redskins Professional football stadiums and Woodrow Wilson Bridge, I-495 - nominated for MDE merit award.
- Received merit award from the MDE Secretary for assisting the Maryland Department of Transportation in resolving environmental and economical conflicts from associated roadway construction.
- One of founding members of Montgomery County Wetland Coordinating Committee to facilitate interagency coordination of county/State/federal environmental regulatory programs.

- Received merit award from the U. S. Army Corps of Engineers Baltimore District Commander and the MDE Secretary for contributing to an interagency Process Action Team to optimize and refine a new federal environmental permit process.
- One of founding members of Interagency Mitigation Task Force creating federal/State wetland mitigation policy in the form of Maryland Compensatory Mitigation Guidance.
- Invited presenter to Millennium Wetland Event, International Association for Ecology and Society of Wetland Scientists, 2000, Quebec and Management of Large River Basins, 8th River Basin Conference, International Association on Water Quality, 1998, Hungary.

EDUCATION AND QUALIFICATIONS

1983 to Present Postgraduate, Credit, continuing education and professional course work:

- Expert witness in administrative and judicial proceedings
- Secondary and Cumulative Environmental Affects, MD SHA
- Watershed Planning, Stormwater Management and Sediment and Erosion Control
- Negotiation and Dispute Resolution
- Ecological Engineering for Stream Stabilization and Protection
- Wetland Delineation, Identification, Function, Values, Indicators of Hydric Soils
- Stream Restoration and Applied Fluvial Geomorphology (Rosgen)
- Dredged Material Assessment and Management

1976 B.S. Degree Biology, Minors: Chemistry and Psychology, University of Tampa, Florida.

PUBLICATIONS

Ongoing contributor to Building Magazine 2008 to present.

- *Time to Put Science Back into Water Regulation* , Building Magazine
- *Stream Buffers – is more Really Better?*, Building Magazine
- *The State of Stormwater Management* , Building Magazine
- *The Limitations of Impervious Limits* , Building Magazine
- *Tier II Waters Regulation and Your Project* , Building Magazine
- *The Muddy Waters of the NTU* , Building Magazine

Balancing Wetland and Stream Preservation with Stormwater Management Goals in September/October 2004 issue of Stormwater Magazine

Authored chapter *Balancing Wetland and Stream Preservation with Stormwater Management Goals: a Case Study* in Short Subjects for Design Professionals for professional development series textbook: Engineering Methods and Techniques for Improving Water Quality, Landscape Architects Registration Board, 2002

Published and presented the paper *Balancing Wetland Habitat and Stream Preservation with Stormwater Management Goals: A Case Study* in the following venues: Journal: 1999 Water Science and Technology, Elsevier Science, Ltd.,the proceedings of, and presented at, the 2007 Watershed-Wide Strategies to Maximize Wetland Ecological and Social Services, Association of State Wetland Managers, Virginia; the 2006 Land Development Breakthroughs Best Practices Conference, South Carolina; the 2001 Wetlands Regulatory Workshop, U. S. EPA, Atlantic City, New Jersey.

Section 401 Water Quality Certification Stormwater Management Guidelines, 1991, Maryland Department of the Environment, Baltimore, Maryland

Turbidity: a literature review of its impacts on aquatic resources, 1986, Maryland Department of the Environment, Baltimore, Maryland

MARK W. EISNER, P.G. *C.V.*

Mr. Mark W. Eisner, P.G. is President of Advanced Land and Water, Inc. (ALWI). Possessing more than twenty-six years experience in environmental and hydrogeological consulting, Mr. Eisner directs hydrogeologic and hydrologic investigations for both private and public sector clients.

Mr. Eisner's foremost technical expertise is in matters relating to water resources, including the occurrence, movement, use and management of both groundwater and surface water as a natural resource, its susceptibility and properties when contaminated, and in methods for its safe and sustainable development, and when necessary, its remediation. He is a licensed Professional Geologist in all Mid-Atlantic states that have regulatory licensure and certification programs (DE, PA and VA).

