KANE COUNTY

Rudd, Young, Feltman, Podraza, Wallers, Slowinski, Bardol, Wills, Olsem, Culp, Lobbes, Huddleston-Ag Chair

Non-Voting: Wilford, Finke, Custic, Polzin

STORMWATER MANAGEMENT TECHNICAL ADVISORY COMMITTEE

JANUARY 24, 2018

Auditorium | **Agenda** | **12:00 PM**

Kane County Government Center, 719 S. Batavia Ave., Bldg. A, Geneva, IL 60134

1. **Call to Order**
2. **Approval of Minutes:** November 29, 2017
3. **Public Comments**
4. **Discussion:**
   A. Floodplain/Floodway (Continued)
   B. Wetlands/Buffers
5. **New Business**
   A. TAC Updated Meeting Schedule
   B Stormwater Management Planning Committee Meeting – March 13, 2018
6. **Adjournment**

ENGINEERING
RESOURCE ASSOCIATES

ENGINEERS | SCIENTISTS | SURVEYORS

Recommendations

continued Floodplain/ Floodway and begin Wetlands/Buffers

I. Overview:

The floodplain topics not discussed at last month's meeting are being continued for discussion. In addition to the remaining floodplain issues, ERA has provided topics for wetlands and buffers for discussion.

II. Objectives:

To obtain a consensus from TAC on the direction for the following:

- *A. Floodplain/Floodway Topics*
  - *a. Compensatory Storage exemptions and Depressional Storage definition*
  - *b. Streamlined permitting process for routine projects*
- *B. Wetland/Buffer Topics*
  - *a. Definitions*
  - *b. Requirements for Wetland Delineation*
  - *c. Mitigation to be local*
  - *d. Threatened and Endangered Species Consultation*
  - *e. Wetland Preservation During Development*
  - *f. Buffer Requirements*
  - *g. Qualified Review Specialist*
  - *h. Wetland Impacts and Mitigation*

** The details and ordinance language will be discussed with TAC during future phases of this project.*

III. Topics

A. Floodplain/Floodway Topics

Updated language should:

1. <u>Compensatory Storage</u>:
   a. Add <u>exemptions to compensatory storage</u> requirements for certain projects that result in minimal fill.
      i. Septic system replacement projects. Would not apply to new septic systems. In floodplain only.

ii. Fill up to 0.2 feet in depth if fill is composed of ditch dredging spoils generated from ditch cleaning. In floodplain and floodway.
iii. Fill less than 5 cubic yards. Allow one time per parcel. In floodplain only.
iv. Building structural members, including horizontal and vertical, such as foundation walls, joists, decking.
v. Floodproofing existing lawful buildings within 10-feet of face of building. In floodplain and floodway.
vi. Artificially created storage. In floodplain and floodway.
vii. Stormwater Administrator may deny exemptions if negative impacts.

b. Consider exemption/reduced standard to hydraulically equivalent comp storage (i.e. 0-10 year and 10-100 year) for certain projects such as linear developments (roadways, trails) and agricultural dredging.

2. Clarify Definition for Depressional Storage. Current Standard: The Volume contained below a closed contour on a one foot contour interval map, the upper elevation of which is determined by the invert of a surface gravity outlet. Recommend: Clarify that "surface gravity outlet" does not include a surface inlet (hickenbottom) that connects to a drain tile/subsurface drainage system.
3. Consider adding "General Permits" which waive certain requirements in order to streamline the permitting process for specific types of routine projects provided they meet certain terms and conditions (similar to IDNR-OWR regional permits). Projects can include:
    a. Restoring subsided soil,
    b. Construction of Seawalls & Shoreline/Streambank Stabilization,
    c. Minor floodplain fill,
    d. Decks, Patios, Driveways,
    e. Fences,
    f. Septic systems/Wells,
    g. Dredging,
4. Add Public Health Protection Standard: No development in the SFHA shall include locating or storing chemicals, explosives, buoyant materials, animal wastes, fertilizers, flammable liquids, pollutants or other hazardous or toxic materials below the FPE.
5. Define storage of materials and/or fill. Reason: It is unclear that mulch, wood piles, landscape material, equipment and other buoyant materials are not allowed to be stored in the floodway.
6. Review and Require CRS minimum prerequisites, such as, community must maintain FEMA Elevation Certificates on all new buildings and substantial improvements constructed
7. Benchmarks / survey datum shall be NAVD88. Define appropriate use of GPS.

B. Wetland/Buffer Topics – See Table A for comparison of surrounding counties and USACE.

1. Definitions:

    a. Wetland: Update to wetlands as defined by the current Corps Wetland Delineation Manual, including any relevant regional supplements, or superseded and as authorized under Section 404 of the Clean Water Act.

b. Wetland Impact: Currently the ordinance only includes dredge and fill as an impact. Consider revising the Wetland Impact definition to include indirect impacts. This could be determined via a reduction in the tributary area exceeding 25% or addition in tributary area exceeding 125% of the existing tributary. In the event that an applicant feels this reduction or addition does not change the hydrology the applicant may provide an inundation duration analysis that proves otherwise. The designed hydrology should be maintained as close to 100 percent of the existing hydrology as possible. An indirect wetland impact shall be assumed if the development activity causes the wetland hydrology to fall below 80 percent, or to exceed 150 percent, of the existing condition storm event runoff volume to the wetland for the 2-year, 24-hour storm event.

