Natural Resource Inventory
APPENDICES

Natural Resource Inventory

APPENDIX A: QUESTIONNAIRE RESULTS

In March of 2009, the Town proposed a public opinion survey to Gilford residents. The survey was introduced as a way of gathering resident input for the natural resource inventory. There were a total of 195 resident responses. The following is an overview of the results.

Question 1: Rank each of Gilford's natural resource features of importance to you using 1-3. (1 = Most Important, 2 = Somewhat Important, 3 = Not Important)

For question one, residents found water quality as the most important feature. Residents found cemeteries as the least important feature. The following table contains the percentages of the respondents' beliefs. Not all 195 residents responded, so the number of respondents is listed as well.

Natural Resource	Most Important	Somewhat Important	Not Important	Total Respondents
Fields/Agriculture	73%	21%	6%	158
Fish/Wildlife	68%	27%	5%	164
Wetlands & Vernal Pools	56%	34%	10%	154
Ridgelines	53%	33%	14%	152
Cemeteries	28%	54%	18%	152
Forests	80%	16%	4%	167
Rivers/Streams	83%	14%	3%	161
Scenic Views & Vistas	74%	21%	5%	165
Rural Atmosphere	67%	25%	8%	157
Ponds & Lakes	87%	10%	3%	167
Open Space	75%	20%	5%	162
Water Quality	92%	4%	4%	162
Historical Features	55%	37%	8%	153

Residents were also given an "Other" category. Under "Other," the following resources were written in:

Human Cultural Resources
Beach
Country Roads
Agriculture
Air Quality
Small Town Community
Gilford Meadows

Question 2: In what ways do you enjoy Gilford's recreational opportunities? Check all that apply.

For Question 2, the most used recreational activity was swimming, followed by hiking. The least used recreational activity was hunting. All survey takers responded to this question, except for Athletic Fields/Courts and Parks, which had a total of 190 respondents (5 abstained)

Recreational Resource	Use	Don't Use
Fishing	40%	60%
Hiking	74%	26%
Canoeing/Kayaking	46%	54%
Running	30%	70%
Athletic Fields/Courts	44%	56%
Parks – Day Use/Picnics	58%	42%
Hunting	19%	81%
Nature Observation	65%	35%
Personal Watercraft	30%	70%
Downhill Skiing/Boarding	52%	48%
Snowmobiling	24%	76%
Swimming	81%	19%
Boating	55%	45%
Mountain Biking	27%	73%
Snowshoeing	58%	42%
Cross Country Skiing	43%	57%

Residents were also given an "Other" category. Under "Other," the following activities were written in:

Walking
Triathlon
Stargazing
Biking
Cycling on Roads
Horseback Riding
Team Sports

Question 3: Is there a need for development of a trail system in Gilford for recreational use that would include snowmobiles, horseback riding, mountain biking, walking, and etc.?

The majority of respondents feel there is a need for development of a trail system in the Town.

Yes	No	No Opinion	Enough Trails Already
61%	10%	16%	13%

Question 4: Please indicate how important the conservation of open space in Gilford is to you.

The majority of respondents feel that conservation of open space is very important. One survey taker abstained.

Very Important	Not Important	No Opinion
89%	4%	7%

Question 5: Do you support the acquisition of lands for conservation purposes?

The majority of respondents support the acquisition of land for conservation purposes.

Yes	No	No Opinion
88%	5%	7%

Question 6: Are you interested in learning more about the tax benefits of selling or donating your land or its development rights to a conservation organization?

Yes	No	No Opinion
12%	66%	21%

Question 7: List your three favorite natural resources; resource areas or properties in Gilford.

The following information is a summary of the respondents' choices. A few natural resources have more than one specified area, which are listed below the table.

Natural Resource	Number of Respondents
Woods/Forest[1]	42
Trails[2]	30
Lake Winnipesaukee	32
Lincoln Park	5
Lakes (Lake Access) & Streams	31
Meadows	6 23
Gilford Beach	28
Skiing (Includes downhill/cross country, ski area)	8
Belknap Mountains	51
Farms[3]	28
Mountains[4]	12
Gunstock	32
Views	2
Ponds[5]	35
Backyard	2

Open Space	3
Wildlife	2
Rural Atmosphere	2
Ellacoya Park	2
Gilford Village Area	4
Properties[6]	4
Recreational Areas and Activities	6
Quality of Life	1
Wetland	1
Historic District/Homes	2
Fresh Air	1
Gilford Islands	1
Land behind GES	2
Sidewalk	1
Sun	1
Green Ball	1

1 – Includes the following specified forests:
Weeks Woods
Big Woods
Woods Behind Belknap Mtn. Rd
Morrill St. Forest

2 – Includes the following specified trails:
Belknap Mountains/Trails
Liberty Hill Trails
Locke Hill Trails
Hiking trails
Nature trails
Snowmobile trails

3 – Includes the following specified farms:
Rambling View Farm
Person's Farm
Morrill Street Farm
Buffalo Farm
Howe's Farm
Smith Farmland

4 – Includes the following specified mountains:
Mount Major
Mount Rowe
Whiteface
Piper/Whiteface Area
Piper Mountain
Locke's Hill

5 – Includes the following specified ponds:
Round Pond
Salt Marsh Pond
Lily Pond

6 – Includes the following specified properties:
Fornez Bean Property
Andy Howe's Property
Outing Club Property
Powell Property

Question 8: If the Town could preserve one area permanently, what or where should it be and why?

The location with the most responses was Gilford Meadows, followed by Belknap Mountains. The following table includes the most listed locations, followed by a list of locations with only one respondent. 106 survey takers abstained.

Location	Number of Respondents
Gilford Meadows	22
Belknap Mountains	11
Piper Mountain	8
Person's Farm	6
Gunstock Area	6
Gilford Beach	5
Week's Farm	4
Lake Winnipesaukee	3
Saltmarsh Pond	2
Nature Trail behind GES	2

The following list is locations which only had one respondent:

Airport
Whiteface Mountain Area
Behind Lyman's
Brook by Mountain View Yacht Club
Village/Schools
Library lot on Potter Hill Rd.
Morrill St. Farm
Ridge Lane
Rowe House
Village Recreation Fields
Any farm
Lincoln Park
Bolduc Park
Forest
Large, undeveloped tracts
Streams
Rambling View Farm
Round Pond
Lake shorefront

The reasons why were varied, and included the following:

Hiking
Farm atmosphere
Family recreation
Natural beauty and views
Refrain from development
Town heritage and character

Natural Resource Inventory

APPENDIX B: EXCERPTS FROM 1984 WETLAND STUDY

TABLE 1
(continued)

Wetland No.	Tax Map No.	Soils	Drainage	Acres	Classification Code	Wildlife	Vegetation	Aesthetics	Scientific	Hydrology	Recreation
48	29	Sc-AuB	P	6.0	PEM1Ef	M	M	H	L	L	L
49	22-29	Sc-AuB	P	6.0	PEM1Ef	M	M	H	L	L	L
50	22	RhB	P	3.5	PEM1C	M	L	L	L	L	L
51	22	RhB	P	9.7	PFO1C	M	L	L	L	L	L
52	23	RhB	P	4.6	PFO1Cf	M	M	M	L	L	L
53	30	RbB	P	1.7	PEM1Jf	M	M	M	L	L	L
54	29	RhB	P	2.4	PFO1J	M	L	L	L	L	L
55	30	RhB	P	3.1	PFO1J	M	L	L	L	L	L
56	29	RhB	P	2.0	PSS1J	M	L	L	L	L	L
57*	22	Sc-AuB	VP	7.2	PEM1Hb						
58	29-36	Ru-Po	P	8.2	PSS1A	M	L	L	L	H	M
59	29-36	MI	P	19.7	PSS1A	M	L	L	L	H	M
60	29	AuB-Sc	P	12.4	PSS1/EME	M	M	M	L	H	M
61	29	Po	FP	3.5	PEM1Af	M	M	M	L	H	M
62	29-22	MI-Ru	P	12.1	PSS1C	M	L	M	L	H	M
63	22	Ru-MI	P	5.2	PEM1/SS1A	M	L	M	M	H	M
64	22-15	MI-Ru	P	17.6	PSS1C	M	L	M	L	H	M
65	15	Ru	P	1.0	POWH	M	M	M	L	H	L
66	22	RhB	P	4.1	PEM/FO1L	M	L	M	L	L	L
67	15-22	RhB	P	14.8	PFO1E	M	L	M	L	M	M
68*	15	MP	VP	7.6	PSS1F						
69	22	AuB	P	5.9	PSS1/EM1C	M	M	H	L	M	M
70	22	RbA	P	2.8	PSS1C	M	M	L	L	L	M
71	22	RhB	P	2.7	PFO1C	M	L	L	L	M	L
72	15	RhB	P	5.5	PFO1A	U	L	L	U	M	U
73	15	RhB	P	3.8	PFO1E	M	M	L	L	L	M
74	17	RbB	P	1.4	PFO1A	M	L	H	L	L	L
75	17	RhB	P	9.7	PFO1C	M	M	L	L	M	M
76	17	RhB	P	4.1	PEM1/SS1Axd	M	L	H	L	L	L
77	16-10	RhB	P	7.5	PFO1C	M	L	U	U	L	U
78	16	RhB	P	1.4	PSS1C	M	L	M	L	L	L
79	16	Sc-MP	P	6.2	PFO1C	M	M	M	M	H	M
80*	10-11	RhA	VP	17.9	PEM1/SSH						
81	34	RhA	VP	1.4	PEM1E	M	M	M	L	L	L
82	41-42	RbB	P	2.8	PFO4C	M	M	M	L	L	L
83	34	RhA-Wa	VP	15.9	PFO1/4C	M	H	H	M	L	M
84	34-35	RbB	P	32.4	PEM1Ef	H	M	H	L	L	L
85	34-41	RhB	P	5.2	PFO4Cf1	H	M	L	L	M	M
86	35	RhA-RhB	P	14.5	PFO1/4C	M	M	M	M	H	M
87*	35	RhA	VP	44.0	PFO5Hb						
88	35	RbB	P	2.1	PEM1Af	M	L	L	L	L	L
89	35	RbB	P	1.4	PEM1E	M	M	L	L	L	L
90*	35	RhA	VP	8.3	PEM1H						
91	35	RhB	P	1.4	PFO1C	M	L	U	U	L	U
92	34	Sc	P	7.6	PSS1E	H	M	L	L	L	M
93	34-27	RhA	P	6.6	PSS1C	M	L	L	L	L	L
94	27	AuB	P	2.0	PSS1C	L	L	L	L	L	H
95	27	RhB	P	6.2	PSS1C	M	U	M	U	M	M
96	27	AuB	P	2.0	PEM1C	L	L	L	L	L	H
97	27	AuB	P	7.5	PEM1E	M	M	M	L	L	H
98	27	RhB	P	4.5	PSS1C	M	L	L	L	M	L

TABLE 1
(continued)

Wetland No.	Tax Map No.	Soils	Drainage	Acres	Classification Code	Wildlife	Vegetation	Aesthetics	Scientific	Hydrology	Recreation
99	27	RhA	VP	3.0	PFO1/4E	M	M	M	L	L	L
100	28	RhB	P	2.1	PFO1E	M	M	L	L	M	L
101*	28	Mp	VP	4.9	PFO5E						
102	28	--	VP	34.5	L1OWH	H	H	H	H	H	H
103*	28	RhB	VP	1.0	PEM1E						
104*	28	Mp	VP	4.1	PSS1E						
105	28	Sc-AuB	P	6.2	PFO4C	M	M	L	L	L	L
106	27,28,20,21	Sc,AuB,RhB	P	10.3	PFO1/4C	M	M	M	L	L	L
107	20,27	AuB-Mp	VP	4.7	PEM1/SS1E	M	M	L	L	L	L
108	20	Ru & MI	P	13.8	PFO1/SS1A	H	H	M	L	H	M
109	20	MP	VP	2.8	PFO1A	M	M	M	L	L	L
110	20,13	RhA-RbA	P	8.3	PEM1/SS1E	H	M	M	L	L	M
111	20	RhA	VP	2.1	PEM1E	M	M	M	L	L	L
112	20	RhA-Wa	P	14.5	PSS1E	M	M	M	L	M	M
113	20	RbA	P	3.0	PSS1A	M	L	L	L	L	L
114	21	AuB-RhB	P	12.6	PEM1/SS1A	M	M	H	L	H	L
115*	20	MP	VP	2.0	PSS1A						
116	21	RhB	P	6.6	PFO1E	L	M	L	L	L	L
117	14,13	RhB,RbA	P	17.6	PSS1/FO1E	H	M	M	L	M	M
118	13	RhB	P	3.1	PFO1A	H	M	L	L	L	L
119	13	RhB	P	4.1	PFO1A	M	M	L	L	M	L
120	13,14	RhB	P	7.6	PFO1A	M	M	U	U	L	U
121	14	RhB	P	8.3	PFO1A	M	M	L	L	M	L
122	14	RhB	P	2.4	PFO4/1A	M	M	M	L	L	L
123	14	RhB	P	11.0	PFO1/SS1C	M	L	L	L	L	L
124	14	RhB	P	2.7	PSS1A	M	L	L	L	L	L
125	14	RhB,RbA	P	7.6	PSS1A	M	L	L	L	L	L
126	14,15	Sc,AuB,RhB	P	17.6	PFO1/EM1Cf	H	M	M	L	M	L
127	14,15	Sc,AuB,RhB	P	11.4	PEM1Cf	H	M	M	L	M	L
128	15	RhB	P	10.0	PFO1/4A	M	L	M	L	L	L
129	15	RhB	P	4.8	PSS1/EM1A	M	L	M	L	L	L
130	8,9,14,15	RhB	P	15.9	PFO1A	M	L	L	L	L	L
131	9	Sc	VP	2.5	PEM1L	L	L	L	L	L	M
132	9	RhB	P	16.3	PFO1/4C	M	M	M	L	L	M
133*	9,15	MP	VP	3.8	PSS1E						
134	15	RbB	P	2.4	PSS1A	M	M	L	L	L	L
135	8	Sc-AuB	VP	4.0	PSS1E	M	L	M	L	H	L
136*	3,8	RhA,MP,Sc	VP	35.0	PFO/SS5E						
137	3,8	NA	VP	41.0	L1OWH	H	H	H	H	H	H
138	8	RhB	P	5.5	PSS1C	H	M	M	L	M	M
139	8	AuB-RhA	P	2.4	PEM1C	M	L	H	L	H	L
140*	4,9	Sc	VP	24.0	PFO/PSS1E						
141*	1,4	MP	VP	27.6	PFO1E						
142	4	RhA	P	9.5	PFO1C	M	L	L	L	L	L
143	1	RbB	P	2.4	PFO1A	M	L	L	L	L	L

TABLE 1
(continued)

Wetland No.	Tax Map No.	Soils	Drainage	Acres	Classification Code	Wildlife	Vegetation	Aesthetics	Scientific	Hydrology	Recreation
144	1	RhB	P	2.1	PFO1A	M	L	L	L	L	L
145	1	MP	VP	4.0	PFO1E	L	L	M	M	L	L
146	1	RhA	VP	2.7	PFO1E	M	L	L	L	M	L
147	1	RbB	P	3.1	PFO1C	M	L	L	L	M	L
148	1	RhB	P	1.5	PFO1A	L	L	L	L	L	L
149	54	RdA	P	2.8	PFO1A	M	M	H	L	H	M
150	54	Wa	VP	2.9	PFO1C	M	M	M	L	M	M
151	9	MP	VP	3.5	PSS1E	M	M	H	L	H	L
152*	9	MP	VP	43.5	PSS/EM1E						
153*	4,5,9	MP	VP	34.0	PSS/EM1E						
154	4,5,9	MP	VP	12.0	PSS1C	M	M	M	L	L	M
155*	9	Sc	VP	6.9	PFO1E						
156	5,10	Ml,AuB,RdA	P	17.3	PFO/SS1C	M	L	L	L	H	L
157	4,5	Sc,AuB	P	7.6	PFO1/4C	M	L	M	L	H	M
158	5	Ru	P	5.2	PFO1E	M	M	M	L	H	M
159*	5	MP	VP	12.1	PSS1E						
160	10	Po,Ru	P	95.0	PEM/SS1Cf	H	H	H	L	H	L
161*	10	RhA,MP,Sc	VP	29.0	PEM/SS1E						
162	15	RhB	P	4.1	PFO1E	M	L	M	L	M	M
163	14	RhB	P	5.2	PSS1E	M	M	M	L	L	L

Key to Table:

1. U = Unknown
2. * = See Table 3: Part 2, 'Prime Wetland Final Evaluation: A Summary'
3. Classification Code: Appendix 5 & 11 and/or the Legend to the Official Wetlands Map explain these codes in more detail.

Table 2 shows the distribution of wetland area in Gilford by soil drainage.

TABLE 2

Soil Drainage in Gilford

Soil Drainage	Number of Areas	Number of Acres
Very Poorly	51	601 (517.4 excluding lakes)
Poorly	112	937 (includes approx. 90 acres of floodplain soils)
TOTAL	163	1,538

Table 3 summarizes the most common classification codes by level of hierarchy:

System, Subsystem and Class

Of the five systems (Estuarine, Marine, Riverine, Lacustrine, and Palustrine), only 3 systems occur in Gilford: Riverine, Lacustrine and Palustrine. The Riverine systems were not mapped; however, the National Wetlands Inventory map for the area does map the Riverine systems. Palustrine wetlands adjacent to Riverine systems were mapped. There were only three Lacustrine systems within Gilford and the remaining 160 areas mapped were Palustrine.

Because Palustrine wetlands have no subsystem associated with them, 98 percent (160) of the wetlands in Gilford have no subsystem.

Of the ten possible classes of vegetation, only 4 (forested, scrub-shrub, emergent and open water) occur in Gilford. Wetlands where forest cover is the predominant vegetation, comprise 45.4 percent of the wetland areas in Gilford. Scrub-shrub wetlands are the second most common class, comprising 22.7 percent of the wetland areas in Gilford. Wetlands with predominantly emergent vegetation comprise 14.7 percent of Gilford's wetlands, open water 3.1 percent and those areas containing 2 classes, 14.1 percent.

TABLE 3

Most Common Wetland
Classification Characteristics

Level of Hierarchy	Categories	Number of Wetlands Represented	% of Total
System	Palustrine	160	98.2%
	Lacustrine	3	1.8%
		163	100.0%
Subsystem	None	160	98.2%
	Limnetic	2	1.2%
	Littoral	1	.6%
		163	100.0%
Class	Forested	74	45.4%
	Scrub-Shrub	37	22.7%
	Emergent	24	14.7%
	Open Water	5	3.1%
	Mixed (2 classes)	23	14.1%
		163	100.0%

PRIME WETLAND #1

Wetland #39 is located in the upper reaches of the Gunstock River, essentially the headwaters of the river system. The wetland area has been aided in its development by the activity, over many years, of a number of beavers. Four beaver dams divide the wetland into 4 major wetland subsystems. Each of the beaver dams is a different age, consequently each of the 4 areas created by the dams, is at a different stage in vegetative succession. The variety of vegetative types make the area invaluable to wildlife in the area and of great potential educational and historical interest to its watershed, and because the soils surrounding the wetland are steep and highly erodible, the wetland serves strong flood retention, sediment retention, and shoreline anchoring functions. The area is one of the most unique wetlands in Gilford.

PRIME WETLAND #2

Wetland #136 comprises all of the wetland area adjacent to and surrounding Lily Pond, including wetlands disturbed by the by-pass. Lily Pond is a highly visible and scenic area in Gilford. Varying combinations of very poorly drained soils and water levels have created a truly unique pattern of vegetational covers in the Lily Pond area, valuable for their uniqueness, their importance to wildlife and fisheries and their recreational and educational potential. Because of its location, (close to Lake Winnipesaukee and Paugus Bay) and because of the extensive development adjacent to the area, the Lily Pond area has the opportunity to perform crucially important nutrient trapping, shoreline anchoring and flood storage functions. The Lily Pond area has a relatively high potential to be a groundwater discharge area.

PRIME WETLAND #3

Wetlands #14 and 15 comprise this prime wetland area, located along West Alton Brook along the eastern edge of the Gilford line. Recent and long-term beaver activities have created a variety of vegetation conditions. The area is highly scenic, evidently used by many and varied types of wildlife and supports and aquatic population (Brook Trout, tadpoles and salamanders were observed in the area). Because of its uniqueness, the area has a high scientific potential. The vegetation in combination with the beaver activity have created a wetland that exhibits high shoreline anchoring potential, high sediment trapping potential and high nutrient retention potential. This area has a relatively high potential to be a groundwater recharge area.

PRIME WETLAND #4

Wetlands #103 and 104 comprise this wetland area, located along the shores of Saltmarsh Pond, a stocked trout pond. Because it is a stocked trout pond, wetlands along its shore provide very important habitat, breeding and feeding grounds for fish and wildlife. Habitat potential is also high. Saltmarsh Pond is located high in one of the tributaries to Jewett Brook and provides a significant flood storage function. Other outstanding values of this area are its sediment trapping potential, nutrient retention potential, recreational potential and high potential as a groundwater recharge area.