- **RANGE OF EXPERT WITNESS EXPERIENCE** - On numerous occasions, Mr. Eisner has testified as an expert on matters related to groundwater resources, surface water resources, hydrogeological conditions, water use and demand, water quality and potability, hydrology, wastewater discharge, environmental contamination and due diligence studies. Specific areas of his prior expert qualifications include the above as well as regulatory permitting of water supply and discharge systems, water supply and demand planning, mathematical modeling of hydrogeologic systems, pumping tests, the prediction of sustainable well yields, surface water hydrology, groundwater-surface water interaction, and groundwater contamination investigation and remediation. Testimony has been offered in various planning and zoning meetings and hearings, before local and State elective officials including legislative bodies, public informational hearings, state adjudicatory hearings and a variety of courts.

- **TECHNICAL EXPERTISE** - Specific areas of his technical expertise include fracture trace analysis; well design and construction management; pumping test design and analysis; well interference impact evaluation and mitigation; groundwater mounding evaluations for spray irrigation and other large-system land treatment and groundwater discharge projects, wellhead protection delineations and source water assessment plans; surface water studies; and mathematical modeling of hydrogeologic systems.

- **REGULATORY FAMILIARITY** - Mr. Eisner is a former state regulator and groundwater allocation policy maker with the State of Maryland. He has provided technical guidance and advise to officials in Virginia, Delaware and Pennsylvania on matters of groundwater management policy, regulation and protection. Mr. Eisner is fully knowledgeable and conversant in both technical and policy aspects of water supply and wastewater discharge planning and permitting criteria applied by state agencies throughout the Mid-Atlantic region. Accordingly, his unique insights allow ALWI to provide its clients with the highest level of technical service and regulatory expertise.

EDUCATION

B.S., Geology, University of Maryland
M.S., Geology, University of Delaware

- "Structural and Hydro-Structural Geology: Theory and Applications for the Practicing Professional", Pennsylvania Council of Professional Geologists, Malvern, PA, 2010.

- "Groundwater Management", Association of Groundwater Scientists and Engineers, National Groundwater Association, Denver, CO, 2000.

- "IBM PC Applications in Groundwater Hydrology", Association of Groundwater Scientists and Engineers, National Groundwater Association, Boston, MA, 1994.

- "The Use of U.S. Geological Survey (USGS) MODFLOW for Analysis of Groundwater Flow Systems", Association of Groundwater Scientists and Engineers, National Groundwater Assoc., Tampa, FL, 1989.

CERTIFICATIONS AND MEMBERSHIPS:

Licensed P.G./Delaware, Pennsylvania, Virginia
Certified for Potable Water Sampling/MDE
Certified Hazardous Waste Site Worker Supervisor/OSHA
Member/Geological Society of America
Member/National Groundwater Association

SUMMARY OF EXPERTISE, ADMISSIONS AND TESTIMONY

- **Court** - Frederick County, Carroll County, Baltimore County, Maryland State Office of Administrative Hearings (OAH), State of Maryland District / Circuit.

- **Recent Contested Cases / Adjudicatory Hearings** including: John and Virginia Lovell v. Carroll County Commissioners, Carroll County Public Schools and MDE - contested discharge permit; and Chesapeake Water Association vs. Calvert County Commissioners and MDE – contested groundwater appropriation permit.

- **Planning, Zoning and Development Review** - Adams County, Allegany County, Washington County, Frederick County, Carroll County, City of Westminster, Town of Mount Airy, Baltimore County, Harford County, Cecil County, Talbot County, Wicomico County, Worcester County.

- **Areas of Qualified Expertise** - Hydrogeology, geology, hydrology, water occurrence and movement, processing and issuing MDE water appropriation permits, water demand evaluations, groundwater mounding, groundwater flow and transport, groundwater modeling, environmental site assessments, well construction, pumping tests, hydrogeologic impact evaluations.

- **Areas of Challenged Expert Qualification** - None.

RECENT AUTHORSHIPS AND PRESENTATIONS

- "Delmarva Groundwater Sustainability", orally presented at the ECO3 Eastern Shore Symposium, 2009.

- "Suggestions for Harford County MTBE Task Force" – orally presented to the Harford County MTBE Task Force, contemplating recommending ordinances regarding minimum setbacks between gasoline USTs and supply wells, Bel Air MD, November 2008.

- "The Developer's Role in Municipal Water Supply Expansion", orally presented as invited faculty at a professional seminar on Water and Land Development sponsored by Lorman Educational Services, Baltimore, MD, 2007.