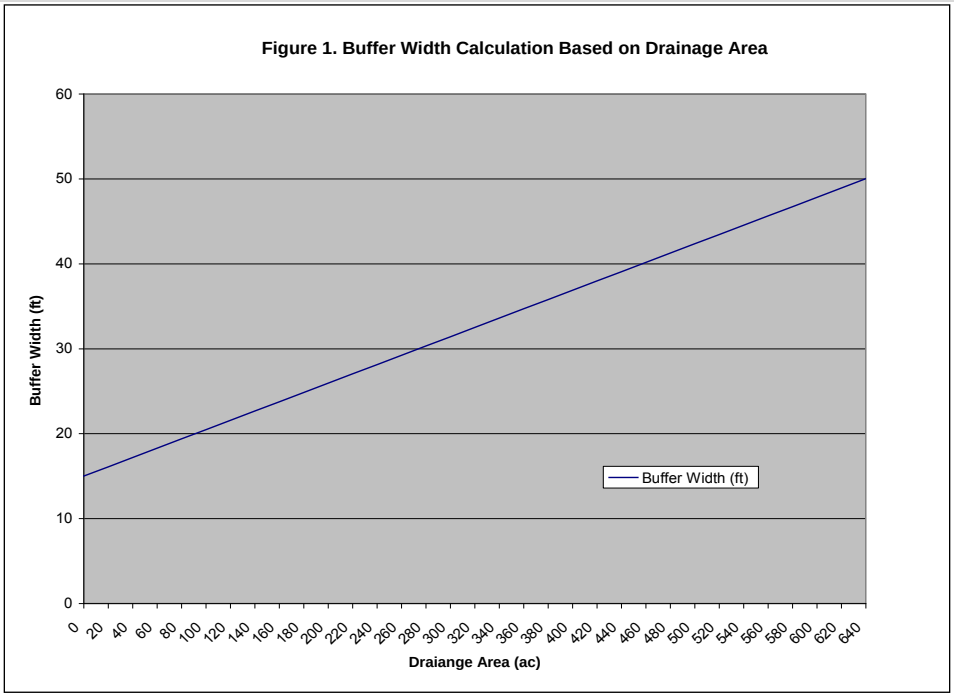
2. Requirements for Wetland Delineation
    a. Update to the current Corps Wetland Delineation Manual, including any relevant regional supplements, or superseded and as authorized under Section 404 of the Clean Water Act.
    b. Add requirements for Farmed Wetland Delineation procedures. Farmed wetlands located on the site in agricultural areas which are in production and which are not determined to be wetlands through the federal wetland methodology shall be delineated through the current National Food Security Act Manual methodology. Agricultural areas that have been abandoned for five consecutive years shall be delineated in accordance with the Corps Manual.
    c. Include a listing of areas that may meet the criteria for a wetland but are generally not regulated. Examples include:
        i. Wetlands in drainage, irrigation and roadside ditches created by excavation in upland areas;
        ii. Wetlands created by excavation or by other unfinished development activities in upland areas;
        iii. Wetlands created by artificial hydrology including, but not limited to, irrigation or site runoff storage facility outlets which would revert to upland areas if irrigation were to cease;
        iv. Wetlands created by the construction of stormwater facilities in upland areas, provided that the facility was not created for the purpose of wetland mitigation;
        v. Wetlands in pits or quarries excavated in uplands for the purpose of obtaining fill, stone, aggregate, sand or gravel unless or until the construction or operation is abandoned for a period of 5 years; and
        vi. Wetlands created by the construction of ponds in upland areas for aesthetic purposes.

    Currently many of these are listed in the Mitigation Required section of Article 9.
    d. Currently the Ordinance does not allow wetland delineations to take place between November and March. Consider revising this to allow delineations to take place during the winter when site conditions allow. The Floristic Quality Index (FQI) should be updated between June and October.
3. Mitigation to be local – Divide by watershed, Fox River and Kishwaukee. Currently there are no banks within Kane County in the Kishwaukee watershed. The Director can approve banking outside of the County within the same watershed.
4. Threatened and Endangered Species Consultation – This section states, “Prior to the issuance of a stormwater management permit the applicant shall consult with IDNR and the United States Fish and

Wildlife Service (USFWS) with respect to the presence of threatened or endangered species and shall obtain a "positive outcome" letter or other instrument of approval."

a. Update to reflect the current IDNR consultation process. IDNR provides consultation through their EcoCAT program. They charge a $500 fee for this unless the consultations by State or Federal Government (i.e. NOI, etc).
b. Update to include current USFWS Section 7 requirements. An evaluation of the wetland completed in accordance with the current U.S. Fish and Wildlife Service review procedure.

5. Wetland Preservation During Development – This section states, "Preserved wetlands shall be protected during development such that an FQI calculated two (2) years after the commencement of development will not be more than two (2) points less than the FQI originally calculated. The developer shall mitigate for any wetland not so preserved at the ratio required for the FQI originally calculated." It is unclear if this requirement is being enforced. Consider adding a performance security to help enforce this.
6. Buffer Requirements
    a. Linear Buffers
        i. The current standard states:
            1. When the lineal waters of the U.S. have a drainage area greater than six hundred forty (640) acres, measured at the downstream property line, or are designated as ADID because of high habitat value or an adjacent wetland has a calculated FQI greater than sixteen (16), the buffer shall be fifty feet (50'). Note: this does not apply to redevelopments on the main channel of the Fox River.
            2. When the lineal waters of the U.S. have a drainage area less than six hundred forty (640) acres, measured at the downstream property line, the buffer width shall be determined utilizing the formula, X = (A * 0.0547) + 15, where "X" equals the buffer width in feet and "A" equals the drainage area in acres. The width calculated by this formula shall be rounded up to the nearest multiple of five (5). Figure 1 of this section may be used to determine buffer widths provided the resultant width is increased to the nearest multiple of five (5)." The current Table is below in Figure 1.



ii. The State of Illinois has adopted water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act. The States water quality standards should:

- provide, wherever attainable, water quality for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water ("fishable/swimmable"), and
- consider the use and value of State waters for public water supplies, propagation of fish and wildlife, recreation, agriculture and industrial purposes, and navigation.