PRIME WETLAND #5

Wetlands #9 and 10, located along Poor Farm Brook, close to its headwaters, comprise this prime wetland system. Several beaver dams can be found within the wetland system. A variety of vegetational types make the area important for wildlife habitat and downstream food chain support functions. Gunstock Recreation Area surrounds this wetland and a multitude of cross-country, hiking and horse trails provide easy access to this scenic wetland, and contribute to the wetlands recreational potential. Other outstanding attributes are its flood storage potential (a large basin high in the watershed), shoreline anchoring potential (especially important as surrounding soils are highly erodible), aesthetic beauty, uniqueness of geomorphologic type, and a high potential as a groundwater recharge area.

PRIME WETLAND #6

This very scenic cattail and reed wetland supports a wide variety of plants important to wildlife and supports a limited amount of aquatic life (tadpoles and salamanders were observed and bird-watching is a favorite local pastime here). Other important functions that this prime wetland area provide are flood storage, sediment trapping, long-term nutrient retention and a high potential as a groundwater discharge area.

PRIME WETLAND #7

This large marshy area is located along the south side of Highway 11 and close to Lake Winnipesaukee. The area is very accessible, very visible and thus highly aesthetic. Because of its size and its location (in a highly developed plateau between Gilford's mountains and the lake), this wetland area has the opportunity to provide significant flood storage, shoreline anchoring, sediment trapping and nutrient retention services for the community. The types of vegetation present and their interspersion make this area important to wildlife--(especially deer). The area has a high potential as a groundwater discharge area.

PRIME WETLAND #8

Wetlands #4 and 6 comprise the wetland portion of Round Pond. Round Pond is an exceptionally scenic and unique vegetational community located at the headwaters of the Suncook River. The pond is accessible by a hiking trail only, but is frequently used for hiking, fishing, hunting and skiing, thus providing a valuable recreational resource to the community, as well as providing important fish and wildlife habitat.

Because of its size and high location in the watershed, the wetland provides a valuable flood storage potential, and sediment trapping potential. Another outstanding feature of this prime wetland system is that it is located in an area of highly unusual geomorphology (volcanic neck area).

PRIME WETLAND #9

This large marshy area (wetland #161) is located behind the Harris Farm. This wetland supports many reeds, grasses, sedges and cattails and consequently attracts many waterfowl. Thus, it is a very important contribution to this type of wildlife habitat. The area has a high flood storage potential, a high sediment trapping potential and a high nutrient retention potential. This wetland is very scenic and supports a mixture of vegetation relatively unique to Gilford.

PRIME WETLAND #10

Wetland #57 is located behind the Gilford Elementary School. Because of its proximity to the school, the area has high aesthetic, scientific and recreational values. A beaver dam is located within this wetland. The beaver dam and the vegetation present in the area indicate that the area is important to wildlife. Other important functions that the wetland provides for Gilford are a high sediment trapping potential, a high nutrient retention protential and a high flood storage potential. The wetland is located in a Kame Terrace and therefore has a high geomorphological significance.

PRIME WETLAND #11

Wetland #159 is located at the mouth of a small stream which empties into Lake Winnipesaukee. Because of its proximity to Lake Winnipesaukee and because of the high degree of development all around this wetland, it is an extremely important wetland, serving many water quality functions. The wetland has a high shoreline anchoring potential and a high nutrient-retention potential. The area has a high potential as a groundwater discharge area. Because of its location along the lake, it is an important area for fish habitat and because of the variety of shrubs present, it is a somewhat unique habitat for wildlife, especially deer. Because of the high degree of development along the lake, the lake itself and the need to maintain visual diversity in an urban setting, the wetland serves an outstanding aesthetic function.

PRIME WETLAND #12

Wetland #87 is located in the southwest portion of Gilford and is at the headwaters of one of two tributaries to Jewett Brook. (Saltmarsh Pond is located at the headwaters of the other tributary to Jewett Brook.) The area is exceptionally unique because of its size and the extensive degree of current and historic beaver activity. The area obviously serves an extremely important flood storage function and sediment trapping function (i.e., the watershed above this area is flashy and soils are highly erodible). The vegetation is unique to Gilford and exhibits a high wildlife habitat potential. The area is highly aesthetic.

PRIME WETLAND #13

Wetland #153 is located on the north side of Highway 11 and adjacent to the east end of the Laconia Airport runway. Although this area has been disturbed by the highway and the runway, the wetland still provides a high degree of flood storage protection, sediment trapping and nutrient retention. The high degree of development surrounding this wetland increases its remaining values to the community (i.e., the wetland has a greater opportunity to perform these functions

because more surface waters end up flowing into the wetland instead of to surrounding less permeable surfaces. The wetland is in a high potential for groundwater discharge and has a high potential to provide wildlife habitat (especially important in a developing area where vegetative cover is declining rapidly).

PRIME WETLAND #14

Wetland #101 is located about a mile below the outlet to Saltmarsh Pond. This wetland was probably formed when the construction of Liberty Hill Road occurred, thus retarding drainage of the area. The area is covered with standing dead trees, and the former forest vegetation has been replaced with emergent vegetation (i.e., especially tearthumb, yellow-eyed grass and others). The area is important for shoreline anchoring, sediment-trapping, nutrient retention and wildlife habitat. It is also an aesthetically unusual and therefore unique wetland.

PRIME WETLAND #15

Wetland #90 is located high in the watershed of Jewett Brook. Soils in the watershed flowing into this wetland are highly erodible and silty. In addition, a housing development has been allowed on the steep, erodible soils directly above and adjacent to this wetland, thus increasing the flashiness of the watershed and the erosion potential of the area. For these reasons, this wetland serves a flood storage potential and a high sediment-trapping and nutrient-retention potential. This wetland drains into Saltmarsh Pond, a stocked trout pond, thus increasing its sediment-trapping and nutrient-retention values. The wetland is in a high potential for groundwater recharge area, and provides high aesthetic value for the housing development.

PRIME WETLAND #16

Wetland #140 is located in the western "L" of the airport runway (i.e., just north of the proposed industrial park). This wetland was logged recently, but a great variety of ground cover and shrubs remain. This wetland exhibits the most interspersion of vegetation of any wetland in Gilford and is threfore highly important to wildlife. The area is also in a high potential area for groundwater recharge, and has a high potential to store flood waters. Because it has a restricted outlet (i.e., a drainage pipe), the wetland serves a high nutrient-retention function.

PRIME WETLAND #17

This red maple swamp (#141) is located northwest of the airport. Although the vegetation is common to Gilford, this is an excellent representative of this wetland type. The unique aspect of this particular wetland is that it is hydrologically isolated (no inlet or outlet) and that it is in an area of high potential for groundwater recharge. It has a high potential for long-term nutrient trapping, thus protecting the quality of the groundwater, it is recharging. The wetland is located in a Kame, thus giving it a high potential for uniqueness because of its geomorphology.

PRIME WETLAND #18

Wetland #33 is located along a small stream that empties into Lake Winnipesaukee at Lake Shore Park. The wetland is on the south side of the road. Because of its proximity to the lake, and the fact that the watershed which the stream drains is steep and somewhat erodible, the wetlands flood storage, nutrient retention, shoreline anchoring and sediment-trapping functions are very important to Gilford and Lake Winnipesaukee.

TABLE 3

PRIME WETLAND FINAL EVALUATION: A SUMMARY

Prime Wetland #	Location on Official Wetlands Map	WETLAND FUNCTION																		
		Size	Groundwater	Flood Storage	Shoreline Anchoring	Sediment Trapping	Nutrient: Long Term	Nutrient Seasonal	Food Chain Downstream	Food Chain In-Basin	Wildlife Habitat	Fisheries Habitat	Vegetative Type	Aesthetic Value	Geomorph. Type	Archaeological/ Historical	Recreation	Scientific	Final Score	Acres
1.	#39 - Headwaters Gunstock River	H	R-H	H	H	H	M	M	M	M	H	L	H	H	H	L	M	H	85	15.1
2.	#136 - Lily Pond	M	D-H	H	H	M	H	H	M	M	H	H	H	H	L	L	H	L	84	35.0
3.	#14-15 - West Alton Brook	H	R-H	M	H	H	H	H	M	M	H	H	M	H	M	L	M	H	84	15.2
4.	#103,104 - Saltmarsh Pond	H	R-H	H	M	H	H	H	M	M	H	H	M	H	H	L	H	M	83	5.1
5.	#9,10 - Poor Farm Brook	H	R-H	H	H	M	M	H	H	M	H	H	M	H	H	L	H	M	83	30.2
6.	#80 - Up hill from Harris farm	H	D-H	H	M	H	H	M	M	M	H	L	H	H	L	M	M	M	82	17.9
7.	#152 - So. of 11 (adjacent to B1)	M	D-H	H	H	H	H	H	M	M	H	L	M	H	M	L	H	M	77	43.5
8.	#4,6 - Round Pond	H	R-H	H	M	H	M	M	M	L	H	M	M	H	H	L	H	L	76	17.3
9.	#161 - Behind Harris farm	M	R&D-M	H	M	H	H	H	M	M	H	L	H	H	M	L	M	L	75	29.0
10.	#57 - Behind Elementary School	H	R&D-M	H	M	H	H	H	M	M	H	L	M	H	H	L	H	H	75	7.2
11.	#159 - Smith Cove & Marina	H	R-H	M	H	M	H	H	M	M	H	H	M	H	H	L	M	L	74	12.1
12.	#87 - 2nd Jewett Brook tributary	M	R-M	H	H	H	M	M	M	M	H	M	H	H	L	L	M	M	74	44.0
13.	#153 - North of 11, airport runway	M	D-H	H	H	H	H	H	M	M	H	L	M	H	L	L	M	L	72	34.0
14.	#101 - Outlet of Saltmarsh Pond: J. Brook	L	R-H	M	M	M	H	H	M	M	H	M	M	H	H	L	M	M	69	4.9
15.	#90 - Junction Liberty Hill & Swain Roads	H	R-M	(H)	(H)	(H)	(H)	(H)	M	M	(H)	L	M	H	L	L	M	L	68	8.3
16.	#140 - West side of airport runway	H	R-H	H	L	M	H	H	L	L	H	L	M	M	L	L	M	M	63	24.0
17.	#141 - Kimball Rd. & Lily Pond Rd.	M	R-H	H	M	H	H	M	L	M	M	L	L	M	H	L	M	M	63	27.6
18.	#33 - Lake Shore Park	H	R&D-M	H	H	H	H	H	M	M	M	L	L	M	H	L	M	L	62	8.9
19.	#29 - Below Gunstock Rec. Area	H	R&D-M	H	H	H	H	H	M	M	M	L	M	L	L	L	H	L	59	20.7
20.	#20 - Above Gunstock Pond	H	R-H	M	M	M	M	M	M	M	M	L	M	M	L	L	H	M	59	6.9
21.	#68 - Black Br; headwaters to tributary	H	R-M	M	M	M	M	M	M	M	H	L	M	H	L	L	M	L	56	7.6
22.	#155 - Next to modular home park; old lake	H	R&D-M	H	M	M	H	H	M	M	M	L	L	M	L	L	L	L	53	6.9
23.	#133	L	R-H	H	M	H	H	H	L	M	M	L	L	L	L	L	L	L	49	3.8
24.	#115 - Along 11A; adjacent to animal home	L	R&D-M	H	M	L	M	M	M	M	M	L	L	M	M	L	L	L	46	2.0
25.	#25 - 2nd Trib. to West Alton Brk.	H	R-H	M	M	M	M	M	M	L	M	L	L	L	M	L	L	L	45	6.2
26.	#24 - Logged area in West Gilford on 11A	H	R-M	M	H	M	M	M	M	L	M	L	L	M	L	L	L	M	44	7.6

Natural Resource Inventory

APPENDIX C: RIPARIAN BUFFER RESEARCH & RECOMMENDATIONS

2.6 Shoreland Protection: The Importance of Riparian Buffers

RELATED TOOLS:

- Habitat Protection
- Permananent (Post-Construction) Stormwater Management
- Environmental Characteristics Zoning
- Density Transfer Credit

BACKGROUND AND PURPOSE

The purpose of this chapter is to provide municipalities with a model ordinance designed to promote shoreland and riparian protection.

The simplest and most effective way to protect streams, rivers, lakes and estuaries is to leave an area of undisturbed native vegetation adjacent to the water body. These undisturbed areas act as buffers by performing functions that protect water quality and enhance wildlife habitat. Preserving and restoring riparian buffers is essential to surface water quality protection.

There are a number of important guides, technical reports and scientific bulletins available to help New Hampshire municipalities better understand the importance of shoreland protection and the value of riparian buffers (see References).

Two of the key resources for municipal planners are *Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities* and *Riparian Conservation: A Professional's Practical Guide to Financial Assistance and Program Support*.

Surface waters can be broadly classified as either lakes and ponds or rivers and streams. Streams are typically classified according to their *order (see the definition of Stream Order in Glossary)*. In general, streams of higher order are larger than those of lower order. Rivers are examples of higher order streams. The size of a stream is one parameter that can be used to determine the amount of protection or buffer size that is desired for the water body.

In New Hampshire, municipalities currently have four options to regulate development for shoreland and riparian purposes:

Option 1: They may rely solely on the state's Comprehensive Shoreland Protection Act (CSPA) to protect the specific types of surface water bodies that fall under the jurisdiction of the CSPA[1]; or

Option 2: They may elect to adopt regulations that extend protection to the streams and surface water bodies that are not covered by the CSPA; or

Option 3: The municipality may adopt more stringent regulations than the minimum standards of the CSPA as provided for under RSA 483-B:8; or

[1] RSA 483-B, Comprehensive Shoreland Protection Act (CSPA); Effective Date of Enactment: 1991. Revised: 2008.

Option 4: The municipality may elect to develop separate stream corridor (watershed) regulations to protect the riparian buffers along first, second and third order streams and rivers within the community leaving the CSPA or a more stringent local shoreland ordinance to regulate the lakes, ponds, and higher order streams and rivers within the community.[2]

[2] If a municipality desires to pursue this option, the following applicable provisions from this Model Ordinance should be considered: I, II, III, IV, V, VI, VII a, b, d. 3, e, g, VIII, XI, and X.

Four primary resources were used to develop the ordinance of this chapter; the three-zone riparian buffer system developed by the Center for Watershed Protection; the Standards of the CSPA where those standards are most effective in protecting shorelands; the recommendations recently proposed by the Senate Commission to Review the Effectiveness of the CSPA as they relate to this ordinance; and the DES Model Rule for the Protection of Water Supply Watersheds.

The model ordinance is designed to implement Option 3 above. It includes a provision to protect lower order streams and expands upon the buffers established by the CSPA.

The ordinance contains three basic components: (1) a shoreland protection overlay district and zoning map; (2) shoreland protection district standards; and (3) riparian buffer standards. It is drafted as a complete zoning ordinance amendment.

Buffers for wetlands, fire and farm ponds, beaver impoundments, and coastal shorelands are excluded from the model ordinance.

For the purposes of this chapter, the terms "shoreland" and "riparian" shall be used interchangeably to refer to anything connected or immediately adjacent to the shoreline or bank of a stream, river, pond, lake, bay, estuary or other similar body of water. The term "riparian buffer" shall refer to the naturally vegetated shoreline, floodplain or upland forest adjacent to a surface water body.

APPROPRIATE CIRCUMSTANCES AND CONTEXT FOR USE

THE FUNCTION AND CONFIGURATION OF BUFFERS

There are many types and sizes of riparian buffers. Within any given watershed, riparian buffers can be strips of grassy land leading to the water's edge, thickly forested upland areas or floodplain areas that provide a transition zone between development areas and adjacent surface waters. Typically, these areas are managed to reduce the impacts of adjacent land use and to protect water quality by providing a buffer between upland development and the adjoining surface waters.

Most riparian buffers in New Hampshire consist predominately of forest vegetation. When left undisturbed and intact, these natural forest systems help to maintain clean water and healthy aquatic wildlife. Specifically, they serve to:

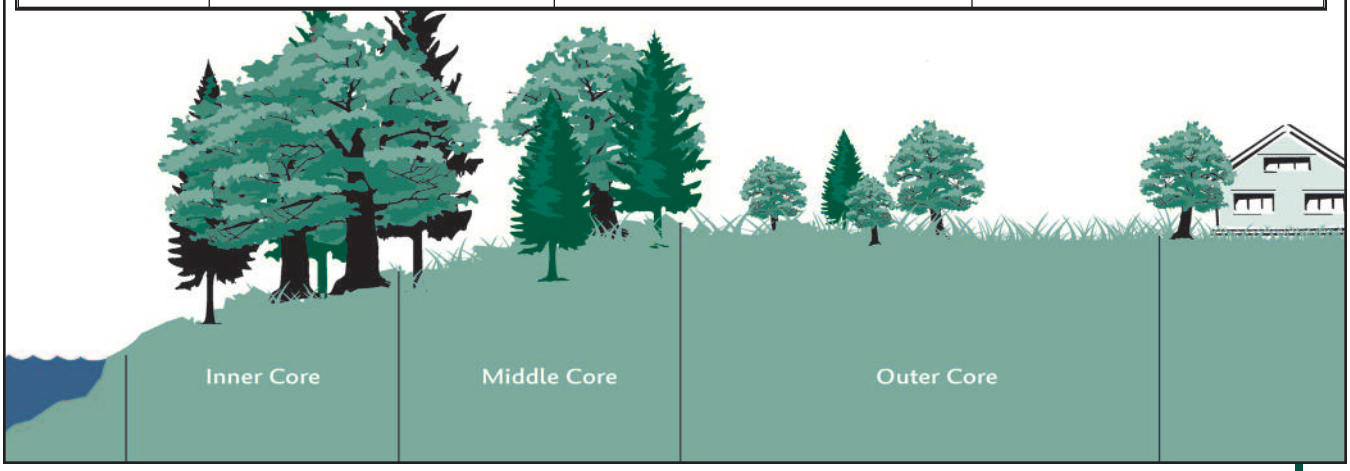
- Stabilize stream banks and shorelands with healthy root systems.
- Moderate the impact of heavy rains.
- Act as a natural filter, capturing sediment and pollutants from runoff.

- Protect people and property from flood damage by slowing and storing flood waters.
- Shade the shoreline and help to lower water temperatures. Cooler water holds more oxygen which is essential to aquatic animal species.
- Provide the organic matter that helps give soil the structural ability to hold oxygen and moisture. The duff layer (downed leaves, small twigs, and dead herbaceous vegetation) also moderates the impact of heavy rain, holds moisture, and can act as a natural mulch to prevent weed species.
- Increase property values by improving the appearance, beauty and aesthetics of the shoreland.
- Provide wildlife habitat on the shore with tree canopy, snags, and downed woody debris.
- Provide organic matter and woody material that falls into the water. The biomass that falls naturally into the water serves as food and habitat for the aquatic life in the water body.

The Center for Watershed Protection (CWP) has developed an effective three zone vegetated buffer model. The principles from that model have been adopted for the buffer strategy reflected in this model ordinance (see Figure 2.6.1). The CWP model consists of an inner core (closest to the water's edge), a middle core, and outer core.

Figure 2.6.1 The Three Cores of the Natural Riparian Buffer

Characteristics	Inner Core	Middle Core	Outer Core
Function	Protect the physical and ecological integrity of the shoreland	Provide distance between upland development and inner core	Prevent encroachment and filter backyard runoff.
Width	Minimum 25 feet from the reference line	Minimum 25 feet: first order streams; 50 feet: all other water bodies depending on stream order, slope, and floodplain	Minimum 25 feet
Vegetative Target	Undisturbed mature forest. Reforest if grass.	Managed forest, some clearing allowable.	Forest encouraged, but usually turfgrass.
Allowable Uses	**Very restricted** e.g., flood control, utility right of ways, footpaths, etc.	**Restricted** e.g., some recreational uses, some stormwater BMPs, bike paths, etc.	**Untrestricted** e.g., residential uses including lawn, garden compost, yard waste, most stormwater BMPs.
Target Pollutant Removal Rates	50% - 60% range	60% - 70% range	70% - 80% range



The inner core most closely matches the waterfront buffer in the CSPA. The middle and outer cores closely match the woodland buffer standards of the CSPA.

Inner Core: extends a minimum of 25 feet from the water's edge for 1st and 2nd order streams (about the distance of one to two mature trees) and 50 feet for lakes, ponds and 3rd and 4th order streams. The Inner Core serves to protect the physical and ecological integrity of the adjacent water ecosystem. A mature riparian forest is the desired vegetation because it provides multiple canopy layers, interwoven root systems, shade, leaf litter, woody debris, and erosion protection. Only limited tree cutting and very restricted uses such as access paths and utility rights of way should be allowed. No land clearing or impervious surfaces (except an access path) should be considered within this zone.

Middle Core: extends beyond the inner core to the beginning of the outer core, a minimum of 25 feet for 1st and 2nd order streams and a minimum of 50 feet for all other water bodies. The exact size of this zone will depend on stream order and slope. This zone is mainly composed of managed forest with some clearing allowed. This zone protects adjacent water quality and offers wildlife habitat. Fifty percent of this area can be allowed for structures, recreational use, stormwater best management practices (BMPs), and tree removal. The other fifty percent of this zone should remain in an undisturbed state.