- "Groundwater Capacity and the Politics of Growth in the Exurbs; Safe Yield vs. Scientific Limitations of Pumping Tests", orally presented at the annual meeting of the American Water Resources Association, Baltimore, MD, 2006.

- "Groundwater Capacity and the Management of Growth; How Sustainable Well Yields Govern Suburban Sprawl", orally presented at the annual meeting of the Geological Society of America, Philadelphia, PA, 2006.

- "Alaskan Earthquake Mysteriously Thieves Water From A Pennsylvania Municipal Supply Well?" orally presented at the annual state-county groundwater symposium, MDE, Baltimore, MD, 2003.

- "New Methods for Estimating the Long-Term Sustainable Yields of Bedrock Production Wells Relied Upon for Community Water Supply", orally presented at the Pennsylvania Department of Environmental Protection, Annual Groundwater Symposium, 2002.

- "The Truth Revealed: Comparison of Operational Yields to Pumping Test Yield Estimates for Bedrock Wells Relied Upon for Community Supply", orally presented at the annual state-county groundwater symposium, MDE, Baltimore, MD 2002.

- "When client, hydrogeological and regulatory interests collide; a case study from southern PA", orally presented at the NE sectional meeting, Geol. Soc. of America, Providence, RI, 1999.

- "Do large-scale groundwater withdrawals *cause* the failure of neighboring septic systems? New data from a site in southern Pennsylvania", orally presented at the annual state-county groundwater symposium, MDE, Baltimore, MD, 1999.

- "Forum on Geologic Mapping Applications in the Washington-Baltimore Urban Area", USGS Circular No. 1148, invited participant in technical forum, Reston, Virginia, 1999

EXPERT TESTIMONY AND LITIGATION SUPPORT

- Adjudicatory Hearing Support: Technical and Regulatory Expert Testimony, Chesapeake Water Association vs. Calvert County Commissioners and Maryland Department of the Environment, MD Office of Administrative Hearings - Reviewed file records and documents pertaining to contested appropriation, performed independent computer modeling and peer review of prior models and technical agency testimonies, assisted legal counsel in forming strategies and preparing questions for other experts in the case, prepared and offered testimony during OAH hearing including impartial explanations of basic hydrogeologic concepts.

- Water Demand and Regulatory Feasibility Evaluation; Proposed Church in Monrovia; Frederick County, Maryland - Researched average and maximum day unit and project-wide water demands for proposed church; reviewed existing water appropriation permit for adequacy of allocation; reviewed basic hydrogeologic information to evaluate potential for adverse impact on neighboring wells; presented technical findings at informal community meeting; testified as expert supporting planning and zoning application before County agencies

- Water Demand and Regulatory Feasibility Evaluation; Proposed Municipal Annexation in Thurmont, Frederick County, Maryland - Researched average and maximum day unit and project-wide water demands for proposed mixed-use annexation; reviewed existing water appropriation permits for Town; developed plans for supplementing existing Town water capacity; reviewed potential plans to acquire existing well in lieu of drilling new ones; reviewed basic hydrogeologic information to evaluate potential for adverse impact on neighboring wells;; testified as expert supporting planning and zoning application before Town planning agency.

- Water Demand and Regulatory Feasibility Evaluation; Proposed Senior Housing Complex, Westminster, Maryland - Researched average and maximum day unit and project-wide water demands for proposed senior housing project; identified and developed means for water supply predicated on replacing irrigation groundwater supply with treated effluent such that groundwater could be reserved to meet sanitary and potable project requirements; testified as expert supporting planning and zoning application.

- Water Supply and Demand Feasibility Evaluation; Terrapin Run, Allegany County, Maryland - Researched average and maximum day unit and project-wide water demands for proposed major land development project, identified means for water supply predicated on a combination of groundwater and surface water sources; testified as expert supporting planning and zoning application.

- Contaminant Trespass Evaluation; Cross-Claim for Professional Malpractice; Baltimore County, Maryland - Performed hydrogeologic site characterization; Performed fracture trace analysis; used fracture fabric evaluation and pumping test results to assess potential for contaminant migration; Made recommendations to limit risks; case settled.