The State carries out regular appraisals of waterways with the purpose of determining compliance with the goals of the Clean Water Act. These appraisals are used to guide the NPDES permit updates for area Publicly Owned Treatment Works (POTWs) and will likely be used increasingly for NPDES Phase II permits. Many of assessed waterways in Kane County are not in compliance with the aquatic life designated use. Continued failure to meet the aquatic life use goal will likely lead to increased and more costly permit requirements for public agencies.

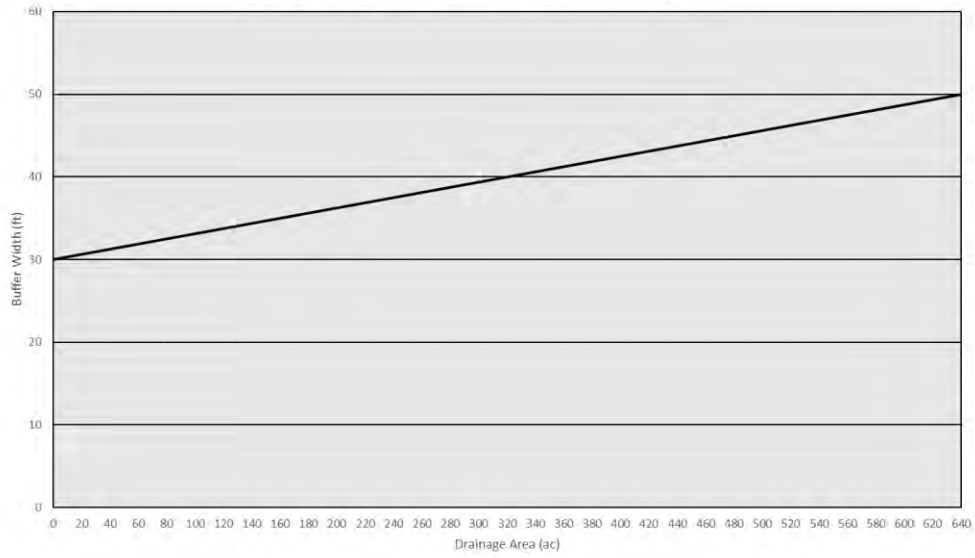
Research (see attached) indicates that the buffer width for nutrient retention should be between 5-30 meters (16.4-98 feet); while the effective buffer width for protection of aquatic wildlife and stream temperature is between 10-30 meters (33-98 feet).

Research indicates that buffering low order streams has greater positive influence on water quality than wider buffers on portions of larger order streams already carrying polluted water. Failure to protect to the smaller headwater streams ignores important sources of sedimentation and pollution. The USACE requires a 50-foot buffer for Waters of the U.S. and most other collar counties require between 30 and 50 feet. We

recommend increasing the minimum buffer of 15 feet to at least 30 feet for linear water bodies with less than 640 acres of tributary area. If 30 feet is the desired width the new equation would be:
X = (A * 0.03125) + 30.

See revised Table Below in Figure 2:

Figure 2. Buffer Width Calculation Based on Draingage Area



We also recommend considering a 100' buffer for streams rated A or B for Diversity or Integrity, or mapped as Biologically Significant: as described in the Integrating Multiple Taxa in a Biological Stream Rating System published by the Illinois Department of Natural Resources. These include: Tyler Creek, Ferson Creek, Little Rock Creek, Big Rock Creek, Welch Creek, Mill Creek, and Blackberry Creek. This is consistent with the USACE requirement of a 100 foot buffer for High Quality Aquatic Resources.

<u>Recommendation Summary:</u>

- 100 feet for Streams rated A or B for Diversity or Integrity or mapped as Biologically Significant
- 50 feet for streams with a tributary area greater than 640 acres, and
- 30-50 feet for streams with a tributary area less than 640 acres.

b. Water Body Buffers
    i. The High Quality Wetland Table currently allows for a buffer between 15' and 30'. Consider changing the table to FQI > 16 < 20 with a minimum width of 30' and a max width of 50'.
    ii. The current standard for wetlands with an FQI greater than 25 the buffer width is 50 feet per 9-94.A.3. However, wetlands with an FQI greater than 20 are considered High Quality Aquatic Resources by the USACE and a 100 foot buffer is required. Most other collar counties require a 100 foot buffer for high quality wetlands. Consider changing

the buffer width for wetlands that are considered a High Quality Aquatic Resource or those with a FQI greater than 20 to 100 feet.

Recommendation Summary:

- Low Quality Wetlands FQI < 7, buffer 15-35 feet
- Medium Quality Wetlands 7 > FQI < 16, buffer 15-50 feet
- High Quality Wetland 16 > FQI < 20, buffer 30-50 feet
- High Quality Aquatic Resource Wetlands, 100 feet

c. Free from Development - The current standard allows path up to 10' wide. Consider allowing paths up to 14' wide. This is the widest path requirement per the latest version of AASHTO Guide for Development of Bicycle Facilities.

7. Qualified Review Specialist – The Society of Wetland Scientists has a Professional Certification Program that many wetland professionals have gotten certification through. Consider including Professional Wetland Scientists as meeting the requirements to become a Qualified Wetland Review Specialist.
8. Wetland Impacts and Mitigation – This article is currently separated from the previously discussed wetland requirements. Consider moving this section to Article 9.
    a. General – Consider removing fees from this section. Relocate to an Appendix. This allows municipalities to adopt their own fees.
    b. Unmitigable Wetlands: Current standard states, "Wetlands identified as having an FQI greater than or equal to twenty five (25) shall not be filled or dredged as part of any development. The FQI shall be based solely on the wetland vegetation. Buffers and adjacent plant communities shall not be included in the calculation." Consider revising this to state impacted (not filled or dredged).
    c. Mitigation Required – the current standard states, "All mitigable wetland impacts shall be mitigated as described herein with the following exceptions:
        A. A wetland impact created by the dredging of a wetland with an FQI of less than seven (7) need not be mitigated.
        B. A wetland impact upon manmade wetlands created by excavation or other unfinished development activities in previously nonwetlands areas need not be mitigated.
        C. Wetland impacts upon wetlands created by irrigation which would revert to nonwetlands areas if irrigation were to cease need not be mitigated.
        D. Wetland impacts upon wetlands created by the construction of manmade stormwater management facilities in previously nonwetlands areas need not be mitigated. Proof may be required to verify the purpose and use of the facility.
        E. Wetland impacts created by the construction of manmade ponds in previously nonwetlands areas need not be mitigated.
        F. Wetland impacts occurring on agricultural land that has been enrolled in any program under the food security act for the previous three (3) years need not be mitigated."