Outer Core: extends a minimum 25 feet out from the middle core for 1st and 2nd order streams and 50 feet for lakes, ponds and all 3rd and 4th order streams. This zone is mainly composed of forest or turf and typically contains the yard, garden, or woods between a residential dwelling and the rest of the buffer. This zone traps sediment and consists of play areas, gardens, compost piles, and other common residential activities.

While many factors including slope, soil type, adjacent land use (including amount of impervious cover), floodplain, vegetation type, and watershed condition all influence buffer width, in most cases, the most commonly prescribed minimum buffer widths for use in water quality and habitat protection are 35 to 250 feet (Tjaden and Weber). Buffers of less than 35 feet have not been found to sustain long-term protection of aquatic communities.

A minimum 100-foot buffer width is recommended in *Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Communities*, as a standard width for all surface waters and wetlands in New Hampshire (Chase, et al. 1997)

Even for narrow creeks or intermittent streams that run through residential neighborhoods or commercial developments, riparian buffers are important for sediment control and aquatic integrity. Protection of these smaller creeks and streams is particularly important because:

- they are numerous across the landscape;
- they feed larger streams and rivers – one of the best ways to protect larger rivers is to protect the small streams that flow into them; and
- they can be readily impacted by sedimentation, erosion and non-point source pollution.

LEGAL BASIS AND CONSIDERATIONS FOR NEW HAMPSHIRE

This chapter is being prepared at a time when sweeping changes have been recommended to the State of New Hampshire's Comprehensive Shoreland Protection Act (CSPA). These changes, adopted by the legislature during 2007, will help to improve the implementation of the CSPA at both the state and local level.

Under the current CSPA, municipalities may adopt land use ordinances (zoning, subdivision, site plan, etc.) to regulate protected shorelands within their boundaries. These ordinances can be more stringent than the minimum standards of the CSPA (see RSA 483-B:8, Municipal Authority). In fact, the CSPA encourages municipalities to adopt land use control ordinances designed to protect the shorelands of water bodies and water courses not subject to the CSPA. These other water bodies can include first and second order (headwater streams and tributaries), third order streams and rivers, lakes, and ponds, and other impoundments. In addition, municipalities may elect to enforce the provisions of the CSPA by issuing cease and desist orders, and by seeking injunctive relief or civil penalties as provided in RSA 483-B:18, III(a) and (b). One of the advantages of local enforcement is that any civil penalties and fines collected by the court, can be remitted to the treasurer of the municipality prosecuting violations, for use of the municipality. In order to enforce the provisions of the CSPA, however, municipalities must have a knowledgeable code enforcement officer on hand who understands and can apply the provisions of the act on a case by case basis.

The CSPA minimum standards are designed to overlay other state and municipal permitting programs. This means that state permitting programs such as Subsurface, Wetlands, and Alteration of Terrain as well as local building permits must ensure that any permits issued are in compliance with the CSPA.

Currently, the protected shoreland under the CSPA includes all land located within 250 feet of the reference line (see glossary for definition of reference line) of public waters and fourth order and higher streams.

Exemptions for forestry and agricultural activities are built into the CSPA and can be considered when establishing a local ordinance. The CSPA also provides an urban exemption for situations in which specialized urban conditions exist. This exemption requires the governing body to make a formal request to the Commissioner of DES to grant an exemption form the CSPA.

On July 1, 2005, the New Hampshire legislature established a "Commission to study the effectiveness of the CSPA." On November 30, 2006, the Commission's final report was released and in the spring of 2007, most of the Commission's recommendations were incorporated into house bills. The following summarizes the major proposed legislative changes that are important considerations in developing a local shoreland protection ordinance:

- The setback for primary structures to protected shoreland shall be at least 50 feet in all towns whether or not the municipality has an established lesser setback.

- The current methodology for measuring and maintaining the Natural Woodland Buffer (50 percent basal area removal/well distributed stand) would be replaced by establishing a waterfront buffer that extends 50 feet back from the reference line. Within the waterfront buffer there would be no root, rock, duff, or understory removals and no fertilizer or pesticide use. Tree cutting would be limited and would be managed in accordance with a grid and points system. Fifty percent of the area outside of permitted impervious surfaces would be left undisturbed.
- Impervious surfaces would be limited to 20 percent of the area within the protected shoreland. With mitigation, the impervious surface allowance could be up to 30 percent.
- The full protection of the CSPA would be extended to all third order and higher streams (including the Saco and Pemigewasset Rivers) as identified by the N.H. Hydrologic Database.

EXAMPLES AND OUTCOMES

There are many municipalities in New Hampshire that have developed regulations to protect shorelands and riparian buffers. The Office of Energy and Planning currently maintains a list of 48 communities within New Hampshire that have adopted local regulations for shoreland and riparian protection.

The model ordinance contained in this chapter provides municipalities with a new and effective tool for shoreland and riparian protection. Key provisions within the ordinance include:

- a 25 foot setback for primary structures from the reference line for first and second order streams;
- a 50 foot setback for primary structures from all third, fourth and higher order streams, lakes, ponds, and coastal estuaries;
- a 20 percent impervious surface limitation requirement for any portion of any lot located within the Shoreland Protection District. (see sidebar)
- The inclusion of Conditional Use Permit requirements for water-dependent structures, including but not limited to docks, piers, breakwaters, boathouses and marinas, etc. Many of these uses currently require planning board approval subject to both local site plan review and DES permits as applicable.
- Requirements for the submittal of a stormwater management plan for all earth moving or excavation activities on lots greater than one acre in size.
- Requirement for planning board approval of a selected clearing and landscape plan

Municipalities may wish to consider a 10 percent impervious surface limitation as studies show that there is a level (between 7 and 14 percent impervious surface) at which water quality and wildlife habitat become affected by urban characteristics, such as impervious surface. These results are similar to other studies, where measures of impervious surface of about 10 percent have been identified as the level at which stream quality decreases (Klein, 1979; Schueler, 1994; Booth and Reinelt, 1993).

Model Language and Guidance for Implementation

MODEL ORDINANCE FOR SHORELAND AND RIPARIAN PROTECTION

Shoreland Zoning Ordinance for the Municipality of _____

I. TITLE AND AUTHORITY

A. **Title:** This Ordinance shall be known as the "Shoreland Protection District of the City/Town of _____, New Hampshire."

B. **Authority:** Pursuant to the authority granted by RSA 483-B:8, Municipal Authority; RSA 674:17 I., Purposes of Zoning Ordinances; and RSA 674:21 I., Innovative Land Use Controls this ordinance is hereby adopted by the Town/City of _____, New Hampshire to protect the public health, safety, and general welfare.

II. PURPOSE

The purpose of this Ordinance is to establish regulations for the design of riparian buffers to protect the flowing streams and surface water bodies of the Town/City of _____ to protect the water quality of these resources; to protect the Town/City of _____'s riparian and aquatic ecosystems; and to provide for the environmentally sound use of the Town/City of _____'s land resources.

III. FINDINGS

The City/Town of _____, New Hampshire finds that shoreland protection and riparian buffers adjacent to flowing waters and surface water bodies provide numerous environmental benefits. Shoreland forested buffers serve to:

A. Restore and maintain the chemical, physical and biological integrity of the water resources;

B. Provide infiltration of stormwater runoff;

C. Remove pollutants delivered in stormwater runoff;

D. Reduce erosion and control sedimentation;

E. Stabilize lake and stream banks;

F. Maintain base flow of streams;

G. Contribute food and habitat for the aquatic ecosystem;

H. Moderate the temperature of near shore waters

I. Provide and enhance terrestrial wildlife habitat; and,

J. Enhance scenic value and recreational opportunities

Therefore, the City/Town of _____, New Hampshire adopts this ordinance to protect and maintain the native vegetation along the shorelands of the community's water courses and surface waters by implementing standards for protection, use and development of these areas within the jurisdiction of the municipality.

IV. APPLICABILITY

A. **Shoreland Protection District.** The Shoreland Protection District of the City/Town of _____, New Hampshire is an overlay district superimposed over the existing conventional zoning districts of the municipality. It includes within its boundary a protected shoreland on either side of all 1st, 2nd, 3rd and 4th order and higher rivers and streams, and a protected shoreland adjacent to all natural and impounded lakes and ponds and coastal estuaries (if applicable) located within the municipality. The Shoreland Protection District does not apply to wetlands, ephemeral streams, beaver impoundments, fire ponds, and farm ponds as defined in this ordinance. The Shoreland Protection District subject to this Ordinance shall be shown on the municipality's Official Shoreland Zoning Map, which is incorporated as part of this Ordinance.

B. **Official Shoreland Zoning Map.**

1. **Scale of Map.** The Official Shoreland Zoning Map shall be drawn at a scale of not less than 1 inch = 2,000 feet. District boundaries shall be clearly delineated and a legend indicating the symbols for each district shall be placed on the map.

A municipality may have a series of maps instead of one map depicting its shoreland protection district. The state's regional planning commissions are available to assist your municipality in preparing this map. A reliable source of stream location and stream order classification i.e. the identification of first, second, third and fourth and higher streams within your municipality is available from the New Hampshire Hydrography Dataset (NHHD) developed by Complex Systems Research Center, University of New Hampshire. The Final Report of the Commission reviewing the effectiveness of the CSPA recommends that the state adopt the NHHD for the purpose of identifying stream order.

Planning boards are encouraged to include in their site plan and subdivision regulations, requirements for the submittal of surveyed plans depicting the true location of the streams, rivers and other water bodies subject to this ordinance within the subject property. This plan information can then be used to supplement the NHHD data.

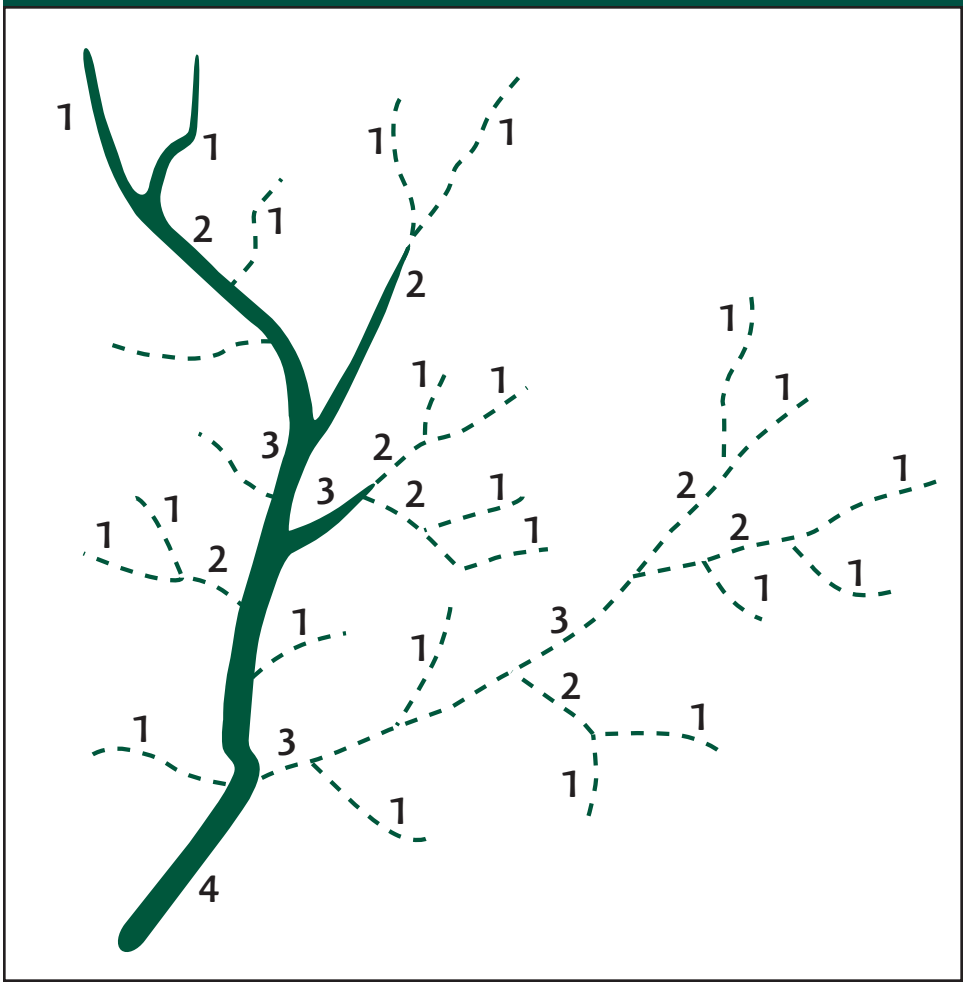
Other reliable mapping resources:

Stream Buffer Characterization Data and Maps; town specific maps that assess 150 and 300 buffer areas.
Online: www.nhep.unh.edu/resources/actions.htm

Buffer Data Mapper; demonstrates the land area impact of various buffer widths.
Online: http://mapper.granit.unh.edu/viewer.htm

2. **Certification of Official Shoreland Zoning Map.** The Official Shoreland Zoning Map shall be certified by signature of the municipal clerk and shall be located in the municipal planning office. In the event the municipality does not have a planning office, the municipal clerk shall be the custodian of the map.

Figure 2.6.2 Fourth Order Rivers: The Strahler Method



3. **Changes to the Official Shoreland Zoning Map.** If amendments are made to the Shoreland Protection District or other matters portrayed on the Official Shoreland Zoning Map, such changes shall be made on the map within 30 days after the amendment has been adopted by the municipality.

V. DISTRICT BOUNDARIES

A. **Definition of District Boundaries.** The district boundaries of the Shoreland Protection District shall encompass all land within a horizontal distance of 150 feet of the reference line of any 1st and 2nd order stream, and 250 feet of the reference line of any 3rd and 4th order stream and higher, lake, pond or coastal estuary as defined by this Ordinance.

B. **Interpretation of District Boundaries.** Where uncertainty exists as to the exact location of district boundary lines, the city/town code enforcement officer with the assistance of the N.H. Department of Environmental Services (DES) shall be the final authority as to boundary locations.

Municipalities are encouraged to incorporate specific written descriptions of district boundaries into this Ordinance so that disputes over boundaries are minimized. The Official Shoreland Zoning Map is only one of the primary tools in determining district boundaries. Other tools include actual field verification of the reference line. This is where the assistance of DES will be the most useful.

VI. DEFINITIONS

Accessory Structure or Use: A use or structure located on the same lot and customarily incidental and subordinate to the primary structure, including but not limited to paths, driveways, patios, any other improved surface, pump houses, gazebos, woodsheds, garages, or other outbuildings. A deck or similar extension of the primary structure or a garage attached to the primary structure by a roof or a common wall is considered part of the primary structure.

Base flow: The groundwater contribution to stream flow arising from submerged springs and seeps.

Beaver Impoundment: An area this is generally inundated most of the year as a result of flowing water impounded by a beaver dam. Beaver impoundments and the meadows that develop when the dams are not kept up and deteriorate are generally considered wetlands.

Best Management Practices (BMPs): A proven or accepted structural, non-structural, or vegetative measure the application of which reduces erosion or sedimentation, stabilizes stream channels, or reduces peak storm discharge, or improves the quality of stormwater runoff, or diminishes the quantity of stormwater runoff flowing to a single location by using multiple BMPs at separate and dispersed locations. BMPs also include construction site maintenance measures such as removing construction debris and construction waste from construction sites and disposing of debris and waste appropriately in order to reduce contamination of stormwater runoff.

Boat Slip: On water bodies over 10,000 acres, means a volume of water 25 feet long, 8 feet wide, and 3 feet deep as measured at normal high water and located adjacent to a structure to which a watercraft may be secured. On water bodies of 10,000 acres or less, a volume of water 20 feet long, 6 feet wide, and 3 feet deep as measured at normal high water mark and located adjacent to a structure to which a watercraft may be secured (RSA 482-A:2 VIII.).

Buffer: A vegetated area, including trees, shrubs and herbaceous vegetation, which exists or is established to protect a stream, river, lake, pond, reservoir, or coastal estuarine area.

Canopy: The more or less continuous vegetative cover formed by tree crowns in a wooded area.

Disturbed Area: An area in which natural vegetation is removed, exposing the underlying soil.

Ephemeral Stream: A drainage feature that carries only stormwater in direct response to precipitation with water flowing only during and shortly after large precipitation events. An ephemeral stream may or may not have a well defined channel, the aquatic bed is always above the water table, and stormwater runoff is the primary source of water. An ephemeral stream typically lacks the biological, hydrological, and physical characteristics commonly associated with the continuous or intermittent conveyance of water.

Estuaries: A tidal wetland whose vegetation, hydrology or soils are influenced by periodic inundation of tidal waters.

Farm Pond: A small, shallow (3-14 foot) artificial impoundment maintained for private recreational use, such as fishing or swimming, or to provide water for livestock, irrigation, or other agricultural uses. Such ponds may be addressed as part of an approved USDA Natural Resources Conservation Service conservation plan and as such do not need to be protected by this Ordinance.

Fire Pond: A small, naturally-occurring or artificially constructed water body designated and maintained for the purpose of providing water for fire suppression, characterized by large-vehicle access to the water's edge throughout the year and/or the presence of a dry hydrant. Typically such ponds have been identified or designated by the municipality's fire department as a fire pond.

First Order Streams: Are intermittent and perennial streams identified as either dashed lines or solid lines on the New Hampshire Hydrography Dataset (NHHD) or the most recent edition of USGS topographic maps, where mapped.

Defining "First Order Streams" is perhaps the most difficult issue in developing this ordinance. This model ordinance defines first order streams as both intermittent and perennial streams because these streams are the most important headwater streams within a watershed. However, municipalities may elect to limit the application of this ordinance to "perennial" streams only. To accomplish this, intermittent streams would need to be excluded from the definition of first order streams. This would require revisions to the NHHD database, because intermittent streams are currently identified as first order streams in this database.

Forest Management: The application of scientific and economic principles to conserve forest resources and obtain forest benefits.

Great Pond: All natural bodies of fresh water situated entirely in the state having an area of 10 acres or more are state-owned public waters, and are held in trust by the state for public use; and no corporation or individual shall have or exercise in any such body of water any rights or privileges not common to all citizens of this state; provided, however, the state retains its existing jurisdiction over those bodies of water located on the borders of the state over which it has exercised such jurisdiction (RSA 271:20).

Ground Cover: Any herbaceous or woody plant which normally grows to a mature height of two feet or less, especially mat forming vegetation which stabilizes the soil.

Headwater Streams: Intermittent streams and perennial streams of first and second order.

Impervious Surface: Any areas covered by material that impedes the infiltration of water into the soil. Examples of impervious surfaces include buildings, roofs, decks, patios, and paved, gravel, or crushed stone driveways, parking areas, and walkways.

Intermittent Streams: A well-defined channel that contains water for only part of the year, typically during winter and spring when the aquatic bed is below the water table. The flow may be heavily supplemented by stormwater runoff. An intermittent stream often lacks the biological and hydrological characteristics commonly associated with the conveyance of water. Intermittent streams (or portions thereof) are portrayed as dashed blue lines on a USGS topographic map, where mapped).

Lake: A natural or impounded inland body of fresh water. May also be called a pond or great pond. The terms lakes and ponds are commonly used interchangeably,

however, a lake can be distinguished from a pond because a lake contains a thermocline layer while a pond does not.

Lot of Record: A legally created parcel, the plat (keep "or" here in case there is only a recorded metes and bounds description) description of which has been recorded at the registry of deeds for the county in which it is located.

Marina: A commercial waterfront facility whose principal use is the provision of public services such as the securing, launching, storing, fueling, servicing, repairing and sales of watercraft equipment and accessories.

Natural Vegetation: All existing live woody and herbaceous trees, shrubs, and other plants.

Natural Woodland Buffer: Is defined in the CSPA, RSA 483-B as a forested area consisting of various species of trees, saplings, shrubs, and ground covers in any combination and at any stage of growth.

Non-Conforming Lot: A single lot of record which, at the effective date of adoption or amendment of this Ordinance, does not meet the dimensional requirements of the district in which it is located.

Non-Conforming Structure: A structure which does not meet any one or more of the following dimensional requirements; setback, height, or lot coverage, but which is allowed solely because it was in lawful existence at the time this Ordinance or subsequent amendments take effect.

Non-Conforming Use: Use of buildings, structures, premises, land or parts therefore which is not permitted in the district in which it is situated, but which is allowed to remain solely because it was in lawful existence at the time this Ordinance or subsequent amendments take effect.

Mean High Water Level: See Reference Line definition.

Ordinary High Water Mark: Means the line on the shore, running parallel to the main stem of the river or stream, established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the immediate bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial Streams: A stream that normally flows year round because it is sustained by groundwater discharge as well as by surface water. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water. Perennial streams (or portions thereof) are portrayed as solid blue lines on a USGS topographic map, where mapped.

Pond: Means a natural or impounded still body of water. The term is often used conterminously with "lake."

Primary Structure: A structure built for the support, shelter or enclosure of persons, animals, goods, or property of any kind, as well, as anything constructed or erected with a fixed location on or in the ground, exclusive of fences. The primary

structure is central to the fundamental use of the property and is not accessory to the use of another structure on the same premises.

Protected Shorelands: The area subject to this Ordinance.

Public Waters: See CSPA, RSA 483-B:4, Definitions.