- Expert Testimony and Litigation Support; Environmental Impacts from Proposed Wastewater Discharge; Carroll County, Maryland - Evaluated baseline water quality and environmental conditions to assess the feasibility of planned operations involving the raising of organic livestock; Identified off-site potential sources of surface and groundwater contamination; Provided expert testimony and litigation support for client's efforts to pursue a legal remedy to the construction of an unpermitted wastewater plant on property adjoining the livestock farm and pasture.

WATER SUPPLY DEVELOPMENT & PROTECTION

- Groundwater Development - Located, developed, and permitted municipal production wells for several municipalities in northern Maryland and southern and eastern Pennsylvania. Developed water supply facilities and implemented wellhead protection programs. Designed and executed drilling programs and aquifer pumping tests to evaluate long-term sustainable well yields, quantify hydraulic parameters and assess impacts on neighboring supplies. Designed and implemented plan for long-term groundwater monitoring and impact mitigation.

- Wellfield Rehabilitation Design and Management - Investigated cause for decline in efficiency and performance of wellfield; designed and executed program for well rehabilitation; performed pumping tests to evaluate success of rehabilitation measures; developed and implemented long-term operational plans to limit risk of reoccurrence of inefficient operations.

- Groundwater Supply Development and Permitting - Sited, drilled, tested and permitted prolific new groundwater supplies for an existing subdivision in central Pennsylvania wherein its proposed expansion was opposed by neighboring well owners. Performed field studies, developed computer simulations and prepared testimony on the existence and likely development of adverse water supply impacts to existing domestic wells in the region surrounding the project.

- Countywide Public Supply SWAP - Prepared Source Water Assessments for 25 community and NTNC groundwater supply wells in northeastern Maryland. Work included hydrologic water balances, fracture trace analyses, time-of-travel calculations, geologic mapping, contaminant hazard reconnaissance, and mapping, land use planning reviews and ordinance development. Project was awarded SWAP of the Year by EPA Region III.

- Hydrologic Evaluation; Increase Surface Water Allocation - Performed hydrographic evaluation in support of planned increase in surface water appropriation from existing on-stream reservoir; negotiated for lessened flow-by requirements and greater allowable lake-level fluctuations; performed technical analyses pursuant to issuance of increased allocation; testified at public informational hearing.

REGIONAL WASTEWATER DISCHARGE EVALUATIONS

- Hydrogeologic Impacts from Spray Irrigation - Performed spray irrigation feasibility studies and permitting evaluations at farms planned for receipt of municipal and/or industrial wastewater in Maryland, Delaware and Pennsylvania. Designed and established long-term groundwater monitoring programs to evaluate potential water quality impacts arising from wastewater disposal projects. Designed and executed field tests and computer models to evaluate the potential for unacceptable groundwater mounding to arise from on-site wastewater disposal projects. Developed a means for estimating drainfield size from hydraulic conductivity and infiltrometer test data.

- Hydrogeologic Support for Large-System Permitting - Designed and oversaw programs involving collection and analysis of field data in support of large and controversial wastewater disposal projects. Negotiated customized testing protocols for sites underlain by ephemeral, perched and other unusual water table conditions.

SPILL ASSESSMENTS AND CLEANUP EXPERIENCE

- Hydrogeologic Risk Assessment - Performed a comprehensive environmental impact study of a retail gasoline service station planned in a sensitive watershed. Collected and interpreted hydrogeologic data on which were based construction and operations recommendations designed to lessen the future risk of an environmental impact due to a hypothetical fuel spill. Testified at planning and zoning hearings and helped secure project approval.

- Contaminant Flow Assessment in Fractured Bedrock - Assessed nature, transport and fate of dissolved phase gasoline contamination in a fractured bedrock aquifer relied upon as domestic water supply. Used pumping tests and computer models to predict future contaminant migration and assisted counsel in negotiating corrective action plan elements with agency officials and in pursuing legal remedies relating thereto.

- Contaminant Trespass Investigation - Designed and executed an environmental assessment of commercial property located down gradient from a fuel spill site. Identified gasoline-contaminated groundwater and used trace element chemistry to fingerprint the source. Performed a limited risk assessment and assisted counsel in preparation of legal documents charging environmental trespass. Strength of deposition testimony allowed settlement with defendant (a major oil company) on highly favorable but sealed terms.