    Consider deleting B-E if those areas are added to the Requirements for Wetland Delineation Section as non-wetland.
    d. Mitigation Requirements – Letter E of this section currently states, "Wetland impacts upon wetlands with an FQI of more than twenty five (25) shall be mitigated at a minimum ratio of ten

to one (10:1) plus one-half (1/2) for each point by which the FQI exceeds twenty five (25) rounded up to the nearest whole number. For example, a wetland having an FQI of thirty two (32) shall be mitigated at a ratio of fourteen to one (14:1) ((32-25)/2 = 31/2 rounded up to the nearest whole number = 4); 10 + 4 = 14." Consider removing the example from E as it is guidance.

e. Wetland Mitigation Performance Standards – The standards currently state, "A wetland mitigation facility shall not be dominated or contain cumulatively more than twenty five percent (25%) cover of the following species: buckthorn (Rhamnus cathartica or frangula), reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), or giant reed (*Phragmites australis australii*)." Consider including "non-native invasive species, including but not limited to" as the species listed are not an all inclusive list and other species should be included. As new invasive species are constantly changing the standard should reflect that.

C. REFERENCE

Table A - Current County Ordinance Wetland & Buffer comparison:

Ordinance Require-ments / County	Regulated Wetlands Jurisdictional (Jur.) Isolated (Iso.)		Corps Wetland Determination (Det.) & Permit Review Delegation (Rev.)		Wetland Classification High Quality Regulatory (Reg.)		Mitigation Ratio High Quality Regulatory (Reg.)			Wetland Buffers Linear (Lin.) Water Body (WB)			
										High Quality		Regulatory	
	Jur.	Iso.	Det.	Rev.	High Quality	Reg.	Impact Threshold	High Quality	Reg.	Lin	WB	Lin	WB
DuPage	x	x		x[1]	FQI>25 MDNR>5 HQAR	FQI<25 MDNR<5	0.1ac	3:1	1.5:1	100ft		Limits of Regulatory flood plain or Trib area < 100 ac = 15' Trib area > 100 ac = BFE study	50ft
Kane	x	x			FQI > 16 ADID HQAR IBI	FQI<16	0.1ac[2]	FQI >16 3:1 FQI >25+ 10:1+	7<FQI<16 2:1 FQI <7 1:1[2]	50ft	50ft	Trib area >640ac, 15-50ft[3] Trib area >640ac, 50'	FQI<7, 15-35ft FQI>7<16, 15-50ft FQI>16, 15-50ft FQI>16, 50ft
Lake	x	x	x[4]		HQAR ADID IBI>40	All Others	0.1ac	HQAR 3:1 ADID/ Forested 6:1	1.5:1[5]	100ft		Tributary >1mi^2 30ft <1mi^2 50ft	⅓<X<1ac,30ft 1<X<2 ½ac, 40ft >2½ ac, 50ft
McHenry	x	x			HQAR HFVW HQHS	All Others	0.1ac	HFVW 3:1[6] HQAR/HQHS 5:1[6]	1.5:1[7]	100ft		Tributary >20acres 50ft	.25ac<X<.5ac, 30ft X>.5 ac, 50ft
Cook	x	x			FQI>20 C-val>3.5 HQAR	All Others	0.1	3:1	1.5:1	100ft	100ft	Isolated 30ft Jurisdictional 50ft	.1ac<X<.5ac, 30ft X>.5ac, 50ft
USACE	x				HQAR HQHS	All Others	0.1	1.5:1[8]	1.5:1[8]	100ft	100ft	50ft[9]	.25<X<.5 30ft X>.5 50ft

1. DuPage County reviews impacts to jurisdictional wetlands under GP25.
2. Mitigation is not required for dredging a wetland with an FQI less than 7.
3. When the lineal waters of the U.S. have a drainage area less than six hundred forty (640) acres, measured at the downstream property line, the buffer width shall be determined utilizing the formula, X = (A * 0.0547) + 15, where "X" equals the buffer width in feet and "A" equals the drainage area in acres.
4. Lake County performs jurisdictional determinations.
5. 1:1 for approved and fully certified wetland mitigation bank credits, or open water not considered HQAR's.
6. 1:1 ratio may be allowed for IWMC impacts under Categories I, II and III, including HQAR, HQHS, an HFVW, provided that IWMC mitigation occurs onsite according to the requirements of this Ordinance.
7. May be reduced to 1:1 in wetland banking credits.
8. District has the discretion to require additional mitigation to ensure that the impacts are no more than minimal.
9. Water of the US with no associated wetland fringe may use buffer of 50 ft.

C - 1 :

Riparian Buffer Zones: Functions and Recommended Widths

Prepared by
Ellen Hawes and Markelle Smith
Yale School of Forestry and Environmental Studies
For the
Eightmile River Wild and Scenic Study Committee
April 2005

(as attachment)

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1. Functions of Riparian Buffers

Riparian buffers are vital elements of watersheds, primarily due to their protection of surface and ground water quality from impacts related to human land use. These vegetated buffers are complex ecosystems that provide food and habitat for unique plant and animal species, and are essential to the mitigation and control of nonpoint source pollution. In fact, the removal of streamside vegetation, primarily for development purposes, has resulted in degraded water resources and diminished value for human consumption, recreation, and industrial use.[1]

In the Eightmile River watershed, maintenance of riparian buffers in their natural condition has been identified as one of the most effective means of protecting multiple outstanding resource values (ORVs), including water quality, hydrology, unique species and natural communities, and watershed ecosystem function.