Reference Line: Defined in the CSPA, RSA 483-B and under this Ordinance as follows:

a. for natural fresh water bodies without artificial impoundments, the natural mean high water level as determined by the NH Department of Environmental Services;

b. for artificially impounded fresh water bodies with established flowage rights, the limit of the flowage rights, and for water bodies without established flowage rights, the waterline at full pond as determined by the elevation of the spillway crest;

c. for coastal waters, the highest observable tide line, which means a line defining the furthest landward limit of tidal flow, not including storm events, recognized by indicators such as the presence of a strand line of flotsam and debris, the landward margin of salt tolerant vegetation, or a physical barrier that blocks further flow of the tide;

d. for third and fourth order and higher rivers and streams, the ordinary high water mark; and

e. for first and second order streams, the extent of the defined channel.

Removal or Removed: Cut, sawed, pruned, girdled, felled, pushed over, buried, burned or otherwise destructively altered.

Riparian Area: The area of land adjacent to the shoreline or bank of a stream, river, pond, lake, bay, estuary, or other similar body of water.

Riparian Buffer: See Buffer definition.

Sapling: A young tree less than four inches (9.75 cm) in diameter (dbh) and less than 20 feet in height

Selected Clearing and Landscape Plan: A site plan drawn to scale depicting the lot boundaries, shoreland protection district boundaries, shoreline, reference line, all impervious surfaces, structures, septic and well systems, setback requirements, proposed view corridor, and existing and proposed trees and vegetation.

Setback: Horizontal distance from the reference line of a water body to the nearest part of a structure, road, parking space or other regulated object or area.

Shoreland: The area of land adjacent to the reference line of a stream, river, pond, lake, bay, estuary, or other similar body of water.

Shoreland Frontage: The average of the distances of the actual natural shoreline frontage and a straight line drawn between the property lines (RSA 483-B:4, Definitions).

Shoreline: The intersection of a specified plane of water with the beach or bank. It migrates with changes of the water level.

Shrub: A woody perennial, smaller than a tree, usually branching from the base with several main stems.

Stream Order: A classification system for streams based on stream hierarchy. The smaller the stream, the lower its numerical classification. For example, a first order stream does not have tributaries and normally originates from springs or seeps. At the confluence of two first order streams, a second order stream begins and at the confluence of two second order streams, a third order stream begins, et.seq.

Stream ordering is a widely applied method for classifying streams. Its use in classification is based on the premise that the order number has some relationship to the size of the contributing area, to channel dimensions and to stream discharge (Strahler 1964). The most common method used in stream ordering is based on the Strahler Method. This method is applied by DES and GRANIT in classifying streams within the New Hampshire Hydrologic dataset. For more information about the Strahler Method, refer to Strahler, A.N., 1964. Part II. Quantitative geomorphology of drainage basins and channel networks, pp. 4-39 to 4-76. Chow, ed. Handbook of Applied Hydrology, McGraw-Hill, New York.

Stream or River: A free-flowing body of water or segment or tributary of such water body (RSA 483:4, XVII.).

Structure: Anything built for the support, shelter or enclosure of persons, animals, goods or property of any kind, together with anything constructed or erected with a fixed location on or in the ground, exclusive of fences, and poles, wiring and other aerial equipment normally associated with service drops as well as guying and guy anchors. The term includes structures temporarily or permanently located, such as decks, patios, and satellite dishes.

Stormwater or Surface Water Runoff: Water that flows over the surface of the land as a result of rainfall or snow-melt. Surface water enters streams and rivers to become channelized stream flow.

Stormwater Management Plan: An analysis and plan designed in accordance with rules adopted by the DES under RSA 541-A for terrain alteration under RSA 485-A:17, to manage stormwater and control erosion and sediment, during and after construction.

Surface Waters: Those portions of waters of the state as defined by RSA 482-A:4, which have standing water or flowing water at or on the surface of the ground. This includes but is not limited to rivers, streams, lakes, ponds and tidal waters (Env-Wt 101.88).

Timber Harvesting: The cutting and removal of timber for the primary purpose of selling or processing forest products.

Tree: A woody perennial having a main stem.

USGS (United States Geological Survey) topographic map: A map that uses contour lines to represent the three-dimensional features of a landscape on a two-dimensional surface. Map scale: 1:24,000.

Water Body: Any pond, lake, river or stream.

Water Dependent Use or Structure: A use or structure that services and supports activities that require direct access to, or contact with the water, or both, as an operational necessity and that requires a permit under RSA 482-A, including but not limited to a dock, pier, breakwater, beach, boathouse, retaining wall, or launching

ramp. Hydroelectric facilities, including, but not limited to, dams, dikes, penstocks, and powerhouses, shall be recognized as water dependent structures, however, these uses are exempt from the requirements of this Ordinance.

Wetlands: areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (RSA 482-A:2).

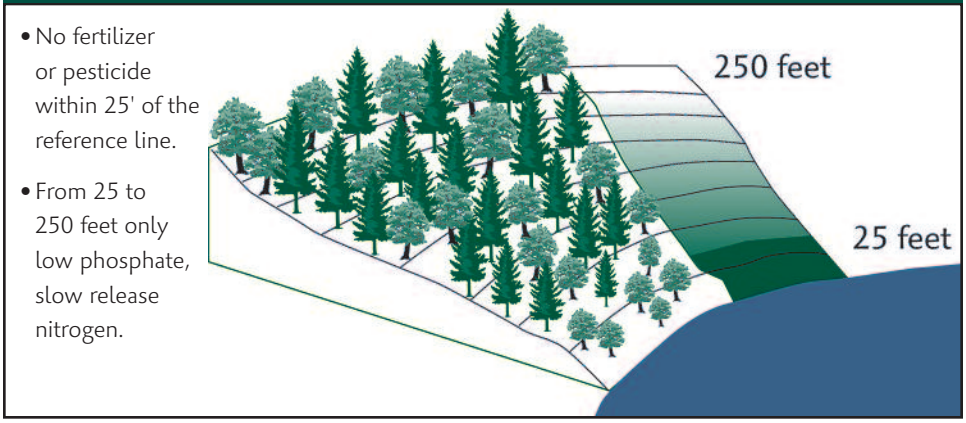
VII. SHORELAND PROTECTION DISTRICT REGULATIONS

A. **Prohibited Water Pollution Hazards, Uses, Structures and Activities**
The following uses, structures and activities are prohibited within the Shoreland Protection District:

1. Establishment or expansion of salt storage yards, automobile junk yards and solid or hazardous waste facilities.
2. Establishment or expansion, dry cleaning establishments and automobile service/repair shops.
3. Laundry/car wash establishments not on municipal or public sewer.
4. Subsurface disposal of pollutants from sewage treatment facilities, other than on-site septic systems.
5. Storage of hazardous substances, including the use of road salt, de-icing chemicals, herbicides, pesticides, or fertilizer, (except limestone) within 50 feet of the reference line of any property. Fifty feet beyond the reference line, low phosphate, slow release nitrogen fertilizer or limestone may be used on areas that are already vegetated.
6. Bulk or temporary storage of chemicals above or below ground.

The following shoreland protection regulations are modeled after specific provisions of the CSPA (RSA 483-B) as applicable, the recommendations contained within the Final Report of the Commission to Review the Effectiveness of the CSPA, as well as the NH DES Model Rule for the Protection of Water Supply Watersheds. Some noted key provisions include a 25 foot setback for primary structures from the reference line of first and second order streams, a 50 foot setback for all other water bodies, a maximum impervious surface requirement of 20% of the lot area located within the shoreland protection district, and Conditional Use Permit requirements for water-dependent uses and structures. The riparian buffer requirements included within this ordinance are modeled after the three-stage riparian buffer design and buffer model ordinance favored by the journal Watershed Protection Techniques and developed by the Center for Watershed Protection, Elliot City, Maryland.

FIGURE 2.6.3 Fertilizer and Pesticide Restrictions



Source: N.H. Department of Environmental Services

7. Bulk or temporary storage of petroleum products or hazardous materials above or below ground, excluding normal residential or business use of liquid petroleum products and heating fuels for on-premise use.
8. Sand and gravel excavations as defined in RSA 155-E.
9. Mining or the processing of excavated materials.
10. Any use or activity not expressly permitted.

B. **Permitted Uses, Structures and Activities**

All necessary state and local approvals and permits shall be obtained prior to the commencement of any activity within the Shoreland Protection District. The following uses, structures and activities are permitted within the Shoreland Protection District, subject to state and local approval:

Under the CSPA, development within the protected shoreland requires a permit from the Department of Environmental Services.

1. All permitted uses allowed within the municipality's underlying zoning district(s), except those uses expressly prohibited as listed above.
2. All primary structures shall be setback a minimum distance of 25 feet from the reference line of all first and second order streams , 50 feet of all third order and higher streams, lakes, ponds, and coastal estuaries as required by the CSPA.
3. All accessory structures shall be setback a minimum distance of 25 feet from the reference line of all streams, lakes, ponds and coastal estuaries.
4. Water-dependent structures, or any part thereof, built over, on or within adjacent public waters subject to the jurisdiction of RSA 483-B 9.2 c.shall be constructed only as approved by the DES, pursuant to RSA 482-A. All water-dependent uses or structures or parts thereof, built over, on or within the adjacent waters subject to this Ordinance shall be required to obtain a Conditional Use Permit from the planning board of the municipality in accordance with the requirements of subsection c) Conditional Uses below.
5. Other permitted uses within the Shoreland Protection District, subject to necessary local and state approval, include the following:
    a. Public water supply facilities, including water supply intakes, pipes, water treatment facilities, pump stations and disinfectant stations;
    b. Public water and sewage treatment facilities;
    c. Hydroelectric facilities, including, but not limited to dams, dikes, penstocks and powerhouses;
    d. Public utility lines and associated structures and facilities;
    e. Existing solid waste facilities, including the construction of accessory structures and other activities consistent with the operation of the facility and its solid waste permit, including filling, grading and installing monitoring wells and other drainage structures;
    f. Flood control structures; and,
    g. Public roads and public access facilities, including boat ramps.

C. **Conditional Uses**

The following Conditional Uses are permitted within the Shoreland Protection District, subject to all applicable local, state and federal regulations:

1. Marinas developed in accordance with the following requirements:
    a. Minimum shoreland frontage shall be 300 feet with an additional 25 feet of shoreland frontage per boat slip.
    b. Off street parking shall be provided at a rate of 500 square feet per boat slip.
    c. Submission of an environmental impact study including measures to mitigate potential negative impact on the adjacent waters, including but not limited to:
        i. Measures to prevent leakage or spills of fuels, lubricants, wastewater and other potential pollutants into the public waters;
        ii. Assurances that impact on wetlands and other related sensitive areas have been avoided.
    d. Submission of a site plan, that is consistent with local regulations, for review by the planning board which includes locations of rest rooms, buildings, parking areas and all related support facilities with assurances that these facilities shall be permanently available to the project.
    e. Receipt of a wetland permit from DES.
2. Water dependent uses and structures including, but not limited to, docks, wharves, boat ramps, etc. All water dependent uses and structures shall be approved as a Conditional Use Permit in accordance with the following requirements:
    a. The use is in keeping with the purpose and intent of this Ordinance.
    b. The least impacting route and methodology for the use have been selected as the best practicable alternative.
    c. Canopies and seasonal covers extend only over the boat slips and shall be removed during the non boating season.

D. **Minimum Lot Requirements**

1. The minimum size for new lots in areas dependent upon on-site subsurface wastewater systems shall be determined by either the municipality's underlying zoning district requirements or the soil type lot size determinations, as established by the DES under RSA 485-A and rules adopted to implement it.
2. The total number of residential units in the protected shoreland district, whether built on individual lots or grouped as cluster or condominium development, shall not exceed:

a. one unit per 150 feet of shoreland frontage; or

b. for any lot that does not have direct frontage, one unit per 150 feet of lot width as measured parallel to the shoreland frontage that lies between the lot and the reference line.

3. The total constructed, impervious surface area within any lot shall not exceed 20 percent of the area of the lot located within the shoreland protection district. In instances when the existing tree cover has been depleted, 25 percent impervious coverage may be granted in exchange for additional native tree and shrub planting within 50 feet of the reference line. This should be enforced through a deed restriction whereby the property owner agrees not to cut after the trees are planted.

E. **Subsurface Wastewater Disposal Facilities**
All new lots, including those in excess of five acres, any portion of which is located within the Shoreland Protection District, shall require subdivision approval by the DES Water Division, Subsurface Systems Bureau pursuant to RSA 485-A:29. All subsurface wastewater disposal facilities shall be in compliance with RSA 485-A:29 and 483-B.

F. **Erosion and Siltation**

1. New structures and all modifications to existing structures within the Shoreland Protection District shall be designed, constructed and maintained to prevent the release of surface runoff across exposed mineral soils.

2. All earth moving or excavation activities on lots greater than 1 acre in size either partially or wholly within the Shoreland Protection District, including the construction of new structures and modifications to existing structures shall be conducted in accordance with a stormwater management plan approved by the municipality's planning board. Such plan shall be designed in accordance with rules adopted by the DES under RSA 541-A for terrain alteration under RSA 485-A:17, to manage stormwater and control erosion and sediment, during and after construction. All erosion control measures shall be implemented before any earth disturbance occurs.

3. In new developments, on-site and non-structural stormwater management alternatives shall be preferred over larger facilities within the riparian buffer.

4. When constructing stormwater management facilities (i.e. BMPs), the area cleared shall be limited to the area required for construction, and adequate maintenance access only.

5. A permit under RSA 485-A:17, I. shall be required for developed, or subdivided land whenever there is a contiguous disturbed area exceeding 50,000 square feet that is either partially or wholly within the Shoreland Protection District.

G. **Riparian Buffer Requirements**

Riparian Buffer: Within the Shoreland Protection District, a riparian buffer of natural vegetation and trees shall be maintained or established within 75 feet of the reference line of all first and second order streams, and 150 feet of

The riparian buffer standards included in this ordinance are based upon the Center for Watershed Protection's Buffer Model Ordinance and as such these standards present the best technical guidance available to create and protect the most effective riparian buffers possible.

Also included are appropriate buffer standards from New Hampshire's CSPA and the Commission's recommendations where applicable. Municipalities should use these standards as a guide to adopt the most appropriate buffer requirements for their community considering such factors as existing site conditions, ease of enforcement, public acceptance, and the sensitivity and vulnerability of the water body to be regulated.

Municipalities are also encouraged to include a reference to these standards in their site plan and subdivision regulations and to add a checklist item or requirement that the location of all streams and water bodies be surveyed and accurately shown on site plans and subdivisions.

the reference line of all third and fourth and higher order streams, lakes, ponds and coastal estuaries. This riparian buffer is similar in terminology to the Natural Woodland Buffer under the CSPA.

To address areas containing steep slopes, the following formula recommended by the Center for Watershed Protection should be used to expand the riparian buffer widths as noted:

Percent Slope*	Width of Buffer
15%-17%	add 10 feet
18%-20%	add 30 feet
21%-23%	add 50 feet
> 24%	add 60 feet

*Percent slope shall be based on an average of the overall slope dividing the average vertical distance of the slope into the overall horizontal distance of the slope.

Source: Southern New Hampshire Planning Commission. Adapted from Center for Watershed Protection

Within the riparian buffer, the following management zones shall be maintained.

1. **Waterfront Zone:** The waterfront zone is located closest to the water's edge and serves to protect the physical and ecological integrity of the shoreland. This zone must be maintained in a natural state although a view corridor and a maximum 6 ft wide path to the water's edge may be established in accordance with an approved Selected Clearing and Landscape Plan. This zone extends a minimum distance of 25 feet from the reference line for 1st and 2nd order streams and a minimum distance of 50 feet from the reference line for all other water bodies. Allowable uses within the waterfront zone are restricted to flood control structures, utility rights of way, footpaths, road crossings such as bridges and culverts as required and water-dependent structures and uses where permitted under Section VII. b. and c. of this ordinance. Target sediment and pollutant removal rates are to be within 50 percent and 60 percent.

A minimum fixed buffer width of 10 meters or 33 feet is documented in the scientific literature as providing approximately 60 percent or greater sediment and pollutant removal while minimally protecting the adjacent water body (Source: Center for Watershed Protection).

Examples of Selective Clearing and Landscape Plans can be found in the following resources: *Vegetated Riparian Buffers and Buffer Ordinances,* Figure 2, pg. 12 and *Environmental Land Use Planning and Management,* John Randolph, Island Press, Figure 14.3, pg. 446, 2004.

Within the Waterfront Zone, the following additional prohibitions and limitations apply:

a. No mechanized logging, no clear cutting of trees, and no cutting or removal of vegetation and natural ground cover (including the duff layer) below 3 feet in height shall be permitted, except as provided by an approved Selected Clearing and Landscape Plan.

b. Restricted tree care involving the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted. All stumps and their root systems, stones, and duff shall be left intact in or on the ground.

c. A view corridor and path to the water's edge may be established in accordance with a Selected Clearing and Landscape Plan submitted to and approved by the planning board of the municipality. This plan shall include photographic documentation of the pre-existing riparian buffer. The view corridor shall not exceed 75 feet in width or one-third the width of the shoreline frontage, whichever is less. View corridors must also be in compliance with the CSPA, Natural Woodland Buffer requirements, RSA 483-B.

d. Preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

e. Planting and reforesting efforts to restore native vegetation within this zone is encouraged.

2. **Middle Zone:** The middle zone begins at the outer edge of the waterfront zone extending out a minimum fixed distance of 25 feet for 1st and 2nd order streams and a minimum distance of 50 feet for all other water bodies. The overall width of the middle zone can vary depending upon stream order and slope. Target sediment and pollutant removal rates are to be within 60 to 70 percent. Forest management and limited tree clearing and removal are allowed within the middle zone as well as limited recreational uses, stormwater BMPs, paths, and other similar uses as permitted under Section VII. b. and c. of this ordinance. However, a minimum of 50 percent of the tree canopy within this zone shall remain in an undisturbed state. Overall tree canopy shall be managed through a Selective Clearing and Landscape Plan.

A minimum fixed buffer width of 15 meters or 50 feet is documented in the scientific literature as providing greater than 60 percent sediment and pollutant removal while providing minimal general wildlife and avian habitat value. (Source: Center for Watershed Protection).

Within the middle zone, the following additional prohibitions and limitations apply:

a. Impervious surfaces on the portion of the lot within the shoreland protection district shall be limited to 20 percent subject to Section D. 3. of this ordinance.

b. No mechanized logging or clear cutting of trees and vegetation shall be permitted.

c. Limited tree removal and clearing, tree pruning, including the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted. All stumps and their root systems shall be left intact in the ground.

d. Fifty percent of this zone should remain in an undisturbed state.

e. A view corridor and path to the water's edge may be established in accordance with a **Selected Clearing and Landscape Plan** approved by the planning board of the municipality. No more than 50 percent of the tree canopy within this zone may be removed as shown on the **Selected Clearing and Landscape Plan.**

f. Preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

g. Planting and reforesting efforts to restore the native vegetation within this zone is encouraged.

3. **Outer Zone:** The function of the outer zone is to prevent encroachment into the inner and middle zones of the riparian buffer and to filter runoff from adjacent residential and commercial development. The outer zone begins at the outer edge of the middle zone extending out a minimum distance of **25 feet** for 1st and 2nd order streams and-a minimum distance of **50 feet** for all other water bodies. Target sediment and pollutant removal rates are to be within 70 to 90 percent.

A minimum fixed buffer width of 20 meters or 66 feet is documented in the scientific literature as providing 70% or greater sediment and pollutant removal while providing minimal general wildlife and avian habitat value. (Source: Center for Watershed Protection).

Within the outer zone, the following additional prohibitions and limitations apply:

a. Tree removal and clearing, tree pruning, including the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted in accordance with a Selected Clearing and Landscape Plan approved by the planning board of the municipality.

b. No more than 50 percent of the tree canopy within this zone may be removed as shown on the Selected Clearing and Landscape Plan.

c. Preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

d. Planting and reforesting efforts to restore the natural vegetation within this zone is encouraged.

e. Impervious surfaces on the portion of the lot within the shoreland protection district shall be limited to 20 percent subject to Section D. 3. of this ordinance.

VIII. NON-CONFORMING LOTS, USES AND STRUCTURES

A. **General Purpose:** It is the intent of this Ordinance to promote the conforming use of land located within the Shoreland Protection District, except that non-conforming lots, structures and uses that existed before the effective date of this Ordinance or amendments thereto shall be allowed to continue, subject to the requirements as set forth in this section. Except as otherwise provided in this Ordinance, a non-conforming lot, use or structure shall not be permitted to become more non-conforming.

B. **Non-conforming Lots:** Non-conforming, undeveloped lots of record that are located within the Shoreland Protection District shall comply with the following restrictions, in addition to any other requirements of the municipality's zoning ordinance:

1. Except when otherwise prohibited by law, present and successive owners of an individual undeveloped lot may construct building or structure on it, notwithstanding the provisions of this Ordinance.

2. Conditions may be imposed which, in the opinion of the municipality's zoning board of adjustment as appropriate, more nearly meet the intent of this Ordinance, while still accommodating the applicant's rights.

3. Building on non-conforming lots of record also include but not limited to docks, piers, boathouses, boat loading ramps, walkways, and other water dependent structures, consistent with this Ordinance.