- Contaminated Groundwater Assessment and Removal - Managed on-scene dewatering and contaminant characterization and water disposal operations for ballfield replacement project at Oriole Park at Camden Yards. Coordinated for emergency response, initial spill assessment work using field-screening equipment. Acted as liaison between client and regulatory officials inspecting work site. Oversaw rapid-response excavations, construction dewatering, stockpiling and composite waste profiling. Directed the lateral and vertical extent of excavations and supporting characterization efforts. Completed manifests for transport, treatment and disposal of contaminated soils and waters.

FORENSIC WATER SUPPLY AND WATER QUALITY INVESTIGATIONS

- Hydrogeologic Risk Assessment; Confidential Property in Sykesville, Carroll County, Maryland - Designed and coordinated for agency approval for a forensic hydrogeologic investigation of historic petroleum releases and an assessment of the possible effect and entrainment of latent contaminants in the circumstance of a new, planned onsite groundwater withdrawal.

- Hydrogeologic Risk Assessment; Mudgett Auto Body; Finksburg; Carroll County, Maryland - Designed secured approval and executed extensive forensic environmental testing program to support a new-groundwater withdrawal proximal to a long-standing petroleum release and remediation site. Testing was successful and requisite approvals for client's development plans were secured.

- Forensic Evaluation of Septic Contamination**;** Silver Run, Carroll County, Maryland - Designed and implemented a forensic environmental testing program, using Methylene Blue Activated Surfactants as tracers, to assess whether a proposed development site was being contaminated by wastewater effluent from an old pipeline originating on a neighboring property. Testing was successful; Carroll County Health Department ordered corrective action as a consequence.

- Solvent Entrainment Risk Evaluation; Carroll County, Maryland - Reviewed historic files on the occurrence, detection, migration and attempted remediation of a solvent release to a deeply-fractured groundwater aquifer. Used fracture trace analysis, computer models and hydrogeologic mapping techniques to opine on the probable fate and transport of solvents under a planned alteration of the local groundwater withdrawal regime. Coordinated for agency review and approval.

- Hydrogeologic Risk Assessment; Residential Development near Gamber; Carroll County, Maryland - Designed and negotiated approval for a hydrogeologic work plan entailing sophisticated groundwater sampling of domestic wastewater effluent tracers to determine whether new residential supply well was at undue risk of septic contamination.

REMEDIAL INVESTIGATIONS AND SOLUTIONS

- Designed and executed site characterizations including: Geoprobe™ and soil vapor surveys, monitoring wells, waste stream analyses, and contaminant fate and transport modeling.

- Provided complete underground storage tank (UST) assessment, testing, removal, closure, and replacement services. Designed and installed groundwater monitoring systems in both unconsolidated and fractured bedrock aquifers.

- Conducted detailed investigations to determine and forecast the extent of existing and potential ground water degradation at various industrial, commercial and agricultural facilities.

- Performed a comprehensive environmental impact study of a retail gasoline service station planned in a sensitive watershed. Collected and interpreted hydrogeologic data on which were based construction and operations recommendations designed to lessen the future risk of an environmental impact due to a hypothetical fuel spill. Testified at planning and zoning hearings and helped secure project approval.

- Assessed nature, transport and fate of dissolved phase gasoline contamination in a fractured bedrock aquifer relied upon as domestic water supply. Used pumping tests and computer models to predict future contaminant migration and assisted counsel in negotiating corrective action plan elements with MDE and in pursuing legal remedies relating thereto.

- Designed and executed an environmental assessment of commercial property located down gradient from a fuel spill site. Identified gasoline-contaminated groundwater and used trace element chemistry to fingerprint the source. Performed a limited risk assessment and assisted counsel in preparation of legal documents charging environmental trespass. Strength of deposition testimony allowed settlement with defendant (a major oil company) on highly favorable but sealed terms.

SOURCE WATER ASSESSMENT AND PERMITTING EXPERIENCE

- Countywide Public Supply SWAP - Prepared Source Water Assessments for 25 community and NTNC groundwater supply wells in northeastern Maryland. Work included hydrologic water balances, fracture trace analyses, time-of-travel calculations, geologic mapping, contaminant hazard reconnaissance, and mapping, land use planning reviews and ordinance development. Project was awarded SWAP of the Year by EPA Region III.

- Countywide NTNC SWAP - Provided wellhead protection and source water assessment assistance to assess and survey approximately 100 TNC and NTNC groundwater supplies as part of a countywide grant-funded demonstration project.