Sedimentation increases turbidity and contributes to rapid siltation of waterbodies, negatively impacting water quality. Increased sediment loads also narrow channel widths and provide substrate for colonization of invasive aquatic plant species. Intact riparian buffers ameliorate these negative impacts by stabilizing streambanks. Roots of riparian vegetation deflect wave action and hold bank soil together. The buffer vegetation also decreases erosional impacts during flood events and prevents undercutting of streambanks.

Excess nitrogen and phosphorous from fertilizers and animal waste, as well as other pollutants originating from pesticides and herbicides, often bond to soil particles. The nutrient-loaded sediment contained in surface runoff then flows to the nearest waterbody and is deposited. This process is the primary cause of accelerated eutrophication of lakes and rivers[2]. Streamside forests function as filters, transformers, and sinks for harmful nutrients and pollutants[3]. Buffer plants slow sediment-laden runoff and depending upon their width and vegetational complexity, may deposit or absorb 50 to 100% of sediments as well as the nutrients and pollutants attached to them[4]. When surface water runoff is filtered by the riparian buffer approximately 80 to 85% of phosphorous is captured[5]. Nitrogen and other pollutants can be transformed by chemical and biological soil activity into less harmful substances. In addition, riparian plants act as sinks, absorbing and storing excess water, nutrients, and pollutants that would otherwise flow into the river, reducing water quality.

One of the most important functions of riparian buffers is enhanced infiltration of surface runoff[6]. Riparian vegetation in the buffer surrounding a waterbody increases surface roughness and slows overland flows. Water is more easily absorbed and allows for groundwater recharge. These slower flows also regulate the volume of water entering rivers and streams, thereby minimizing flood events and scouring of the streambed.

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[1] Welsch 1991
[2] Jontos 2004
[3] Welsch 1991
[4] Connecticut River Joint Commission 2005
[5] Connecticut River Joint Commission 2005
[6] Dillaha et al. 1989

Many plant and animal species depend on the distinctive habitat of riparian buffers, which include elements of both terrestrial and aquatic ecosystems. Forested buffers improve habitat quality by providing shade that cools water temperatures, thereby elevating the dissolved oxygen content that is necessary for many species of fish and aquatic insects. Woody debris from shrubs and trees within the vegetated buffer provides food and cover for a multitude of aquatic species. If large enough, buffers also provide corridors essential for terrestrial wildlife movement.

Vegetated buffers may serve as screens along waterways, protecting the privacy of riverfront landowners and blocking views of any unsightly development. Hiking and camping opportunities are also facilitated by forested buffers, which if large enough, allow outdoor enthusiasts to enjoy the proximity of the water. The diversity of plant species provides visual interest and increases aesthetic appeal.

2. Recommended buffer widths

The width of a buffer depends greatly on what resource you are trying to protect. Scientific studies have shown that efficient buffer widths range from 10 feet for bank stabilization and stream shading, to over 300 feet for wildlife habitat. Furthermore, the necessary width for an individual site may be less or more than the average recommendations, depending on soil type, slope, land use and other factors. The ranges cited below come from four literature reviews by The U.S. Army Corps of Engineers New England Division, the University of Georgia's Institute of Ecology, the U.S. Army Engineer Research and Development Center, and researchers from the UK Forestry Commission.[7] Results from studies done in New England fall within the ranges cited below, and no evidence was found in the literature to suggest that buffers should be, on average, either wider or narrower.

a. Erosion control

Erodibility of soil type is a key factor when assessing adequate buffer widths. Widths for effective sediment removal vary from only a few feet in relatively well drained flat areas to as much as several hundred feet in steeper areas with more impermeable soils. In order to prevent most erosion, vegetated buffers of 30 feet to 98 feet have been shown to be effective.

b. Water quality

Nutrients - Nitrogen and phosphorous can be retained in buffers that range from 16 to 164 feet. The wider buffers will be able to provide longer-term storage. Nitrogen is more effectively removed than phosphorous. In 1995, a study conducted in Maine found that the effectiveness of buffers at removing phosphorous is variable but in most cases, a 49-foot natural, undisturbed buffer was effective at removing a majority of the nutrient from surface runoff. However, the U.S. Army Corps of Engineers concluded in their 1991 study that there was insufficient evidence

[7] U.S. Army Corps of Engineers 1991, Wenger 1999, Fischer and Fischenich 2000, Broadmeadow and Nisbet 2004, respectively.

to determine a necessary buffer width for phosphorous retention. It is important, therefore, to combine buffer zones with strategies to reduce phosphorous at its source.

Pesticides – Buffer widths for pesticide removal range from 49 feet to 328 feet. Pesticides that are applied manually require less of a buffer area than aerially-sprayed pesticides.

Biocontaminants – Buffer widths for biocontaminants, such as fecal coliform, were not reviewed in this study. The University of Georgia found that, in general, buffers should be 30 ft. or greater. However, buffers may not be able to adequately filter biocontaminants and it is also important to reduce these pollutants at the source.

c. Aquatic habitat

Wildlife – The minimum width of riparian buffers to protect aquatic wildlife, including trout and invertebrates, range from 33 feet to 164 feet.

Litter and debris input – Recommendations for buffer widths to provide an adequate amount of debris for stream habitat range from 10 feet to 328 feet, although most fall within 50 feet to 100 feet.