C. **Non-conforming Uses:** Existing uses which are non-conforming under this ordinance may continue until the use ceases to exist or the use is discontinued for a period of one year. An existing non-conforming use may not be changed to another non-conforming use; existing non-conforming uses shall be required to meet the requirements of this ordinance to the maximum extent possible.

D. **Non-conforming Structures:** Except as otherwise prohibited, non-conforming structures, erected prior to the effective date of this Ordinance or amendments thereto, located within the Shoreland Protection District may be repaired, renovated, or replaced in kind using modern technologies, provided the result is a functionally equivalent use. Such repair or replacement may alter the interior design or existing foundation, but no expansion of the existing footprint or outside dimensions shall be permitted. An expansion that increases the sewage load to an on-site septic system, or changes or expands the use of a septic system or converts a structure to condominiums or any other project identified under RSA 485-A:29-44 and rules adopted to implement it shall require DES approval. Between the primary building line and the reference line as shown on the following figure, no alteration shall extend the structure closer to the adjacent water body, except that the addition of a deck is permitted up to a maximum of 12 feet towards the reference line.

IX. RIPARIAN BUFFER MANAGEMENT, MAINTENANCE AND INSPECTION

These buffer markers should be designed and sold by the conservation commission of the municipality to property owners. Examples of tree markers can be obtained from the Town of Bow, N.H. and are shown in the Wetlands Protection chapter. Installation and cost of the markers should be the responsibility of the property owner.

A. It shall be the responsibility of every property owner within the Shoreland Protection District to manage and maintain the vegetation and natural conditions existing within the riparian buffer located on their property. Management includes specific limitations on the alteration of the natural conditions of these resources as specified by this Ordinance. To help property owners assume this responsibility, it shall be the duty of every property owner to secure and install markers every 50 feet on trees depicting the location of the riparian buffer on their property.

B. It shall be the responsibility of the planning board of the municipality to ensure that all plats and rights of way, prepared for recording, and site plans adopted by the planning board clearly:

1. show the extent of the riparian buffer on the subject property by metes and bounds;

2. label the riparian buffer, building setbacks as well as the inner core, middle core and outer core zones of the riparian buffer;
3. provide a note to reference the riparian buffer stating: "There shall be no clearing, grading, construction or disturbance of vegetation except as permitted by the planning board of the municipality"; and
4. provide a note to reference any protective covenants governing the riparian buffer area stating: "Any riparian buffer shown hereon is subject to protective covenants which may be found in the land records and which restrict disturbance and use of these areas.

C. It shall be the responsibility of the planning board of the municipality through aerial photography to inspect the integrity of the riparian buffer both annually and immediately following severe storms for evidence of sediment deposition, erosion, or concentrated flow channels and corrective actions taken to ensure the integrity and functions of the riparian buffer.

Procedures for conducting these inspections should be developed by the planning board and the municipality. This should also include obtaining photographic documentation of the integrity of the riparian buffer as part of the review and approval of stormwater management or selective clearing and landscape plans.

X. EXCEPTIONS

The following land uses are exempt from the provisions of this Ordinance:

A. Forest management not associated with shoreland development or land conversion, and conducted in compliance with RSA 227-J:9.

B. Forestry involving water supply reservoir watershed management.

C. Agriculture activities and operations as defined in RSA 21:34-a. (except animal feedlots) provided such activities and operations are conducted in accordance with best management practices (BMPs).

D. Temporary stream, stream bank, and other vegetation restoration projects, the goal of which is to restore the shoreline and riparian buffer to an ecologically healthy state.

E. Wildlife and fisheries management activities consistent with the State Wildlife Action Plan and applicable state laws.

F. The creation of foot path(s) to the water in accordance with an approved selective clearing and landscape plan and the construction of perched sandy beaches in accordance with a wetland permit issued by DES.

G. Other uses permitted by the DES or under Section 404 of the Clean Water Act. Notwithstanding the above, all except uses, structures or activities shall comply with all applicable best management practices and shall not diminish water quality as defined by the Clean Water Act. All excepted uses shall be located as far from the reference line as reasonably possible.

SUMMARY OF MODEL ORDINANCE

SHORELAND PROTECTION DISTRICT AND RIPARIAN BUFFER STANDARDS

SHORELAND PROTECTION DISTRICT

- **150** ft. for 1st and 2nd order streams and **250** ft. for all other water bodies.
- Establishment/expansion of salt storage yards, auto junk yards, solid waste and hazardous waste facilities, animal feedlot operations, dry cleaning establishments, automobile service/repair shops, laundry/car wash establishments not on municipal water or sewer, disposal or land application of biosolids, including septage, sewage sludge and animal manure are prohibited.
- Subsurface disposal of pollutants from sewage treatment facilities, other than on-site septic systems, storage or hazardous substances, including the use of road salt and de-icing chemicals are prohibited.
- Bulk or temporary storage of chemicals above or below ground, bulk or temporary storage of petroleum products or hazardous materials above or below ground, excluding normal residential or business use of liquid petroleum products and heating fuels for on-premise use are prohibited.
- Sand and gravel excavations as defined in RSA 155-E, mining or the processing of excavated materials, and any other use or activity not expressly permitted.
- No fertilizer, except limestone between the reference line and 50 feet. From 50 ft. landward of the reference line to 250 ft. only low phosphate, slow release nitrogen fertilizer may be used.

Impervious Surface Area Limitations:

- Total constructed, impervious surface area is limited to 20% of a lot either partially or wholly located within the shoreland protection district. This may be increased to 25% in exchange for additional native tree and shrub planting within 50 ft. of the reference line through a deed restriction.

Stormwater Management:

- All earth moving or excavation activities on lots greater than 1 acre in size either partially or wholly within the shoreland protection district, including the construction of new structures and modifications to existing structures must be conducted in accordance with an approved stormwater management plan per NH DES specifications under RSA 541-A for terrain alteration and RSA 485-A:17 to manage stormwater and control erosion and sediment, during and after construction.
- A permit is also required under RSA 485-A:17, I. for developed, or subdivided land whenever there is a contiguous disturbed area exceeding 50,000 square feet that is partially or wholly within the shoreland protection district.

RIPARIAN BUFFER STANDARDS

- **Waterfront Zone:** 25 ft. from reference line for 1st and 2nd order streams and 50 ft. for all other water bodies. The Waterfront Buffer must be maintained in a natural state, although a view corridor and path to the water's edge may be established in accord with an approved Selected.
- **Clearing and Landscape Plan.** No mechanized logging, no clear cutting of trees, and no cutting or removal of vegetation and natural ground cover (including the duff layer) below 3 feet in height is allowed, except as provided by this plan. Restricted tree care involving the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted. All stumps and their root systems, stones and duff shall be left intact in or on the ground.
- **Middle Core:** 25 ft. from reference line for 1st and 2nd order streams and 50 ft. for all other water bodies. Forest management and limited tree clearing and removal are allowed. No more than 50% of the tree canopy within this zone can be removed. Overall tree coverage is managed through a Selected Clearing and Landscape Plan.
- **Outer Core:** 25 ft. from the reference line for 1st and 2nd order streams and 50 ft. for all other water bodies. No more than 50% of the tree canopy within this zone may be removed. Tree removal and clearing, tree pruning, including the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted.
- **Selected Clearing and Landscape Plan:** This plan is required in order to establish a view corridor and path to the water's edge as well as document the pre-existing riparian buffer conditions on the lot. The view corridor shall not exceed 75 feet in width or one-third the width of the shoreline frontage, whichever is less. View corridors must also be in compliance with the CSPA, Natural Woodland Buffer requirements per RSA 483-B.

PRIMARY BUILDING LINE

- Primary structures must be set back at least **25** ft. from the reference line for 1st and 2nd order streams and **50** ft. for all other water bodies.

ACCESSORY STRUCTURES

- Accessory structures must be setback at least **25** feet from the reference line.

REFERENCE LINE

- For coastal waters = highest observable tide line
- For rivers = ordinary high water mark
- For natural fresh water bodies = natural mean high water level
- For artificially impounded fresh water bodies – water line at full pond

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4.3 FOREST MANAGEMENT IN RIPARIAN AREAS

BACKGROUND

Riparian areas should be managed to protect water quality, streamflows, fish and wildlife habitat, and scenic values.

A riparian area is land adjacent to and directly influenced by streams, rivers, ponds, lakes, and associated nonforested wetlands. It forms a transition from aquatic to terrestrial ecosystems. Soils and growing conditions are often moister, more nutrient-rich, and more productive than those in surrounding uplands, resulting in considerable species diversity and productivity. Because of their proximity to surface waters, riparian areas are vital for maintaining water quality and aquatic resources.

Riparian areas have a long history of use and alteration by humans, including urbanization, road-building, agriculture, dam-building, and timber harvesting. The combined pressures of these activities, along with the documented ecological significance of these areas, underscore the importance of properly managing the riparian forest.

The Functions and Values of Riparian Areas

Riparian areas provide many ecosystem services and benefits such as:

- Flood control and streamflow regulation, especially where the riparian area includes a river's floodplain.
- Water-quality protection by filtering and retaining sediment, nutrients, and other pollutants from upslope areas, as well as through bank stabilization.
- Aquatic habitat protection including:
  - Regulating temperatures by shading streams, particularly important for lower-order streams that support coldwater fish (e.g., brook trout). Increases in water temperature can have negative effects on stream chemistry, aquatic insects, stream flora, and fish.
  - Large, woody material (e.g., fallen trees and large branches) that creates pools, riffles, debris-jams, and related aquatic habitat including spawning habitat for brook trout.
  - Leaves, twigs, fruit and insects contributing energy (food) to drive aquatic food webs. Headwater streams and small rivers derive most of their energy this way.
  - Fish habitat during high flow periods.
- Rare natural communities (e.g., ***calcareous riverside seeps, swamp white oak floodplain forest***) and many rare plants. More than one-third of all New Hampshire's vascular plants occur in riparian natural communities, including 93 rare species.
- Habitat for feeding, cover, and travel for many amphibians, birds, furbearers, and reptiles. Deer wintering areas are often associated with riparian softwood forest. Large trees in these areas are the primary nesting sites for bald eagles, osprey, and colonial waterbirds.
- Recreational and scenic opportunities, such as hiking, fishing, hunting, boating, bird-watching, and wildlife viewing.

Identifying Riparian Areas and Designing Riparian Management Zones

Riparian areas are defined by their location adjacent to lakes, ponds, streams and rivers, by their characteristic vegetation, and by the function they serve. Vegetation can vary from a narrow band of shrubs to floodplain forests hundreds of yards wide. The size depends on what function is being considered and may include upland forest as well as truly riparian communities.

4.3: Forest Management in Riparian Areas

Riparian management zones (RMZs) are linear zones along the shores of lakes, ponds, rivers, streams, and associated wetlands, within which special forest management practices are used.

Just how wide should the RMZ be? Unique combinations of ecological functions, physical characteristics, and landscape context make it difficult to arrive at a one-size-fits-all width. An important first step is to identify what you wish to protect—the width needed to provide shade to a stream, for example, may be one tree height or less, whereas riparian wildlife habitat may extend several hundred feet into upland forests adjacent to a river or lake. Foresters and landowners are in the best position to consider and apply localized factors.

Variable, tailor-made RMZs reflect localized site conditions, but are generally more complicated to consistently define, apply, and monitor. Fixed-width RMZs have the practical benefit of being clear, consistent, relatively simple to apply and monitor, and provide reasonable confidence that RMZ values and goals will be attained. We suggest a tiered approach that provides the practical benefits of a fixed-width, but includes key modifiers offering some added benefits of a variable-width approach. For additional information about establishing RMZs, see chapter 2 in *Riparian Management in Forests of the Continental Eastern United States*.

We recommend the following widths as general guidelines. The RMZ extends upland from the top of the streambank or from the upland edge of any stream-, pond-, or lake-side wetland (see illustration).

Table 1. Guidelines for Riparian Management Zones

	Legally Required[1]		Recommended	
	Riparian Management Zone (feet)	No Harvest Zone[2] (feet)	Riparian Management Zone (feet)	No Harvest Zone[2] (feet)
Intermittent streams	none[1]	none	75	none
1st and 2nd order streams	50[1]	none	100	25
3rd order streams[5]	50[1]	none	300[4]	50[3]
4th order and larger streams[5]	150[1]	none	300[4]	25
Pond <10 acres	50[1]	none	100	none
Lake or Great Pond (>10 acres)	150[1]	none	300	25

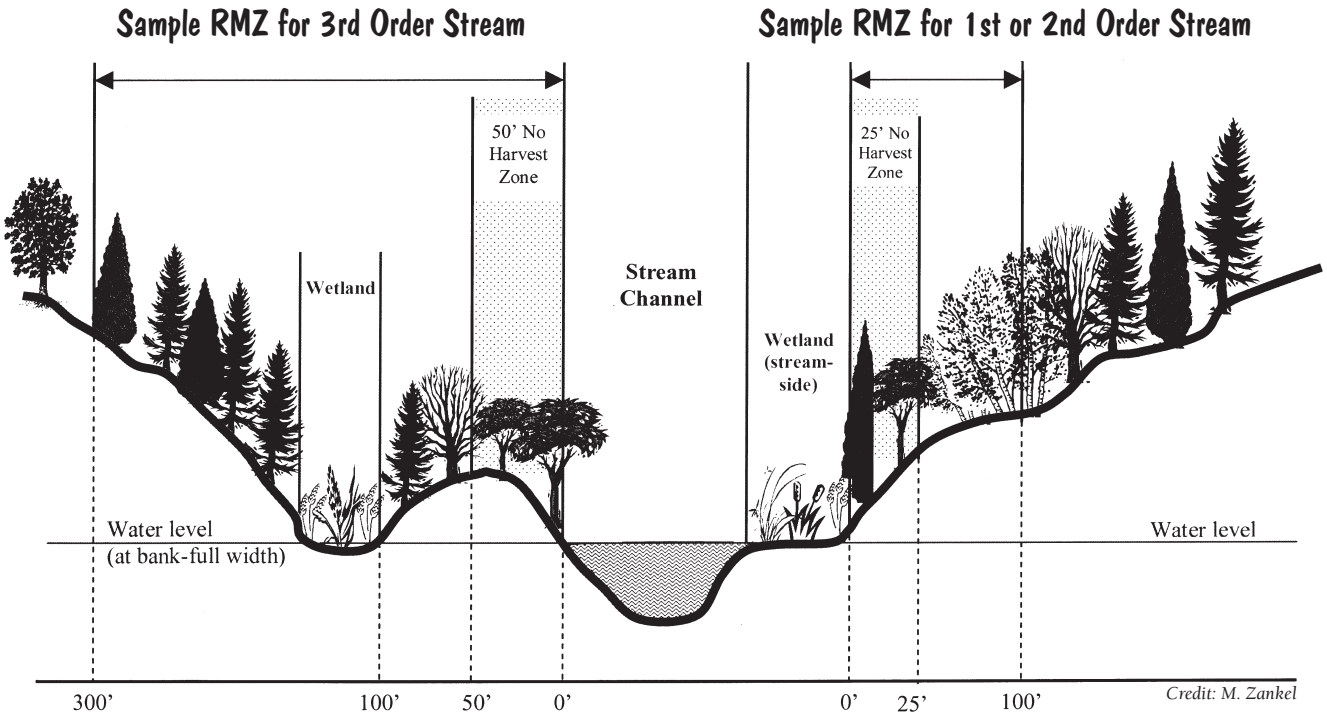
1 Width required under RSA 227-J:9 (basal area law). Within a 12-month period, no more than 50 percent of the basal area may be cut in these areas. Includes ponds less than 10 acres associated with a stream or brook that flows throughout the year.

2 Portion directly adjacent to the water body in which no cutting is recommended. It may be desirable to expand if there are steep slopes (>25%), unstable soils, sensitive wetlands, or exemplary natural communities. Increasing the width of the no-harvest zone will provide greater protection of nontimber values, but will also encumber a larger amount of timber. There may be valid ecological and silvicultural reasons to harvest in the no-harvest zone.

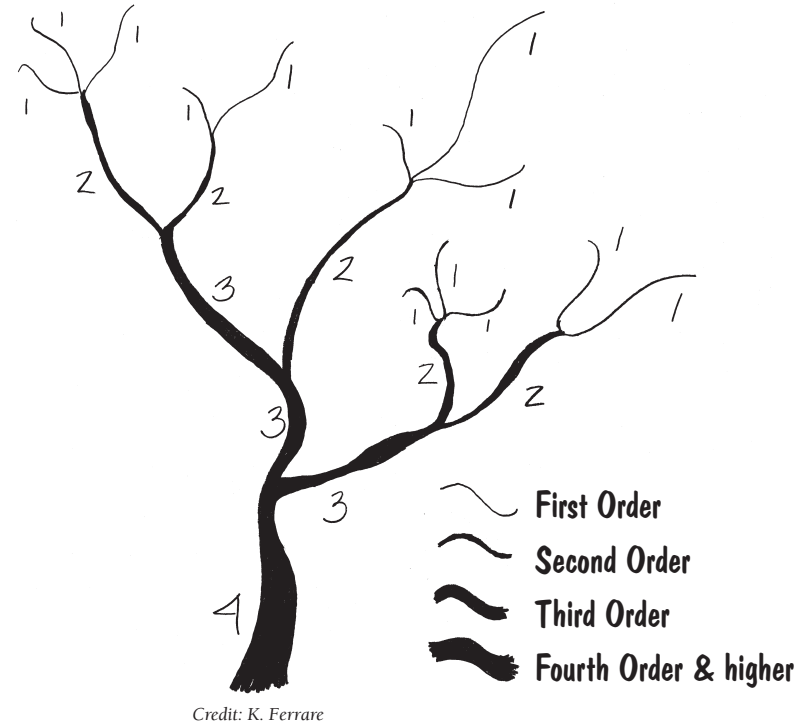
3 A 50-foot, no-harvest zone is recommended for 3rd order streams because of the importance of large woody material on streams of this size.

4 RMZ width on 3rd & 4th order and larger streams and rivers may expand to encompass known wildlife travel corridors, drinking water supply considerations, and the full extent of the 100-year floodplain.

5 For a list of fourth-order and higher streams see N.H. Dept. of Environmental Services Consolidated List of Waterbodies Subject to RSA 483-B.



The left side of the illustration shows the recommended RMZ for a 3rd order stream. The right side shows the recommended RMZ for a 1st or 2nd order stream. Note that the RMZ on the right side is measured from the upland edge of the streamside wetland. If there is no wetland at the edge of the stream, the RMZ is measured from the top of the streambank (at bankfull width). The disjunct wetland on the left side overlaps and is included within the RMZ.



Stream order classifies streams according to their size and position in the watershed. When two first-order streams intersect, the downslope stream is assigned an order of two. When two second-order streams intersect, the downslope stream is assigned an order of three, and so on. This most common method of ordering is known as the Strahler Method.

OBJECTIVE

Maintain the important ecological functions and values of forested riparian areas.

CONSIDERATIONS

- Wetland permits (RSA 482-A) or other legal requirements (RSA 227-J) may apply to forestry operations in riparian areas (4.2 Wetlands). Timber harvesting is exempt from RSA 483-B, the Comprehensive Shoreland Protection Act, so long as it isn't associated with shoreland development or land conversion and is conducted in compliance with RSA 227-J:9.
- Landowner objectives, water-body size, landscape context, vegetative composition, slope, and other factors helps determine the appropriate width and management of RMZs.
- There are benefits to managing riparian areas with a long-term perspective (>100 years). Some potential effects of harvesting in riparian areas may be short-lived; others (e.g., reduced input of large woody material) are much longer lasting. Trees retained today become the source of key terrestrial and instream habitat structure many decades into the future.
- No harvest zones within an RMZ provide optimal water quality benefits, protect sensitive riparian natural communities and wildlife movement corridors, promote quantities of large woody material, and avoid soil disturbance.
- Active forest management can be compatible with maintaining riparian functions and values. Trees regenerated today will provide the future source of cover, cavity trees, woody material, and snags. Some silvicultural and wildlife habitat objectives can conflict with no-harvest or limited harvest RMZs. For example, maintaining beavers at an active flowage within a particular stream reach may require active tree harvesting within these zones (6.8 Beaver-Created Openings). Soil scarification improves the likelihood of regenerating white pine, red oak, or red spruce, and may conflict with the recommendation to minimize ground disturbance.
- Riparian forests may be highly productive. Limiting harvesting in RMZs will entail some financial loss to riparian landowners.
- The integrity of aquatic and riparian ecosystems may be affected by activities of others throughout the watershed.

RECOMMENDED PRACTICES

✓ Survey the property (ideally in early spring) and identify important hydrologic features such as rivers, streams, lakes and ponds.

✓ Establish RMZs along streams, rivers, ponds, and lakes. Recommended minimum zone widths and key considerations are described above and reflected in Table 1.

✓ Include maintaining or restoring riparian functions and values as a silvicultural objective in RMZs.

- Retain trees with cavities, standing dead trees, downed logs, and large supracanopy trees (especially white pine).
- Leave windfirm trees that are well-distributed. Leave other vegetation, including existing groundcover.
- Choose a regeneration system most likely to maintain riparian functions and values and rapidly regenerate the site with the desired trees. Choosing a method is complicated by wet soils and the desire to maintain forest structure that contributes to wildlife habitat and other ecological values.