- Municipal SWAP - Prepared Source Water Assessment and Wellhead Protection Plan for a community on the Delmarva Peninsula served by wells screened in multiple aquifers. Identified neighboring farming as a non-point contaminant hazard and recommended innovative implementation strategy to allow co-existence of agricultural operations and the recharge area for a community water supply.

Legislative Task Force

General Timeline 2013 -2014

6/19/2014 – The Task Force intends to meet the last Thursday of every month (except for November and December of 2013/14). The Division of Planning will work with the Task Force members to confirm specific dates and locations. In the meantime, the general expectation for timing is below.

SEPTEMBER 26, 2013 –Meeting 1 - DOA
Topics: Organizational, Purpose, Summaries of 2013 Public Law 42-64.13-10 and Existing RI Gen. Laws for wetlands and OWTS

OCTOBER 24, 2013 – Meeting 2 - DEM
Topics: Scope of Work, Summary of Prior Wetland Task Forces, DEM and CRMC Rules/Regulations for Wetland and OWTS, Overview of Municipal Regulations **Speakers:** Carol Murphy, Ernie Panciera, DEM, James Boyd, CRMC, Lorrain Joubert, URI

NOVEMBER 19, 2013 - Meeting 3 - DEM
Topic: Wetlands Functions and Values - **Guest Speaker:** Chris Mason, President, Mason and Associates, Inc.

DECEMBER 19, 2013 – Meeting 4 - DOA
Topic: Habitat Functions for Wetland Buffers - **Guest Speaker**: Dr. Peter Paton, Professor of Wildlife Ecology, Department of Natural Resources Science, URI

JANUARY 21, 2014 - Meeting 5 - DOA
Topics: OWTS basics & Groundwater Science: Water Resource Issues, Impacts & Nutrients in Buffer and Riparian Zones **Guest Speakers:** - Dr. Arthur Gold, Dep. of Natural Resources Science, URI, OWTS 101 - George Loomis, Program Director, NE Onsite Wastewater Training Program, Cooperative Extension, URI

FEBRARY 27, 2014 - Meeting 6 - DOA
Topics: Summary of NE States buffers/ regulatory requirements, Summary of RI municipal ordinance inventory, Discussion on case studies for identifying regulatory friction points – **Speakers:** Carol Murphy, DEM, Sean Henry, DOP

MARCH 27, 2014- Meeting 7 - DEM
Topics: Local Wetland Review: Two Perspectives – **Guest & Speakers**: Michael Deluca, Narragansett Community Development Director & Scott Rabideau, Task Force Member

APRIL 17, 2014 - Meeting 8 - DEM
Topics: Summary of NE States –Wetland and OWTS buffers, Recap to date **Speakers:** Carol Murphy, Ernie Panciera, DEM, Nancy Hess, DOP

MAY 29, 2014 - Meeting 9 - RIBA
Topics: Literature Review- Part 1: Summary of Wetland Buffer Reports & Manuals; RI & New England Specific **Speaker:** Carol Murphy, DEM

JUNE 19, 2014 – Meeting 10 - DOA
Topics: Literature Review- Part 1 continued, Wetland Buffer Reports & Manuals and Part 2; OWTS
Speakers: C. Murphy, DEM, J. Boyd, CRMC, N.Hess, DOP, T. Kutcher & R. Chateauneuf, LTF Members

JULY 17, 2014 - Meeting 11- RIBA
Topics: Wetlands/OWTS Issues in the Chesapeake Bay Region, Recap of topics / feedback on Issues from Task Force **Guest Speakers from Maryland:** Andrew Der, Environmental Consultant, Mark Eisner, Professional Geologist

AUGUST 2014
No meeting – Writing Group prepares preliminary draft report

SEPTEMBER 2014
18th - 12thTask Force Meeting - DEM
 Topics: Preliminary Draft Report
25th - 13thTask Force Meeting - DEM
 Topics: Preliminary Draft Report
Also Writing Group prepares draft recommendations

OCTOBER 2014
No meeting - Writing Group – prepares final report & recommendations

NOVEMBER 2014
20th – 14th- Task Force Meeting *(Third Thursday)* - DEM
Topics: Review and census on final report & recommendations

DECEMBER 2014
DOP produces final report and submits by 12-31-2014