Stream temperature. Adequate shading can be provided by a 30-foot buffer, but buffers may need to be up to 230 feet to completely control stream temperature. The amount of shade required is related to the size of the channel. The type of vegetation in the buffer regulates the amount of sunlight reaching the stream channel. Generally, a buffer that maintains 50% of direct sunlight and the rest in dapple shade is considered preferable[8]

d. Terrestrial habitat

The Eightmile River watershed contains a large number of roadless, undeveloped forest blocks and is more than 80% forested in total. Furthermore, the riparian corridor within 300 ft. of the river and its tributaries has remained mostly intact, supporting a high level of biodiversity as well as protecting water quality. The Eightmile River is host to a number of important species, including native brook trout, freshwater mussels, blue back herring, bobcats, great horned owls and cerulean warblers.

The habitat requirements for birds, mammals, reptiles, amphibians and fish vary widely, and the necessary buffer width to protect each species varies widely as well. While trout and salmon can benefit greatly from the shading, habitat, food, and water quality protection that a 150-foot buffer provides, mammals such as the red fox and the bobcat require riparian corridors of approximately 330 feet. Furthermore, birds such as the cerulean warbler, which requires large areas of forest, may need a buffer that is much greater than 330 ft.[9] For this reason, we do not believe that it is feasible to capture all of the habitat needs of all species with a uniform buffer. More careful targeting of potential riparian habitat, work with landowners to create conservation

[8] Broadmeadow and Nisbet 2004
[9] Chase et al. 1995

easements, as well as the creation of protected areas by the town will aid in more specific approaches to habitat preservation for these species.

For a more detailed look at the range of recommended buffer widths, see Appendix 1.

3. Factors influencing buffer width

There are many factors that influence the effectiveness buffers. These include slope, rainfall, the rate at which water can be absorbed into the soil, type of vegetation in the buffer, the amount of impervious surfaces, and other characteristics specific to the site.

a. Slope

As slope increases, the speed at which water flows over and through the buffer increases. Therefore, the steeper the land within the buffer, the wider it needs to be to have time to slow the flow of water and absorb the pollutants and sediments within it. Many researchers suggest that especially steep slopes serve little value as a buffer, and recommend excluding areas of steep slope when calculating buffer width. The definition of "steep" varies from over 10% to over 40% slope[10].

b. Soil type

The type of soil affects how quickly water can be absorbed. Soils that are high in clay are less permeable and may have greater runoff. On the other hand, soils that are largely made up of sand may drain water so rapidly into the groundwater that roots are not able to effectively trap pollutants. Furthermore, soils that are moister and more acidic have a better capacity to take up nitrogen from the soil and release it to the atmosphere (through denitrification).

c. Vegetation mix

Structurally diverse riparian buffers, i.e. those that contain a mix of trees, shrubs and grasses, are much more effective at capturing a wide range of pollutants than a riparian buffer that is solely trees or grass. Removal efficiencies range from 61% of the nitrate, 72% of the total phosphorous and 44% of the orthophosphates from grass buffers to 92% of the nitrate 93% of the total phosphorous and 85% of the orthophosphates from combined grass and woody buffers. [11]

[10] Wenger 1999
[11] Jontos 2004

Table 1: Estimated reduction of nutrient loads from implementation of riparian buffers[12]

Buffer Type	Nitrogen	Phosphorus	Sediment
Forested	48-74%	36-70%	70-90%
Vegetated Filter Strips	4-70%	24-85%	53-97%
Forested and Vegetated Filter Strips	75-95%	73-79%	92-96%

Source: Delaware Department of Natural Resources and Environmental Control

Generally, the grass filter strip works best for sediment removal, while the forested buffer is better for nitrate removal from subsurface flows[13]. Grasses have a shallower and denser root mat that is more effective in slowing runoff and trapping sediments from the surface flow. Trees have a deeper root system that can trap and uptake nutrients from the groundwater, stabilize banks, and regulate the flow of water to the stream.

Forests provide certain functions that grasses cannot. Trees shade the river and provide an input of leaf litter and branches that are necessary for many aquatic species. In addition, a forested buffer provides important habitat for terrestrial wildlife. Native plants species are preferred to ornamentals or exotics due to the habitat advantage they provide for wildlife. Old trees are especially valuable for providing inputs of coarse woody debris.

The most effective riparian buffers should include a mix of trees, shrubs and herbaceous plants native to the region and appropriate to the environment in which they are to be planted. When planting buffers, it is best to use adjacent reference riparian buffers as the basis for selecting floral composition[14].

Table 2: Plant type vs. removal efficiency

Function	Grass	Shrubs	Trees
Sediment trapping	High	Medium	Low
Filtration of Sediment born Nutrients, Microbe and Pesticides	High	Low	Low
Soluble forms of Nutrients and Pesticides	Medium	Low	Medium
Flood Conveyance	High	Low	Low
Reduce Stream Bank Erosion	Medium	High	High

Source: Jontos 2004 (modified after Fisher and Fischenich 2000)

[12] (Palace, 1998; Lowrance et al., 1995; Franti, T.G., (1997); Parsons et al. (1994); Gilliam et al. (1997); Osmond et al., (2000)

[13] Triangle J. Council of Governments 1999

[14] Jontos 2004

4. Buffer types

a. Variable Width

Several models have been created to consider individual site factors in determining buffer width. These range from the complex to the relatively simple. The more complex models take into account multiple factors, such as slope, erodibility and infiltration rates[15]. Examples of such models include:

Brown et al. (1987):

$$Buffer\ width = (average\ slope/erodibility\ factor)^{1/2}$$

Cook College Department of Environmental Resources:

$$Buffer\ width = 2.5\ (time\ of\ travel\ of\ overland\ flow) * (slope)^{0.5}$$

More simple models only take into account slope. A common formula is to set a fixed buffer width and apply 2 feet per percent slope. Many of these models recommend *not* including impervious surfaces or areas of steep slope in the buffer width (**Figure 1**). Cook College recommends excluding anything greater than 15% slope, while Wenger (1999) recommends excluding all slopes over 25%.

b. Fixed Width

A fixed buffer width is the easiest to administer. However, care must be taken to select the appropriate width for the resources you are targeting. Studies unanimously support the conclusion that buffer efficiency at filtering out pollutants increases with width. However, this does not increase infinitely, and the goal is to find the most efficient width. For example, a study in the Mid-Atlantic[16] found that 90% of sediments were removed by a 62 ft. riparian buffer, but only 94% were removed by more than doubling the buffer width to 164 ft

If a fixed buffer width is chosen, it should be on the conservative side to provide leeway for slope and soil type. Data for the Eightmile River watershed show that significant areas of the land bordering the river have slopes that are above 15%. Therefore, we believe it is necessary to make a fixed buffer width wider than the average minimum recommendation of 100 ft.