- Use uneven-aged techniques such as single tree or small group selection, maintaining 60 to 70 percent crown closure or full stocking as recommended in silvicultural guides. (To convert crown closure percentages to basal area, see Leak and Tubbs 1983).
- Use even-aged techniques such as shelterwood or patch cuts to achieve regeneration goals when rapid regeneration is likely (2.3 Regeneration Methods).

✓ Locate new truck roads and log landings outside RMZs, except where doing so would result in greater overall adverse environmental impacts.

✓ Design roads and skid trails within RMZs to minimize the long-term impacts on water quality and wildlife habitat. Apply BMPs according to guidelines in *Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire*. Consult the latest version before harvesting timber. Put roads to bed using BMPs to stabilize the soil, control run-off, and control unwanted vehicular access at the end of the harvest.

✓ Minimize ground disturbance. Operate ground-based equipment when the ground is dry or frozen.

✓ Time harvesting to avoid disturbance to nesting birds (6.10 Woodland Raptor Nest Sites) and other sensitive species.

✓ Leave the area closest to the stream, pond or wetland unharvested to provide increased protection to aquatic habitats, protect wildlife trails, and allow a reliable long-term supply of cavity trees, snags, and down woody material. Refer to the Table 1 for guidance. Larger zones increase the protection of nontimber values; however, no-harvest zones may not always be consistent with ecological or silvicultural objectives.

✓ Keep trees along banks to stabilize shorelines.

✓ Avoid leaving isolated riparian management zones with long distances of abrupt edge (a sharp change in type and size of vegetation). Riparian forests next to heavy cuts, agricultural, or urban land uses may be subject to increased edge effects (e.g., invasives, nest predation) and risk of blowdown. Practices that minimize these risks include limiting harvest within the riparian management zone, increasing the width of the zone, or feathering the edges of a heavy cut.

✓ Refer to 4.2 Wetlands for recommended practices specific to wetlands.

CROSS REFERENCES

2.2 Forest Structure; 2.3 Regeneration Methods; 3.5 Soil Productivity; 4.1 Water Quality; 4.2 Wetlands; 4.4 Stream Crossings and Habitat; 5.2 Invasive Plants; 6.8 Beaver-Created Openings; 6.9 Deer Wintering Areas; 6.10 Woodland Raptor Nest Sites; 6.11 Bald Eagle Winter Roosts; 6.12 Heron Colonies; 6.13 Wildlife Species of Greatest Conservation Need; 7.1 Natural Communities and Protected Plants; 7.3 Vernal Pools.

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Design Recommendations for Riparian Corridors and Vegetated Buffer Strips

by Richard A. Fischer[1] and J. Craig Fischenich[1]

April 2000

Complexity	Value as a Planning Tool	Cost
Low Moderate High	Low Moderate High	Low Moderate High

INTRODUCTION

Riparian zones occur as transitional areas between aquatic and upland terrestrial habitats. Although not always well-defined (Fischer et al. 2000), they generally can be described as long, linear strips of vegetation adjacent to streams, rivers, lakes, reservoirs, and other inland aquatic systems that affect or are affected by the presence of water. Riparian zones typically comprise a small percentage of the landscape, often less than 1 percent, yet they frequently harbor a disproportionately high number of wildlife species and perform a disparate number of ecological functions when compared to most upland habitats. Riparian zones have been widely recognized as functionally unique and dynamic ecosystems only within the past 25 years. Even more recently, these areas have become a major focus in the restoration and management of landscapes (Knopf et al. 1988, Naiman, Décamps, and Pollock 1993).

Unfortunately, many riparian zones in North America do not function properly (e.g., they are degraded to the point that they do not protect water quality or provide the resources needed to make them suitable as wildlife habitat or as movement corridors). This degradation also negatively affects many of the other important functions and values these landscape features provide.

Figure 1. Characteristics of vegetated riparian buffer strips influence water quality, wildlife, and recreational opportunities (photo courtesy of the U.S. Army Corps of Engineers).

WHAT IS THE DIFFERENCE BETWEEN BUFFER STRIPS AND CORRIDORS?

There is considerable confusion in the literature regarding both wetlands and riparian zones (Fischer et al. 2000). At the heart of this confusion is the proper distinction between vegetated buffer strips and corridors. Riparian zones are most commonly referred to as vegetated buffer strips (e.g., riparian buffer

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strips) or as wildlife movement corridors (e.g., riparian corridors). These titles relate to the principal intended or recognized purpose of the riparian zones. Understanding the similarities and differences between these two terms, and having a clear idea of one's objectives, can have major implications for how one might attempt to manage a riparian ecosystem. These terms are defined below:

Riparian Buffer Strip. A linear band of permanent vegetation adjacent to an aquatic ecosystem intended to maintain or improve water quality by trapping and removing various nonpoint source pollutants (NPSP) (e.g., contaminants from herbicides and pesticides; nutrients from fertilizers; and sediment from upland soils) from both overland and shallow subsurface flow. Buffer strips occur in a variety of forms, including herbaceous or grassy buffers, grassed waterways, or forested riparian buffer strips. A buffer strip may provide habitat for a variety of plants and animals if sufficient land area is retained to meet the life-history needs of those species. Buffer strips may also function as movement corridors if they provide suitable connections between larger blocks of habitat (see below).

Riparian Corridor. A strip of vegetation that connects two or more larger patches of vegetation (i.e., habitat) and through which an organism will likely move over time. These landscape features are often referred to as "conservation corridors," "wildlife corridors," and "dispersal corridors." Some scientists have suggested that corridors are a critical tool for reconnecting fragmented habitat "islands."

WHY ARE BUFFER STRIPS AND CORRIDORS IMPORTANT?

The management and restoration of riparian corridors and vegetated buffer strips is becoming an increasingly important option for improving water quality and conserving wildlife populations. There is solid evidence that providing riparian buffers of sufficient width protects and improves water quality by intercepting NPSP in surface and shallow subsurface water flow (e.g., Lowrance et al. 1984, 1986; Peterjohn and Correll 1984; Pinay and Decamps 1988). In the absence of proper buffer strips, there is a greater requirement for water treatment plants and other expensive restoration techniques (Virginia Department of Forestry 1998).

Buffer strips also clearly provide habitat for a large variety of plant and animal species, shade aquatic habitats, and provide organic matter (e.g., leaves) and large woody debris that is critical for aquatic organisms. Their role as movement corridors for wildlife species is not quite as clear, but they have become a popular tool in efforts to mitigate fragmentation and conserve biodiversity. They have been proposed, and in some cases documented, to be habitat components that promote faunal movement, enhance gene flow, and provide habitats for animals either outright or during disturbance in adjacent habitats (e.g., clearcut in upland). However, some scientists suggest that corridors are being used too frequently and at the expense of purchasing and conserving larger blocks of unfragmented habitat.

Vegetated riparian zones in urban areas, often called "greenbelts" or "greenways," are protected open spaces (usually along stream valleys and rivers) that are managed for conservation, recreation, and nonmotorized transportation. They provide numerous social benefits and are a focus of many community enhancement programs. Greenways can provide a community trail system for outdoor recreation activities, such as hiking, jogging, bicycling, rollerblading, horseback riding, cross-country skiing, or walking. Greenways can also stimulate the economy by providing an array of economic and quality-of-life benefits. Numerous studies demonstrate that linear parks not only can improve the quality of life in communities, they can increase nearby property values that in turn increase local tax revenues (McMahon 1994).

STATE OF THE SCIENCE

Many land managers throughout the country are in need of improved design criteria when planning for riparian corridor restoration and management, and they need information on how various land uses influence riparian vegetation, fauna, and water quality. Although

the value of riparian buffer strips is increasingly being recognized, information available to make sound management decisions for enhancing some of the functions that riparian zones can provide is presently limited (Fischer et al. 1999). Criteria for determining proper dimensions of buffer strips for some functions is not well-established and recommended designs are highly variable. Economic, legal, and political considerations often take precedence over ecological factors, and most existing criteria address only reduction or elimination of NPSP (Lowrance et al. 1984, 1986; Peterjohn and Correll 1984; Pinay and Decamps 1988). However, water quality enhancements are only one of many functions performed by riparian buffers (Budd et al. 1987; O'Laughlin and Belt 1995). Because of the lack of information relating riparian zone characteristics to other specific functions, management prescriptions (e.g., width recommendations) are frequently based upon either water quality considerations or anecdotal information. There is little regard for the full range of effects these decisions may be having on habitat, flood conveyance and storage, recreation, aesthetics, and other riparian functions.

Although riparian buffer strips are being planted along thousands of streambank miles throughout the country, the benefits of variable buffer strip designs (e.g., width, length, type of vegetation, placement within the watershed) are effectively unrecognized. There have been few systematic attempts to establish criteria that mesh water quality width requirements with conservation and wildlife values; specifically, the ability of these buffer strips to function as habitat or as corridors for wildlife dispersal between habitats in highly fragmented landscapes. Even less information is available relating riparian vegetation characteristics to hydraulic, sediment transport, and bank stability conditions of streams.

The exact specifications for connectivity[1] provided by wildlife corridors are not well-known. Most connectivity-related research has been done in predominately agricultural and forested landscapes, not riparian systems. Furthermore, it is difficult to extrapolate from individual species connectivity requirements to general rules. However, it is known with certainty that connectivity is important for the survival of some plant and animal populations.

WHAT ARE THE GENERAL DESIGN CONSIDERATIONS?

Unfortunately, there is no "one-size-fits-all" description of an ideal riparian buffer strip. First and foremost, the primary objectives of a buffer strip should be determined. Various objectives might include protection of water quality, streambank stabilization, downstream flood attenuation, or provision of wildlife habitat or movement corridors. In general, the ability of buffer strips to meet specific objectives is a function of their position within the watershed, the composition and density of vegetation species present, buffer width and length, and slope. Some benefits can be obtained for buffers as narrow as a few feet while others require thousands of feet.

Placement with Watersheds. The spatial placement of buffer strips within a watershed can have profound effects on water quality. Riparian buffers in headwater streams (i.e., those adjacent to first-, second-, and third-order systems) have much greater influences on overall water quality within a watershed than those buffers occurring in downstream reaches. Downstream buffers have proportionally less impact on polluted water already in the stream (Alliance for the Chesapeake Bay 1996). 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. Many Corps projects occur along the higher order streams and rivers and have little or no control over water quality resulting from land-use practices higher in the watershed. However, buffer strips along these larger systems tend to be longer and wider than low-order systems, thus potentially providing significant wildlife habitat and movement corridors.

[1] In this case, connectivity refers to a measure of the extent to which riparian zones provide for biological and ecological pathways that sustain plant and animal species throughout a region.

GIS can aid in determining where the most benefit can be accrued from placing buffers on a landscape. Knowledge of soils and valley-floor types provides important information regarding types of channels and riparian processes likely to be present in a given area (Hemstrom 1989). Because interactions between aquatic, riparian, and terrestrial ecosystems are a function of valley-floor morphology, digitized GIS data on valley-floor morphology aids in delineation of specific areas where erosion potential is high (e.g., where streams flow through alluvial deposits) or low (e.g., through bedrock). Thus, critical areas for buffer strips can be identified before significant impacts occur.

How Wide and How Long? Most of the focus on buffer design is the needed width, but the vegetation assemblage, layout, and length are also key design parameters. Buffer width, as defined herein, is measured beginning at the top of the bank or level of bankfull discharge. Width recommendations for buffer strips are either fixed or variable in nature. Fixed-width buffer strip recommendations tend to be based on a single parameter or function. They are easier to enforce and administer by regulatory agencies but often fail to provide for many ecological functions (Castelle, Johnson, and Conolly 1994). Variable width buffer strips are generally based on a variety of functions and usually account for site-specific conditions by having widths adjusted along the length of the strip depending on adjacent land use, stream and site conditions (e.g., vegetation, topography, hydrology), and fish and wildlife considerations (Castelle, Johnson, and Conolly 1994). Protection of water quality is often the most common consideration during buffer strip design recommendations. Although many buffer strip width recommendations tend to be arbitrary or based on anecdotal information, the scientific literature is replete with recommendations for maintaining or improving water quality in a variety of different settings (e.g., various soil types and different slopes) (Table 1).

Wildlife habitat and movement corridors in riparian zones are also an important consideration when determining widths. Appropriate designs for species conservation depend on several factors, including type of stream and taxon of concern (Spackman and Hughes 1995). Recommended widths for ecological concerns in buffer strips typically are much wider than those recommended for water quality concerns (Fischer et al. 1999; Fischer 2000) (Tables 2 and 3). Table 4 organizes buffer/corridor widths recommended in the literature in terms of functions, and Table 5 provides suggestions for general corridor restoration and management.

Management for long, continuous buffer strips adjacent to aquatic systems should be a higher priority in most cases than fragmented strips of greater width (Weller, Jordan, and Correll 1998). Continuous buffers are more effective at moderating stream temperatures, reducing gaps in protection from NPSP, and providing movement corridors for wildlife. Unfragmented buffer strips are also important as habitat. For example, Gaines (1974) found that yellow-billed cuckoos in California most often occur where the riparian vegetation exceeds 300 m in length and 100 m in width.

National and Regional Approaches. Recognizing the importance of riparian buffers and corridors, many Federal, state and local agencies have established riparian restoration and preservation programs. As part of the 1996 Farm Bill, the National Resources Conservation Service (NRCS) started the National Conservation Buffers Initiative to encourage landowners in agricultural and other urban and rural settings to install buffer strips primarily to improve the quality of our Nation's waters. The goal of the initiative is to restore 2 million miles (up to 7 million acres) of conservation buffers by the year 2002. The NRCS has set minimum and maximum widths that landowners can enroll in these programs ranging from a minimum of 30 ft (9m) for some herbaceous filter strips up to a maximum of 150 ft. (45 m) for forested riparian buffer strips. A variety of programs are available to landowners under the Farm Bill, including the continuous Conservation Reserve Program (CRP) sign-up, Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Wetlands Reserve Program (WRP), Stewardship Incentives Program (SIP),

Table 1. Recommended Widths of Buffer Zones and Corridors for Water Quality Considerations

Authors	State	Width	Buffer Type	Benefit
Woodard and Rock (1995)	Maine	≥15m	Hardwood buffer	The effectiveness of natural buffer strips is highly variable, but in most cases, a 15m natural, undisturbed buffer was effective in reducing phosphorus concentrations adjacent to single family homes
Young et al. (1980)		≥25m	Vegetated buffer	25m buffer reduced the suspended sediment in feedlot runoff was reduced by 92%
Horner and Mar (1982)		≥61m	Grass filter strip Vegetated buffer strip	Removed 80% of suspended sediment in stormwater
Lynch, Corbett, and Mussalem (1985)		≥30m		30-m buffer between logging activity and wetlands and streams removed an average of 75 to 80% of suspended sediment in stormwater; reduced nutrients to acceptable levels; and maintained water tempertures within 1^{B}C of their former mean temperature.
Ghaffarzadeh, Robinson, and Cruse (1992)		≥9m	Grass filter strip	Removed 85% of sediment on 7 and 12% slopes
Madison et al. (1992)		≥5m	Grass filter strip	Trapped approximately 90% of nitrates and phosphates
Dillaha et al. (1989)		≥9m	Vegetated filter strip	Removed an average of 84% of suspended solids, 79% of phosphorus, and 73% of nitrogen
Lowrance et al. (1992)		≥7m		Nitrate concentrations almost completely reduced due to microbial denitrification and plant uptake
Nichols et al. (1998)	Arkansas	≥18m	Grass filter strips	Reduced estradiol (estrogen hormone responsible for development of the female reproductive tract) concentrations in runoff into surface water by 98%.
Doyle et al. (1977)		≥4m	Grass filter strips and forested buffers	Reduced nitrogen, phosphorus, potassium, and fecal bacteria from runoff.
Shisler, Jordan, and Wargo (1987)	Maryland	≥19m	Forested riparian buffer	Removed as much as 80% of excess phosphorus and 89% of excess nitrogen

Table 2. Recommended Widths of Corridors and Vegetated Buffer Strips for Vegetation, Reptiles and Amphibians, Mammals, Fish, and Invertebrates

Authors	State	Width	Benefit
Spackman and Hughes (1995)	Vermont	≥30m	Needed to capture >90% of vascular plant species
Brosofske et al. (1997)	Washington	≥45m	...buffers at least 45m wide on each side of the stream are needed to maintain an unaltered microclimatic gradient near streams (but could extend up to 300m in other situations)
			Reptiles and Amphibians
Burbrink, Phillips, and Heske (1998)	Illinois	100-1000m	Wide (>1000m) areas of riparian habitat did not support greater numbers of species of reptiles and amphibians than narrow (<100 m) areas
Rudolph and Dickson (1990)	Texas	≥30m	"We recommend retaining streamside zones of mature trees at least 30 m wide and preferable wider when forest stands are harvested. Zones this wide will benefit amphibians, reptiles, and other vertebrates."
Semlitsch (1998)	Eastern U.S.	≥165m	To maintain viable populations and communities of ambystomatid salamanders, attention must be directed to the terrestrial areas peripheral to all wetlands; maintaining the connection between wetlands and terrestrial habitats will be necessary to preserve the remaining biodiversity of our remaining wetlands.
Buhlmann (1998)	South Carolina	≥135m	Aquatic turtles (e.g., chicken turtle [*Deirochelys reticularia*]) may spend a greater proportion of a year in terrestrial habitat (e.g., buffer strips adjacent to wetlands) than in the wetland where they would have been predicted to occur
			Mammals
Dickson (1989)	Texas	≥50m	The minimum width of streamside management zones that will maintain gray squirrel (*Sciurus carolinensis*) populations is about 50m.
			Invertebrates
Erman, Newbold, and Roby (1977)	California	≥30m	Maintained background levels of benthic invertebrates in streams adjacent to logging activity
			Fish
Moring (1982)		≥30m	Increased sedimentation from logged, unbuffered stream banks clogged gravel streambeds and interfered with salmonid egg development. Buffer strips at least 30m wide allowed eggs to develop normally

Table 3. Recommended Minimum Widths of Riparian Buffer Strips and Corridors for Birds

Authors	Location	Minimum Width	Benefit
Darveau et al. (1995)	Canada	≥60m	There was evidence that 50-m-wide forested buffer strips were required for forest-dwelling birds. Bird populations may decline in strips before regeneration of adjacent clearcuts provide suitable habitat for forest birds
Hodges and Krementz (1996)	Georgia	≥100m	Riparian strips >100 m were sufficient to maintain functional assemblages of the six most common species of breeding Neotropical migratory birds
Mitchell (1996)	New Hampshire	≥100 m	Need >100m-wide buffers to provide sufficient breeding habitat for area sensitive forest birds and nesting sites for red-shouldered hawks
Tassone (1981)	Virginia	≥50 m	Many Neotropical migrants will not inhabit strips narrower than 50 m
Triquet, McPeek, and McComb (1990)	Kentucky	≥100 m	Neotropical migrants were more abundant in riparian corridors wider than 100 m; riparian areas <100 m wide were inhabited mainly by resident or short-distance migrants
Spackman and Hughes (1995)	Vermont	≥150 m	Riparian buffer widths of at least 150 m were necessary to include 90% of bird species along mid-order streams
Kilgo et al. (1998)	South Carolina	≥500 m	Although narrow bottomland hardwood strips can support an abundant and diverse avifauna, buffer zones at least 500m wide are necessary to maintain the complete avian community
Keller, Robbins, and Hatfield (1993)	Maryland; Delaware	≥100 m	Riparian forests should be at least 100 m wide to provide some nesting habitat for area-sensitive species
Gaines (1974)	California	≥100 m	Provide riparian breeding habitat for California yellow-billed cuckoo populations
Vander Haegen and deGraaf (1996)	Maine	≥150 m	Managers should leave wide (>150 m) buffer strips along riparian zones to reduce edge-related nest predation, especially in landscapes where buffer strips are important components of the existing mature forest
Whitaker and Montevecchi (1999)	Canada	≥50 m	50-m-wide riparian buffers only supported densities <50% of those observed in interior forest habitats
Hagar (1999)	Oregon	>40m	Although riparian buffers along headwater streams are not expected to support all bird species found in unlogged riparian areas, they are likely to provide the most benefit for forest-associated birds species if they are >40 m wide

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.

Table 5. General Recommendations for Corridor Restoration and Management[1]

- Think at a watershed scale when planning for or managing corridors. Many species that primarily use upland habitats may, at some stage of their life cycle, need to use corridors for habitat, movements, or dispersal.
- Corridors that maintain or restore natural connectivity are better than those that link areas historically unconnected.
- Continuous corridors are better than fragmented corridors.
- Wider corridors are better than narrow corridors.
- Riparian corridors are more valuable than other types of corridors because of habitat heterogeneity, and availability of food and water.
- Several corridor connections are better than a single connection.
- Structurally diverse corridors are better than structurally simple corridors.
- Native vegetation in corridors are better than non-native vegetation.
- Practice ecological management of corridors; burn, flood, open canopy, etc. if it mimics naturally occurring historical disturbance processes.
- Manage the matrix with wildlife in mind; apply principles relative to the native plant and animal communities in the area.

[1] Craig Johnson, Utah State University, Presentation made at National Conservation Buffers Workshop, San Antonio, TX, January 1998.

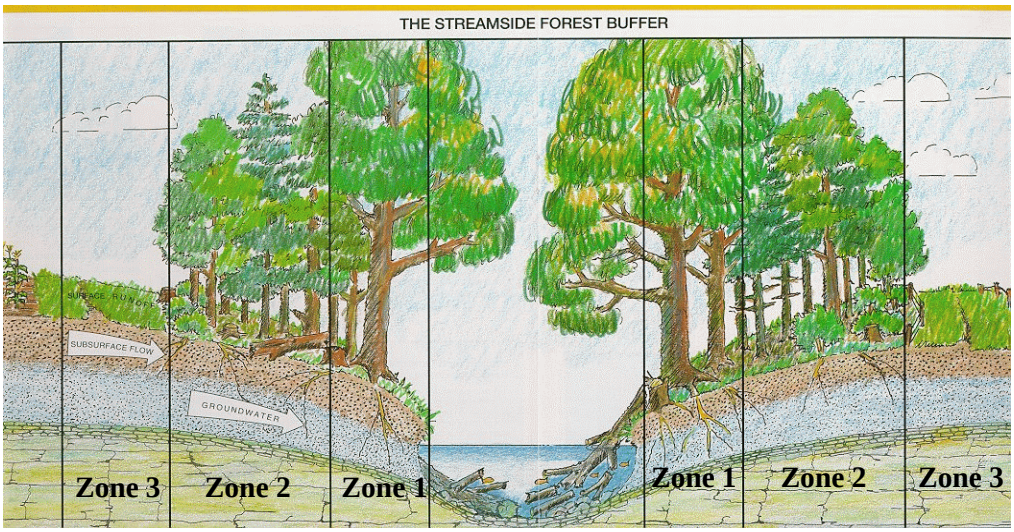

Figure 2. Depiction of a three-zone buffer approach developed for the Chesapeake Bay Watershed. This approach may be applicable to most forested riparian buffer strips in North America (from Welsch 1991).

and Emergency Watershed Protection Program (EWP). Information on these programs can be found on the Internet at http://www.nhq.nrcs.usda.gov/OPA/Buffers.html

The Chesapeake Bay watershed has been the focus of a large restoration effort to improve water quality within the watershed. As part of this initiative, a three-zone riparian buffer was developed to assist with planning, design, and long-term management of forested riparian buffer strips (Welsch 1991). This approach provides a framework through which water quality, habitat, and other objectives can be accomplished. Figure 2 depicts the relative positions of the three zones. The width of each zone is determined by site conditions and objectives, as discussed below.

Zone 1. This zone begins at the stream edge and is the area that provides streambank stabilization and habitat for both aquatic and terrestrial organisms. Primary functions of this zone include provision of shade, and input to the stream or river of detritus and large woody debris from mature forest vegetation. Vegetation in this zone also helps reduce flood effects, stabilize streambanks, and remove some sediments and nutrients. Vegetation should be composed of native, non-invasive trees and shrubs of a density that permits understory growth; it should also tolerate frequent inundations. The width of this zone typically varies between 15 and 25 ft (5 and 8 m) or more.

Zone 2. This zone extends upslope from Zone 1 from a minimum of 10 ft (3 m) up to several hundred feet, depending on objectives, stream type, soil type, or topography. The objective in this zone is to provide a managed riparian forest with a vegetation composition and character similar to natural riparian forests in the region. Species of vegetation used in this zone should be reasonably flood- and drought-tolerant. The primary function of Zone 2 is to remove sediments, nutrients, and other pollutants from surface and groundwater. This zone, in combination with Zone 1, also provides most of the enhanced habitat benefits, and allows for recreation and aesthetic benefits.

The cost of installing and managing a buffer strip is a strong concern to some land managers, as it is often viewed as a loss of productive land. However, these opportunity costs can be offset by including practices such as periodically harvesting trees in this zone for sawtimber or pulp, growing nuts, berries, and fruits for commercial purposes, or leasing lands out for hunting (Washington County Soil and Water Conservation District 1999). Periodic selection harvests within this zone likely

release the growth of smaller trees that will absorb nutrients from the soil at a higher rate than the more mature trees.

Zone 3. This zone typically contains grass or herbaceous filter strips and provides the greatest water quality benefits by slowing runoff, infiltrating water, and filtering sediment and its associated chemicals. The minimum recommended width of Zone 3 is 15 ft (4.5 m) when used in conjunction with Zones 1 and 2, or 35 ft (10.6 m) when used alone. The primary concern in this zone is initial protection of the stream from overland flow of NPSP such as herbicides and pesticides applied to lawns, agricultural fields, and timber stands. Properly designed grassy and herbaceous buffer strips may provide quality habitat for several upland wildlife species, including the northern bobwhite (*Colinus virginianus*), which has experienced significant population declines during the last 2 decades.

Buffer Composition. Generally speaking, vegetation used for buffer projects should consist of a mix of trees, shrubs, and herbaceous plants that are native to the region and well-adapted to the climactic, soil, and hydrologic conditions of the site. The relative effectiveness of different vegetation types at meeting specific objectives within a buffer strip is listed in Table 6. A botanist familiar with local flora should be enlisted to select those species most likely to meet project objectives, as well as ensure that plants are placed in the proper zone in the floodplain (e.g., those that thrive with frequent inundation at the edge of the stream versus those less tolerant of flooding further from the stream). The composition of the natural riparian community in adjacent locations can be a good guide and is often used as a starting point for the revegetation design.

Establishing diverse vegetation, either directly or through succession, is desirable for a variety of reasons. A relatively large number of species means an array of environmental tolerances is represented. As the project site experiences fluctuations in various environmental conditions over time, such as water level, temperature, and herbivory, some plants or species will not survive, but others may thrive. A diverse array of plant species is essential to a riparian system's ability to provide and to sustain a number of functions. Various plant species association and hydrological conditions provide required habitats for different life-history phases of animals, such as feeding, winter cover, and breeding (Heitmeyer et al. 1984, Frazer et al. 1990). Vegetation diversity in a buffer can be increased in numerous ways by:

a. Planting an array of different species in different amounts.

b. Planting a variety of growth forms such as herbaceous ground cover, shrubs, saplings and tree species, or emergents.

c. Planting species with a variety of life histories (e.g., annuals, short-lived or long-lived perennials).

d. Providing a range of site conditions (e.g., through elevational changes, creation of habitats with varying aspects/orientations) to support a diverse range of plant species.

Plans for acquiring plants must be made well in advance of the project implementation (sometimes 1 to 2 years). The availability of plants of the appropriate species, size, and quality is often a limiting factor in the final selection and plant acquisition process. Some native plant species are very difficult to propagate and many desirable species are not commonly available through commercial suppliers. As a general rule, it is advisable to specify as many species as possible and require the use of some minimum number of these species. Table 7 provides guidance for the minimum percentage of any one tree species in a revegetation plan.

Table 6. Relative Effectiveness of Different Vegetation Types for Providing Specific Benefits

Benefit	Vegetation Type Grass	Shrub	Tree
Stabilizes bank erosion	Medium	High	Medium
Traps sediment	High	Medium	Low
Filters nutrients, pesticides, microbes			
sediment-bound	High	Low	Low
soluble	Medium	Low	Medium
Provides aquatic habitat	Low	Medium	High
Provides wildlife habitat			
range/pasture/prairie wildlife	High	Medium	Low
forest wildlife	Low	Medium	High
Provides economic products	Medium	Low	Medium
Provides visual diversity	Medium	Medium	High
Prevents bank failures	Low	Medium	High
Provides flood conveyance	High	Low	Low

Modified from Dosskey, Schultz, and Isenhart (1997).

Table 7. Species Diversity Guidelines for Trees

Number of Trees	Maximum % of Any One Species
10 to 19	50%
20 to 39	33%
40 or more	25%

Other factors that determine species percentages within a plant selection are:

a. Desired ultimate composition of the plant community.

b. Function within the plant community (i.e., overstory, understory, shrub, groundcover, herbaceous).

c. Dominance in the plant community.

d. Growth characteristics and compatibility with other species.

e. Aggressive, fast-growing species such as elderberry (*Sambucus* spp.) and poplar (*Populus* spp.) should be proportioned and managed to reduce conflict with slower growing species.

f. Slower-growing species, such as wintergreen (*Gaultheria* spp.) and spruce (*Picea* spp.) may require a higher

percentage to be successful in the development of the plant association.

g. Some species may not be appropriate for the initial planting phase. These include many of the herbaceous understory plants, such as ferns, and others that demand a micro-environment that can only develop over time.

The planting distance between woody species (trees and shrubs) should account for anticipated maintenance practices. If maintenance is necessary, planting trees and shrubs in well-spaced rows makes maintenance activities, such as mowing or mulching, much easier. Care should be taken to offset the rows of trees and shrubs so as to form a diamond pattern. Tree rows should generally be spaced about 6 to 10 ft (2 to 3 m), and shrubs about 3 to 6 ft (1 to 2 m). Within the row, spacing should be 3 to 6 ft (1 to 2 m) for small shrubs, 5 to 8 ft for large shrubs, 6 to 10 ft (2 to 3 m) for evergreens, and 8 to 12 ft (3 to 4 m) for deciduous trees. If the riparian zone will not be maintained with equipment, there is no need to plant in rows and a more natural-appearing planting arrangement should be utilized.
Other considerations influencing plant spacing are:

a. The competitive strength of the plants at the end of the plant establishment period.

b. Weed control. Densely spaced vegetation hinders weeds from establishing.

c. Species that need support from surrounding plants in order to compete and develop into a functional plant association. Examples are snowberry (*Symphoricarpos*), wild rose (*Rosa* spp.), Salal (*Salal spp.*), leatherleaf (*Mahonia* spp.), and Spiraea (*Spiraea* spp). The initial plant spacing should be based on closure of the planting after approximately three years. The plants will form a thicket over time. This plant layer is important for weed control in its supportive role in the plant community.

d. Species that form groupings or groves should be spaced to support the development of individual plants that form the desired cluster.

e. Climax trees should be spaced to resemble the distribution in the natural plant community.

f. Pioneer species should be spaced to quickly perform their function in the plant succession scheme without causing undesirable competition with desirable plants. Consider a management program that includes periodic removal of plants that have outlived their function.

In grassy buffers, the use of a mixture of native cool- and warm-season grasses planted in a heterogeneous pattern is recommended. This will not only assist in protecting water quality but will also provide wildlife habitat benefits. The inclusion of warm-season grasses provides many wildlife benefits that cool-season grasses alone cannot provide, such as abundant nesting cover for upland game species. In addition, many non-game species such as field nesting songbirds can find protection in the thick canopy this grass provides. Warm-season grasses grow in a dense manner, and resist collapse from snow and ice (they also provide a degree of winter cover when little or no snow cover exists). Finally, warm-season grasses are good seed-producers, creating abundant food for wildlife.

The authors have begun to compile woody and herbaceous vegetation commonly found in riparian systems, including the floodplain zone where they typically are found, and the region of the country where they occur. This will be published as a future ERDC technical note.

APPLICABILITY AND LIMITATIONS

The ability of a riparian buffer strip to provide various functions (e.g., attenuate floods, protect water quality, provide habitat or wildlife movement corridors) depends on such factors as width, length, degree of fragmentation, and type, density, and structure of vegetation

present. Objectives may also be constrained by land ownership, extent of potential for growth of riparian vegetation, soil type, slope, or past land-uses.

In all cases, buffers wider than 10 m should be promoted for optimizing a range of multiple objectives for water quality, stability, and habitat functions. However, widths of 100 m or more are usually needed to ensure values related to wildlife habitat and use as migration corridors. Increasing widths to encompass the geomorphic floodplain is likewise desirable to optimize flood- reduction benefits. If only a narrow forested buffer strip is possible, it should at least be wide enough to sustain a forest or shrub community that will adequately stabilize the streambank from erosion. These recommendations apply to either side of the channel in larger river systems and to total width for lower-order streams. Recommended widths in this report are intended to provide a starting point for land managers to make decisions regarding design of buffer strips in their own area. Proper widths for various objectives may vary significantly by region and depend on a variety of ecological and physical factors.

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Natural Resource Inventory

APPENDIX D: NHDES FACT SHEETS ON SHORELAND WATER QUALITY PROTECTION ACT

RSA 483-B
Shoreland Water Quality Protection Act (SWQPA)
A Summary of the Standards

A STATE SHORELAND PERMIT is required for most new construction, excavation and filling activities within the Protected Shoreland. (*See definitions below*) Forest management not associated with shoreland development or land conversion and conducted in compliance with RSA 227-J:9 and agricultural activities and operations defined in RSA 21:34-a and governed by RSA 430 are exempt from the provisions of the SWQPA. Projects that receive a permit under RSA 482-A, e.g., beaches and retaining walls do not require a shoreland permit. A complete list of activities that ***do not*** require a shoreland permit can be found on the Shoreland Program Page by visiting www.des.nh.gov.

250 feet from Reference Line — THE PROTECTED SHORELAND:

Impervious Surface Area Limitation. If a homeowner or developer wishes to exceed 30% impervious surface coverage of the area of the lot within the protected shoreland, a stormwater management system designed and certified by a professional engineer that will not concentrate stormwater runoff or contribute to erosion must be implemented and if any grid segment within the waterfront buffer does not meet the minimum required 50 point tree, sapling, shrub and groundcover score, each deficient grid segment must be planted with additional vegetation to at least achieve the minimum required score. If a homeowner or developer wishes to exceed 20% impervious area, a stormwater management plan must be implemented to infiltrate increased stormwater from development.

Other Restrictions/ Notes:

- No establishment/expansion of salt storage yards, auto junk yards, solid waste and hazardous waste facilities.
- Setback requirements for all new septic systems are determined by soil characteristics.
  - 75 feet for rivers and areas where the there is no restrictive layer within 18 inches and where the soil down gradient is not porous sand and gravel (perc>2 min.).
  - 100 feet for soils with a restrictive layer within 18 inches of the natural soil surface.
  - 125 feet where the soil down gradient of the leachfield is porous sand and gravel (perc rate equal to or faster than 2min/in.).
- In accordance with RSA 485-A, when selling developed waterfront property, a *Site Assessment Study* is required for all properties with on-site septic that are contiguous to or within 200 feet of waterbodies jurisdiction under the SWQPA. For more information relative to site assessments, contact the NH Subsurface Systems Bureau at (603) 271-3711.
- In accordance with RSA 485-A:17, an Alteration of Terrain Permit is required for any project that proposes to disturb more than 50,000 sq ft of contiguous terrain if any portion of the project is within the protected shoreland or disturbs an area having a grade of 25% or greater within 50 feet of any surface water.

150 feet from Reference Line — NATURAL WOODLAND BUFFER LIMITATIONS:

- At least 25 percent of the area between 50 feet and 150 feet from the reference line must be maintained in an unaltered state.

50 feet from Reference Line — WATERFRONT BUFFER and PRIMARY BUILDING SETBACK:

- All primary structures must be set back at least 50 feet from the reference line. Towns may maintain or enact greater setbacks.
- Within 50 feet from the reference line, a waterfront buffer must be maintained. Within the waterfront buffer, tree coverage is managed with a 50 x 50 foot grid and point system. Trees and saplings may be removed provided the sum score of the remaining trees, saplings, shrubs and groundcover within the affected grid segment is at least 50 points. (see Vegetation Maintenance within the Protected Shoreland FACT SHEET)
- No natural ground cover shall be removed except for a footpath to the water that does not exceed 6 feet in width and does not concentrate stormwater or contribute to erosion.
- Natural ground cover must remain intact. No cutting or removal of vegetation below 3 feet in height (excluding previously existing lawns and landscaped areas). Stumps, roots, and rocks must remain intact in and on the ground unless specifically approved by the department.
- Pesticide and herbicide applications can be applied by a licensed applicator only.
- Only low phosphorus, slow release nitrogen fertilizer can be used beyond 25 feet of the reference line. Only limestone may be used within 25 feet of the reference line.

"REFERENCE LINE"- The reference line is the point from which setbacks are determined. For ***coastal waters*** it is the highest observable tide line; for ***rivers*** it is the ordinary high water mark and for ***lakes and ponds*** it is the surface elevation listed on the Consolidated List of Waterbodies subject to the SWQPA.

"CONSTRUCTION"- Erecting, reconstructing or altering any structure(s) that result in an increase in impervious area.

"EXCAVATION" - To dig, remove, or form a cavity or hole within the ground with mechanized equipment.

"FILL" - To place or deposit materials such as rocks, soil, gravel, sand or other such materials.

"UNALTERED STATE" - vegetation allowed to grow without cutting, limbing, trimming, pruning, mowing, or other similar activities except as needed for plant health, normal maintenance and renewal.

ENVIRONMENTAL Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

WD-SP-4 2011

Shorelands Jurisdiction under the Shoreland Water Quality Protection Act

The NH Shoreland Water Quality Protection Act (SWQPA), formally named the Comprehensive Shoreland Protection Act, RSA 483-B, became effective on July 1, 1994 and established the "protected shoreland." The protected shoreland is all the land located within 250 feet of the "reference line" of public waters.

Within the protected shoreland, certain activities are restricted or prohibited, and others require a permit from the New Hampshire Department of Environmental Services. All activities that are regulated by the DES must comply with applicable local, state and federal regulations. For a complete summary of the minimum standards of the Shoreland Water Quality Protection Act listing the activities and the distances they must be set back from the reference line, see the Summary of the Shoreland Water Quality Protection Act Minimum Standards.

The reference line, used for determining setbacks, is typically the interface between the water and the land for purposes of this act. Determination of the reference line location is waterbody dependent. An explanation of how to locate the reference line for each waterbody type protected under the SWQPA is provided below.

Lakes, Ponds and Artificial Impoundments Greater than 10 Acres
All lakes, ponds and artificial impoundments greater than 10 acres in size are protected under the Shoreland Water Quality Protection Act. The reference line for these waterbodies is the surface elevation as listed in the Consolidated List of Waterbodies subject to the Shoreland Water Quality Protection Act as maintained by DES.

Fourth Order and Higher Rivers and Streams and Designated River Segments
The jurisdiction of the SWQPA includes all fourth order and greater rivers and streams and designated rivers and river segments managed by the NH Rivers Management and Protection Program under RSA 483:15. Stream ordering was determined by using the New Hampshire hydrography dataset archived by the geographically referenced analysis and information system (GRANIT) at the complex systems research center of the University of New Hampshire and developed by GRANIT in collaboration with DES. All rivers and streams protected under the SWQPA are listed on the Consolidated List of Waterbodies subject to the Shoreland Water Quality Protection Act.

The reference line for streams and rivers under the jurisdiction of the CSPA is the ordinary high water mark. The ordinary high water mark is defined as the line on the shore, running parallel to the main stem of the river, established by the fluctuations of water. It is indicated by physical characteristics such as a clear, natural line impressed on the immediate bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas. Where the ordinary high water mark is not easily discernible, the ordinary high water mark may be determined by DES.

Coastal Waters

All coastal waters subject to the ebb and flow of the tide, including the Great Bay Estuary and the associated tidal rivers and streams, are under the jurisdiction of the SWQPA. The reference line for coastal waters is the highest observable tide line, which means a line defining the furthest landward limit of tidal flow. This does **not** include storm events and can be recognized by indicators such as the presence of a strand line of flotsam and debris, the landward margin of salt tolerant vegetation, or a physical barrier that blocks further flow of the tide.

More Information

For more information about the DES Shoreland Program, please go to http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm .

ENVIRONMENTAL
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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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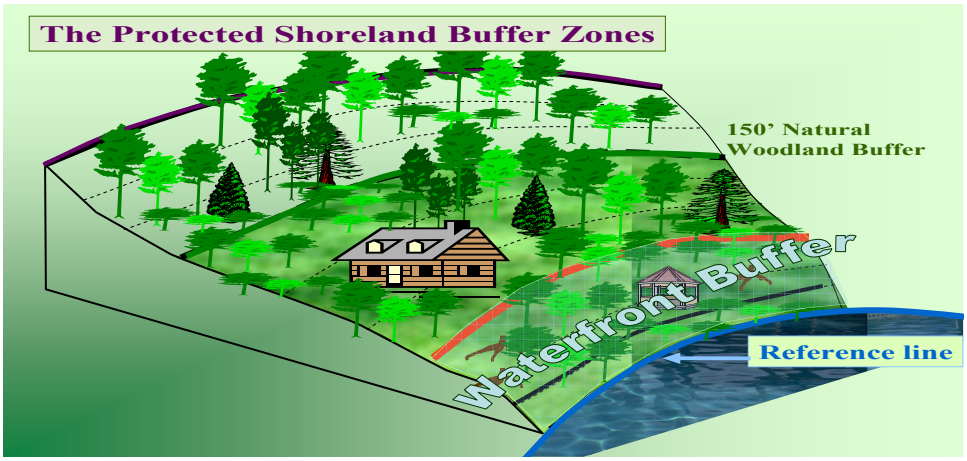
WD-SP-5 2012

Vegetation Maintenance within the Protected Shoreland

Vegetation is a key component in preserving the integrity of public waters and is also a critical element of wildlife habitat. Well vegetated shorelands that include a variety of native trees, saplings, shrubs and natural ground cover are much more apt to naturally manage the harmful effects of stromwater runoff. The NH Shoreland Water Quality Protection Act (SWQPA) RSA 483-B, formally named the Comprehensive Shoreland Protection Act (CSPA), has protected a 150-foot wide vegetated buffer adjacent to public waters since July 1, 1994. For the purposes of the SWQPA, public waters are defined as lakes, ponds and artificial impoundments greater than 10 acres, rivers and streams that are 4th order or higher, designated rivers and all tidal waters. All waterbodies protected under the SWQPA can be found on the Consolidated List of Waterbodies Protected Under the Shoreland Water Quality Protection Act. A shoreland impact permit is *not* required to manage vegetation within the protected shoreland but, property owners must operate in accordance with the guidelines below.