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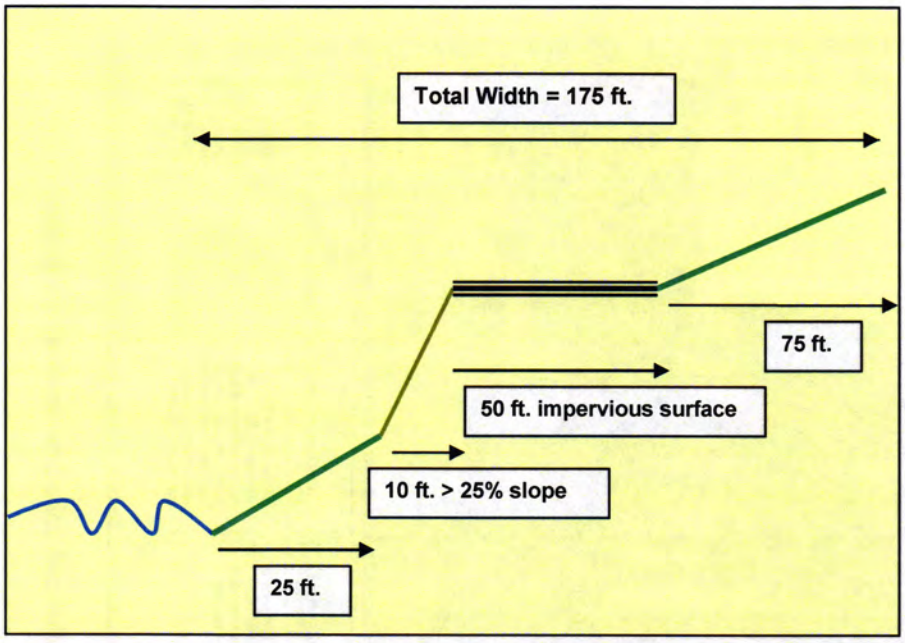
[15] Described in the US Army Corps of Engineers (1991) literature review.
[16] Peterjohn and Corell 1994.

Fig.1: Variable buffer width adjusted from 100 feet to 175 feet to account for effects of slope and impervious surface.



c. Three Zone

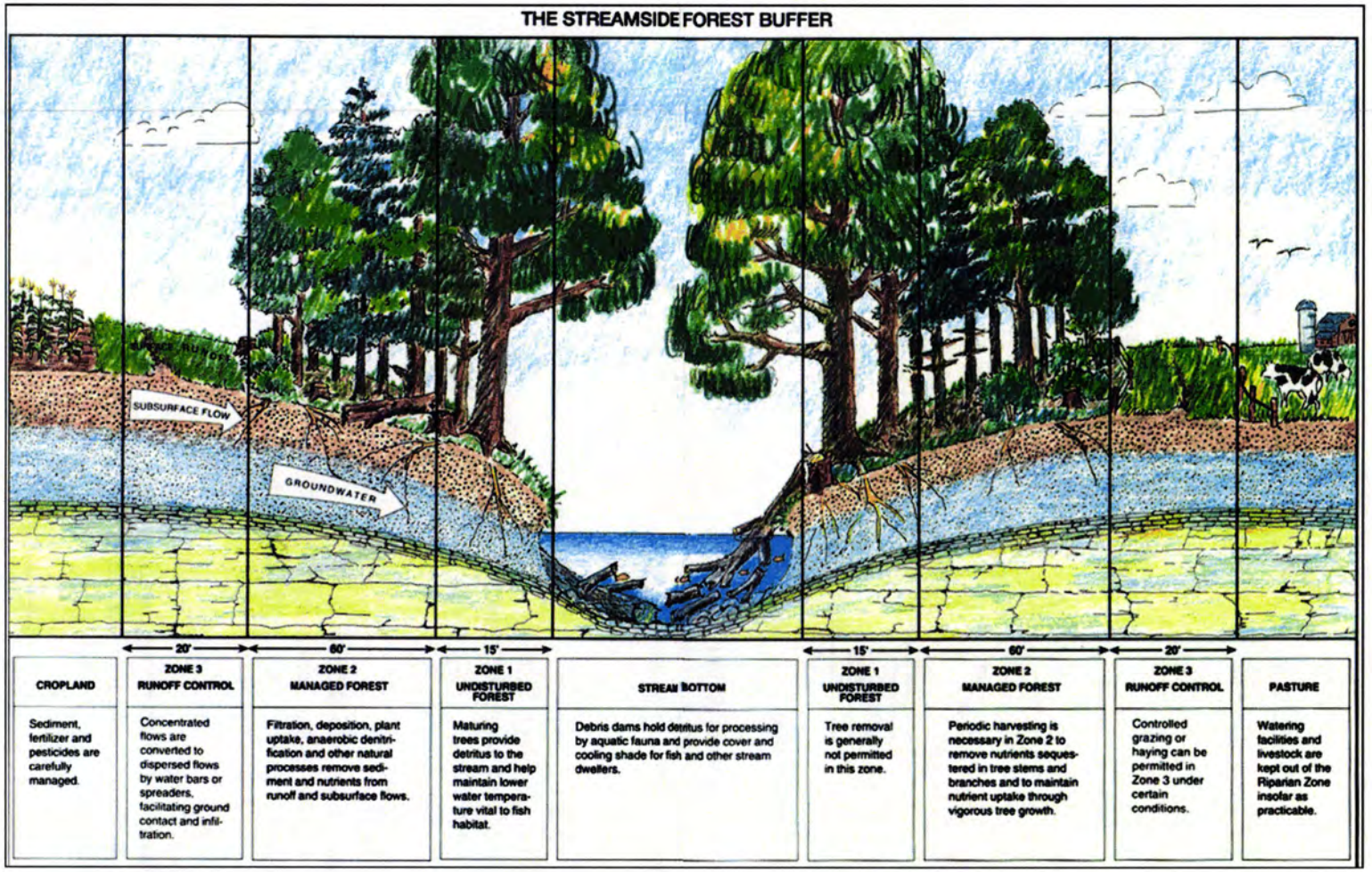
The Three Zone system was originally developed as part of an initiative to protect the Chesapeake Bay. The combination of vegetation types (trees, grass and shrubs) helps maximize the efficiency and diversity of benefits that the buffer provides (Figure 2).

Zone 1
Minimum Width: 15 ft.
Composition: Native trees and shrubs
Function: Bank stabilization, habitat, shade, flood prevention
Management: None allowed except bank stabilization and removal of problem vegetation.

Zone 2
Minimum Width: 60 ft.
Composition: Native trees and shrubs.
Function: Removal of nutrient, sediments and pollutants from surface and groundwater, habitat
Management: Some removal of trees to maintain vigorous growth.

Zone 3
Minimum Width: 30 ft.
Composition: Grasses and herbaceous plants
Function: Slow surface runoff, trap sediments and pesticides
Management: Mowing

Fig. 2: **Three-Zone System**



Source: Welsch 1991. Riparian Forest Buffers: Function and Design For Protection and Enhancement of Water Resources.

5. What order streams to protect

Buffers are most effective when they are contiguous. Guidelines for buffer widths recommend that long, continuous buffer strips should often be a higher priority than fragmented strips of greater width.[17] Small gaps in vegetation along the bank can channelize runoff into the river and effectively negate the effect of surrounding buffers. For this reason, landowners who currently have lawns that run to the edge of the river should be encouraged to replant trees and shrubs along the bank. In addition, footpaths cleared for river access should be winding, rather than straight, and as narrow as possible to minimize sedimentation.

Failure to extend protection to the smaller headwater streams in the river basin also ignores important sources of sedimentation and pollution. To preserve water quality in the Eightmile River, it is essential to protect all of its tributaries. In fact, smaller order streams often account for the greatest miles of watercourse in a basin. Buffering low order streams (1^{st}, 2^{nd} and 3^{rd}) has greater positive influence on water quality than wider buffers on portions of larger order streams already carrying polluted water. While it may be politically infeasible to set wide buffer zones around intermittent and ephemeral streams, this omission is not justified by the science. A University of Georgia study of riparian buffers warns, "Governments that do not apply buffers to certain classes of streams should be aware that such exemptions reduce benefits substantially."[18] A review of buffers by the U.S. Army also notes that "even the best buffer strips along larger rivers and streams cannot significantly improve water that has been degraded by improper buffer practices higher in the watershed".[19]

Smaller headwater streams have the greatest area of land-water interaction, and have the greatest potential to accept and transport sediment. Ephemeral streams, which only exist during periods of high rain, can serve as important sources of sediment and pollutants to the river. It is important that they are maintained in a vegetated condition in order to help trap and slow the flow of pollutants. Furthermore, removing riparian vegetation from the banks of small, heavily shaded streams will have a much greater impact on stream temperature and aquatic habitat throughout the watershed than removing vegetation from larger rivers, where only a fraction of the water is shaded. Rather than ignoring these streams completely, a compromise would be to create a smaller setback. Clinnick et al (1985) advocate a minimum of a 20 m wide buffer for ephemeral streams, and where that is not possible, at least leaving the banks vegetated[20].

[17] Fisher and Fischenich 2000
[18] Wenger 1999
[19] Fisher and Fishenich 2000
[20] Wenger 1999

Appendix 1–Summary of Effective Buffer Widths from Literature Review

	Effective Width of Buffer (in feet)							
Author	**Aquatic Wildlife**	**Terrestrial Wildlife**	**Stream Temperature**	**Litter/Debris input**	**Nutrient Retention**	**Sediment Control**	**Bank Stabilization**	**Pesticide Retention**
Wenger 1999		220-574 ft.	33 – 98 ft.	50 ft.	50 – 100 ft.	82 – 328 ft.	–	> 49 ft.
Army Corps 1991	98 ft.	30 – 656 ft.	33 – 66 ft.	66-102 ft.	52 – 164 ft.	33 – 148 ft.	49 – 98 ft.	49 – 328 ft.
Fisher and Fischenich 2000	> 98 ft.	98-1,640 ft.	–	10 – 33 ft.	16.4-98 ft.	30-200 ft.	30 -66 ft.	–
Broadmeadow and Nisbet 2004	33 –164 ft.	–	49 – 230 ft.	82 – 328 ft.	16.4-98 ft.	49 – 213 ft.	–	–

Appendix 2 - General Recommended Widths of Buffer Zones

Source: Jontos 2004 (modified after Fisher and Fischenich 2000)

Function		Recommended Width
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 NPS loads are particularly high.	5 to 30 m
Stream Stabilization	Buffers, particularly diverse stands of shrubs and trees, provide food and shelter for a wide variety of riparian and aquatic wildlife	10 to 20 m
Riparian Habitat	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.	30 to 500 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

Appendix 3

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Appendix 4 - Web Resources

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TAC Updated Meeting Schedule

February 28, 2018– Best Management Practices (BMP's) and Soil Erosion/Sediment Control,

March 28, 2018 – General Provisions, Administration, Enforcement

Spring 2018 – No Meetings. Consultant to draft ordinance language. Meetings will resume in Summer 2018.