The 150-foot wide protected vegetated buffer is divided into two regions. The first 50 feet, beginning at the reference line, is called the waterfront buffer zone and the region between 50 ft and 150 feet from the reference line is the natural woodland buffer zone. Different vegetation removal limitations apply within each of these zones and are as follows:



Example: The Waterfront Buffer Zone and the Natural Woodland Buffer Zone

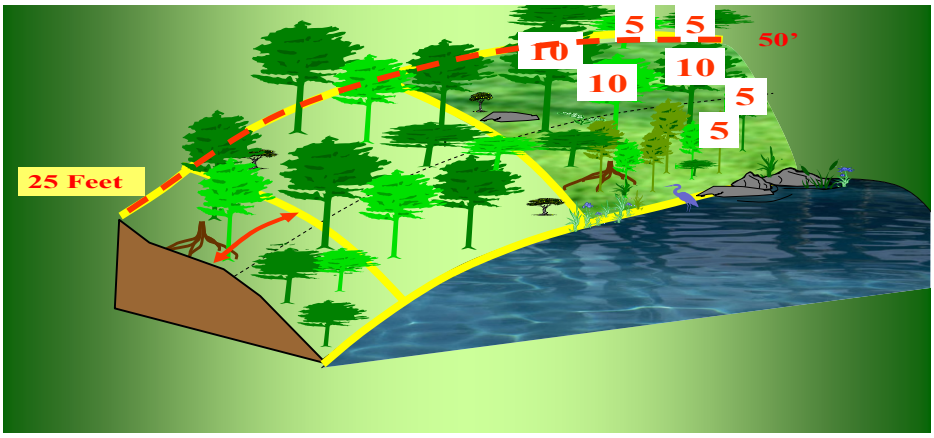
Vegetation maintenance within the Waterfront Buffer

Within the Waterfront Buffer, branches may be trimmed, pruned, and thinned to the extent necessary to protect structures, maintain clearances and provide views. Limbing of branches for the purpose of providing views is limited to the bottom half of trees and saplings to help ensure the health of the tree or sapling. Owners of lots that were legally developed prior to July 1, 2008,

that have cleared areas within the waterfront buffer such as existing lawns or beaches are not required to replant or restore these areas and owners may continue to maintain these areas as they have in the past. Expanding existing beaches, replenishing existing beaches with additional sand or constructing a new perched beach requires a Wetland Permit under RSA 482-A.

Ground cover is protected within the Waterfront Buffer. Vegetation generally less than 3 feet in height, rocks, stumps and their root systems must be left intact in the ground unless removal is specifically approved by the department or rocks and stumps are removed for the purpose of planting new trees or other woody vegetation. Clearing ground cover for a foot path to access public waters, natural areas and shoreline or cutting those portions that have grown over three feet in height for the purpose of providing views is permissible. A permanent 6-foot wide foot path to access docks, beaches, structures, existing open areas, and the waterbody is allowed provided it is configured in a manner that does not concentrate stormwater or contribute to erosion. All rock and stump removal activities that require the use of mechanized equipment or construction of a new, impervious walkway requires a shoreland impact permit.

Live trees and saplings may be removed provided that certain criteria are met. Starting from the most northerly or easterly boundary property boundary, and working along the shoreline, divide the waterfront buffer into 50 feet x 50 feet grid segments. Within each grid segment a minimum combined tree, sapling, shrub and groundcover point score of at least 50 points must be maintained. If for any reason there is insufficient area for a full segment, the number of points required to be maintained is proportional to the requirement of a full segment. For instance, a segment that measures 25 feet x 50 feet, would only need to maintain at least 25 points worth of trees, saplings, shrubs and ground cover.



Example: Lot with two full grid segments and one partial grid segment.

To determine if trees and saplings can be removed, the owner must first verify that at least the minimum tree, sapling, shrub and groundcover point score will remain within the affected grid segment. To accomplish this, at a height of 4.5 feet above the ground, on the uphill side, measure the tree and sapling diameter within each grid segment and score in accordance with the table below. If nursery stock is present, measure the tree diameter with a caliper at a height consistent with established nursery industry standards. Determine the shrub and ground cover score in accordance with the table below. Once the tree, sapling, shrub and groundcover score reaches the minimum score required to remain within a grid segment, then trees and saplings beyond the minimum score may be removed from the grid segment. If the score within a grid segment is less than the required minimum score, then trees and saplings may not be removed. The stumps of felled trees and saplings may be ground flush to ground surface but the stump and root systems

must remain in the ground unless the stump area is replanted with new trees or other woody vegetation. Care must be taken to avoid removal of surrounding ground cover.

Calculating the tree, sapling, shrub and ground cover score within a 50 foot by 50 foot segment:

Determine each tree and sapling diameter 4.5 feet above the ground, uphill side. If nursery stock is present, measure the trees with a caliper at a height consistent with established nursery industry standards

Diameter of Tree or Sapling	Score
1 to 3 inches	1pt
Greater than 3 to 6 inches	5 pts
Greater than 6 to 12 inches	10 pts
Greater than 12 inches to 24 inches	15 pts
Greater than 24 inches	25 pts

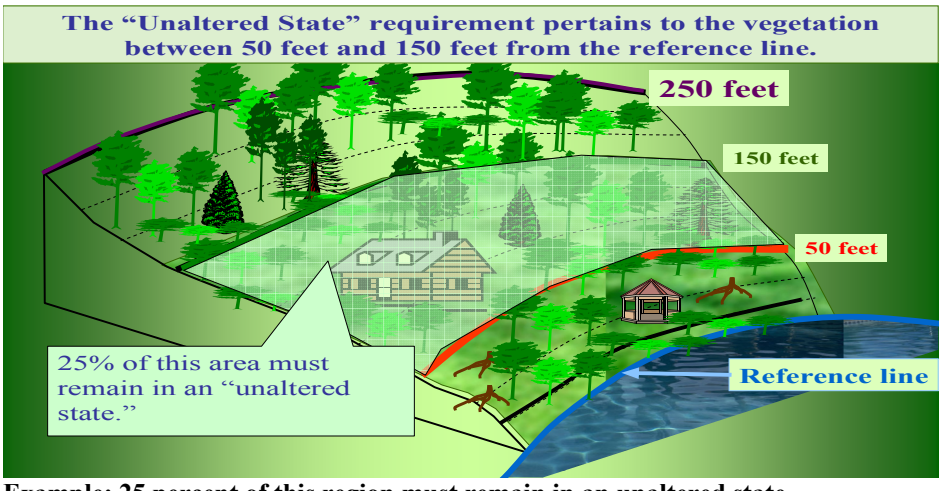
Shrubs and groundcover are scored as follows but, shall not account for more than 25 points within each full grid segment.

4 square feet of shrub area	1 pt
50 square feet of ground cover	1 pt

If possible, owners are encouraged to retain dead trees as they provide valuable wildlife habitat and nesting opportunities. However, dead, diseased or unsafe trees are not included in the scoring and may be removed at any time provided that damage to surrounding trees and natural groundcover is minimized and erosion and sedimentation to the waterbody is prevented.

No fertilizer, except limestone, can be used within 25 feet of the reference line. Beyond 25 feet, slow or controlled release fertilizer may be applied.

Vegetation maintenance within the Natural Woodland Buffer
Within the Natural Woodland Buffer, 25 percent of this region must be left in an unaltered state. "Unaltered State" means vegetation allowed to grow without cutting, limbing, trimming, pruning, mowing or other similar activities except as needed for plant health, normal maintenance and renewal.



Example: 25 percent of this region must remain in an unaltered state.

Owners of lots legally developed or landscaped prior to July 1, 2008, that do not comply with this standard are encouraged to but, shall not be required to increase the percentage of area to be maintained in an unaltered state. Owners of lots that do not currently meet this standard are not permitted to further decrease the area existing in an unaltered state.

Lawns are modified surfaces and are not considered unaltered areas. This does not prevent raking existing lawns and landscaped areas, the removal of non-native or invasive species, or the removal of dead vegetation.

Dead, diseased, or unsafe trees, limbs, saplings or shrubs that pose an imminent hazard to structures or have the ability to cause personal injury may be removed from the natural woodland buffer, even areas that are to remain in an unaltered state. However, preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

For more information

For more information about the Shoreland Water Quality Protection Act and the DES Shoreland Program, please go to http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm or contact the program at(603) 2712147 or shoreland@des.nh.gov.

Town	River / Stream Name	Where River/ Stream becomes jurisdictional under the SWQPA	Lake / Pond Name	a.k.a.	Size in Acres	Surface Elevation
Franklin	**Merrimack River - *Designated Segment***	From the confluence of the Winnipesaukee and Pemigewasset Rivers to Garvin Falls in Bow	**Giles Pond**		32	405
	Merrimack River	Juncture of Pemigewasset & Winnipesaukee Rivers	**Webster Lake**		612	401
	Pemigewasset River - *Designated Segment*	From the outlet of Profile Lake in Franconia Notch State Park to the southern boundary of Franconia State Park and from the northernmost Thornton town line to the confluence with the Merrimack River in Franklin				
	Pemigewasset River	Juncture of Harvard Brook in Lincoln				
	Winnipesaukee River	Outflow of Paugus Bay, Lake Winnipesauke in Lakeport (Laconia)				
Freedom	**Ossipee River**	Outflow of Lake Ossipee	**Berry Bay**		145.3	407.25
	Stony Brook	Juncture of unnamed 3rd order stream	**Broad Bay**		463.8	407.25
			Duck Pond		37.1	434
			Leavitt Bay		176.2	407.25
			Little Loon Pond	Round Pond	13.4	388
			Loon Lake		191.7	388
			Lower Danforth Pond		31.9	408
			Middle Danforth Pond		51	408
			Ossipee Lake		3091.8	407.25
			Shaw Pond	Shawtown Pond	15.4	435
			Trout Pond	Stacy Pond	24.7	670
			Upper Danforth Pond		39.6	406
Fremont	**Exeter River - *Designated Segment***	From the headwaters at the Route 102 bridge in Chester to its confluence with Great Brook in Exeter.	**Loon Pond**		10.8	175
	Exeter River	Juncture of unnamed 3rd order stream in Sandown				
	Unnamed	Junction of two unnamed 3rd order streams				
Gilford			**Lily Pond**		51.3	531
			Round Pond		18.5	1643
			Saltmarsh Pond		30.9	828
			Winnipesaukee Lake		44586	504.32

Natural Resource Inventory

APPENDIX E: NH FISH & GAME – LAKE STOCKING MAPS

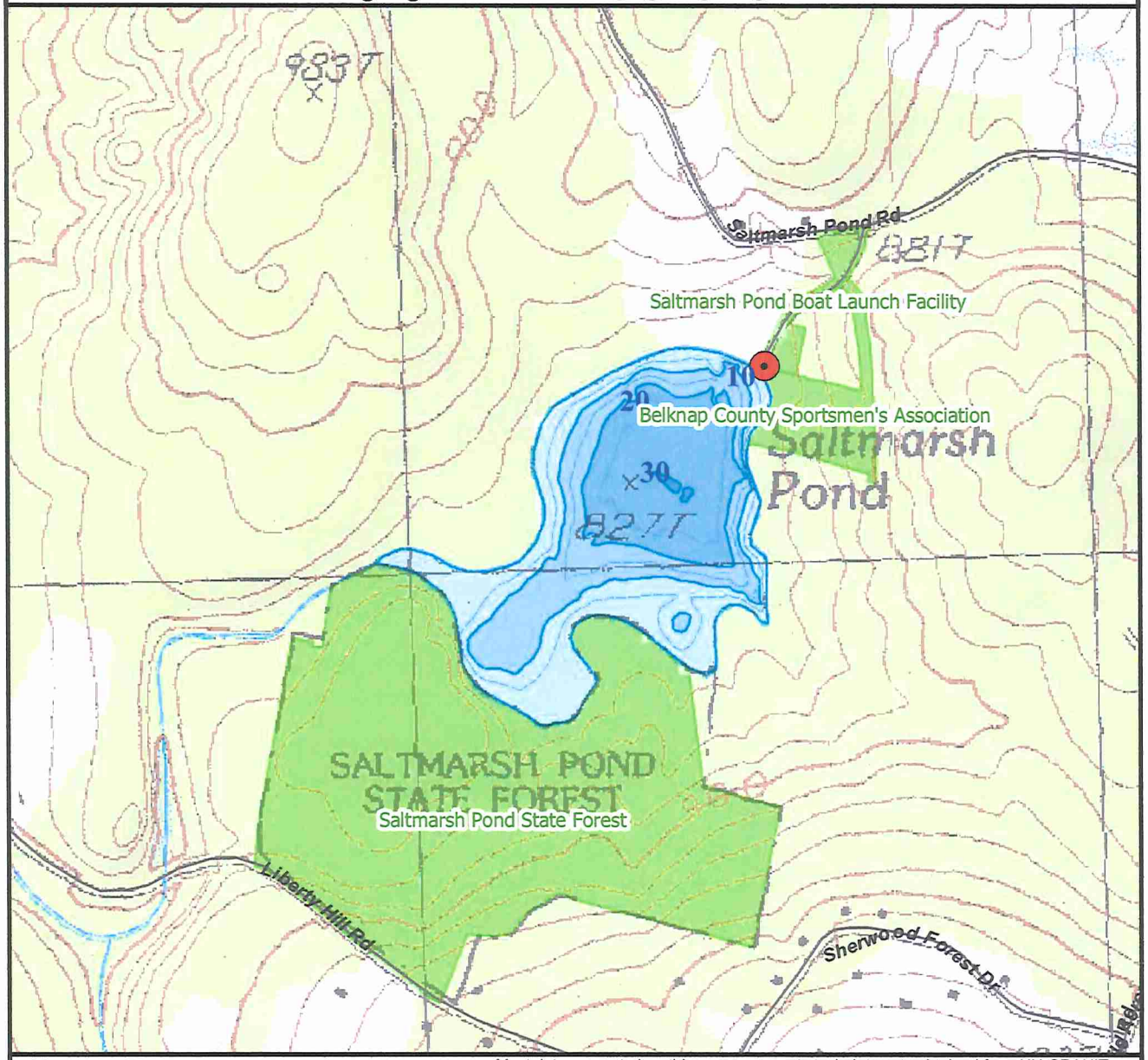
For regulation information, please refer to the NHFGD Freshwater Fishing Digest.

Contact: NHFGD Region 2 (Lakes Region), New Hampton
E-mail: reg2@nhfgd.org Phone: 603-744-5470

SALTMARSH POND
Gilford

FISHERY: Coldwater ACRES: 31
TROPHIC LEVEL: MESO
AVG DEPTH: 10 MAX DEPTH: 26
SPECIES: EBT,RT
ADDITIONAL INFO: restroom facility; No motors
ACCESS: NHFG canoe/cartop, small trailers; shoreline fishing

Contact NH Dept of Safety, Marine Patrol Bureau for information regarding waterbody restrictions (603) 293-0091



Water Access site (State, Federal, or Road-to-Public-Water)

Bathymetric contour

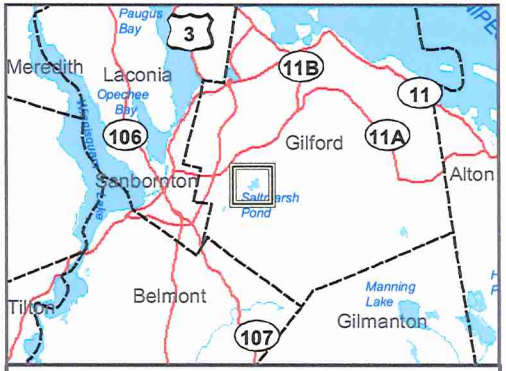
Bathymetry (depth in feet)

- Less than 10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- Greater than 50

Bathymetry data provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation Land
- Restricted Access Conservation
- Cleared
- Forest
- Contour
- Building

Source: USGS



Directions: Rte 11A to Saltmarsh Pond Rd 1.2 mi on R

N

0 500 1,000 Feet

0 0.1 0.2 Miles

Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT FOR NAVIGATION.

DEPARTMENT of ENVIRONMENTAL SERVICES
Water Division - Watershed Management Bureau

LAKE TROPHIC DATA

MORPHOMETRIC:

1 hectare = 2.47 Ac

Lake:	SALTMARSH POND	**Lake Area (ha):**	15.78 = 39 Ac
Town:	GILFORD	**Maximum Depth (m):**	8
County:	BELKNAP	**Mean Depth (m):**	3.2
River Basin:	MERRIMACK	**Volume (m^3):**	396000
Latitude:	43°43'31" N	**Relative depth:**	2
Longitude:	71°71'25" W	**Shore Configuration:**	1.43
Elevation (ft) :	828	**Areal water load (m/yr):**	5.05
Shore length (m):	1800	**Flushing Rate (yr^{-1}):**	1.6
% Watershed Ponded:	0	**P retention coeff.:**	0.7
Watershed Area (ha)	124.8	**Lake Type**	natural

BIOLOGICAL:		**19-Feb-04**	**02-Aug-03**
DOM. PHYTOPLANKTON (% TOTAL)	#1	ASTERIONELLA 55%	DINOBRYON 75%
	#2	RHIZOSOLENIA 18%	CHRYSOSPHAERELLA 12%
	#3	SYNURA 11%	SYNURA 3%
CHLOROPHYLL-A (ug/L)			7.16
DOM. ZOOPLANKTON (% TOTAL)	#1	ciliate spp. 56%	KELLICOTTIA 21%
	#2	POLYARTHRA 15%	rotifer spp. 21%
	#3	NAUPLIUS LARVA 9%	CALANOID COPEPODS 15%
ROTIFERS/LITER		44	105
MICROCRUSTACEA/LITER		21	85
ZOOPLANKTON ABUNDANCE (#/L)		150	223
VASCULAR PLANT ABUNDANCE			Common
SECCHI DISK TRANSPARENCY (m)			3.6
BOTTOM DISSOLVED OXYGEN (mg/L)		4.8	0.3
BACTERIA (E. coli, #/100ml)	#1		<10
	#2		<5
	#3		

SUMMER THERMAL STRATIFICATION:

stratified

Depth of thermocline (m):	5
Hypolimnion volume (m^3):	69500
Anoxic Volume (m^3):	30500

CHEMICAL:

Lake: SALTMARSH POND
Town: GILFORD

	19-Feb-04		04-Aug-03		
DEPTH (M)	3.0	6.0	2.0	5.0	7.0
pH (units)	6.4	6.2	6.9	6.6	6.3
A.N.C. (Alkalinity)	5.9	6.4	5.6	6.3	9.4
NITRATE NITROGEN	< 0.05	0.07	0.07		0.06
TOTAL KJELDHAL NITROGEN	0.60	0.50	< 0.25	0.30	0.30
TOTAL PHOSPHORUS	0.008	0.009	0.006	0.008	0.019
CONDUCTIVITY (umhos/cm)	188.1	203.0	181.3	189.2	222.0
APPARENT COLOR (CPU)	17	17	20	20	22
MAGNESIUM			1.58		
CALCIUM			5.8		
SODIUM			22.5		
POTASSIUM			0.98		
CHLORIDE	42	46	42		53
SULFATE	6	6	5		5
TN : TP	78	63	33		19
CALCITE SATURATION INDEX					

All results in mg/L unless indicated otherwise

TROPHIC CLASSIFICATION: 2003

D.O.	S.D.	PLANT	CHL	TOTAL	CLASS
6	2	3	1	12	MESO

COMMENTS:

1. No motor boats allowed.
2. Previously surveyed in 1979. No change in trophic class and little change in trophic quality between the two years, although the chlorophyll doubled (from 3.8 to 7.2). More frequently collected data is needed to determine if this is a trend or part of the normal year-to-year fluctuation.
3. Good Fish & Game launch site with rest rooms.
4. One house on the pond.

Saltmarsh Pond
Gilford

5 foot depth contours

III-246

FIELD DATA SHEET

LAKE: SALTMARSH POND **TOWN:** GILFORD

DATE: 8/4/03 **WEATHER:** Overcast, warm, light breeze

DEPTH (M)	TEMP (^{o}C)	DISSOLVED OXYGEN (mg/L)	PERCENT SATURATED
0.1	23.5	8.2	96.0
1.0	23.4	8.2	96.7
2.0	23.1	8.2	96.3
3.0	22.8	8.0	93.4
4.0	22.1	7.8	89.1
5.0	16.9	13.3	137.5
6.0	12.8	9.8	92.2
7.0	10.7	2.6	23.1
7.5	10.1	0.3	2.7

SECCHI DEPTH (m) : 3.6

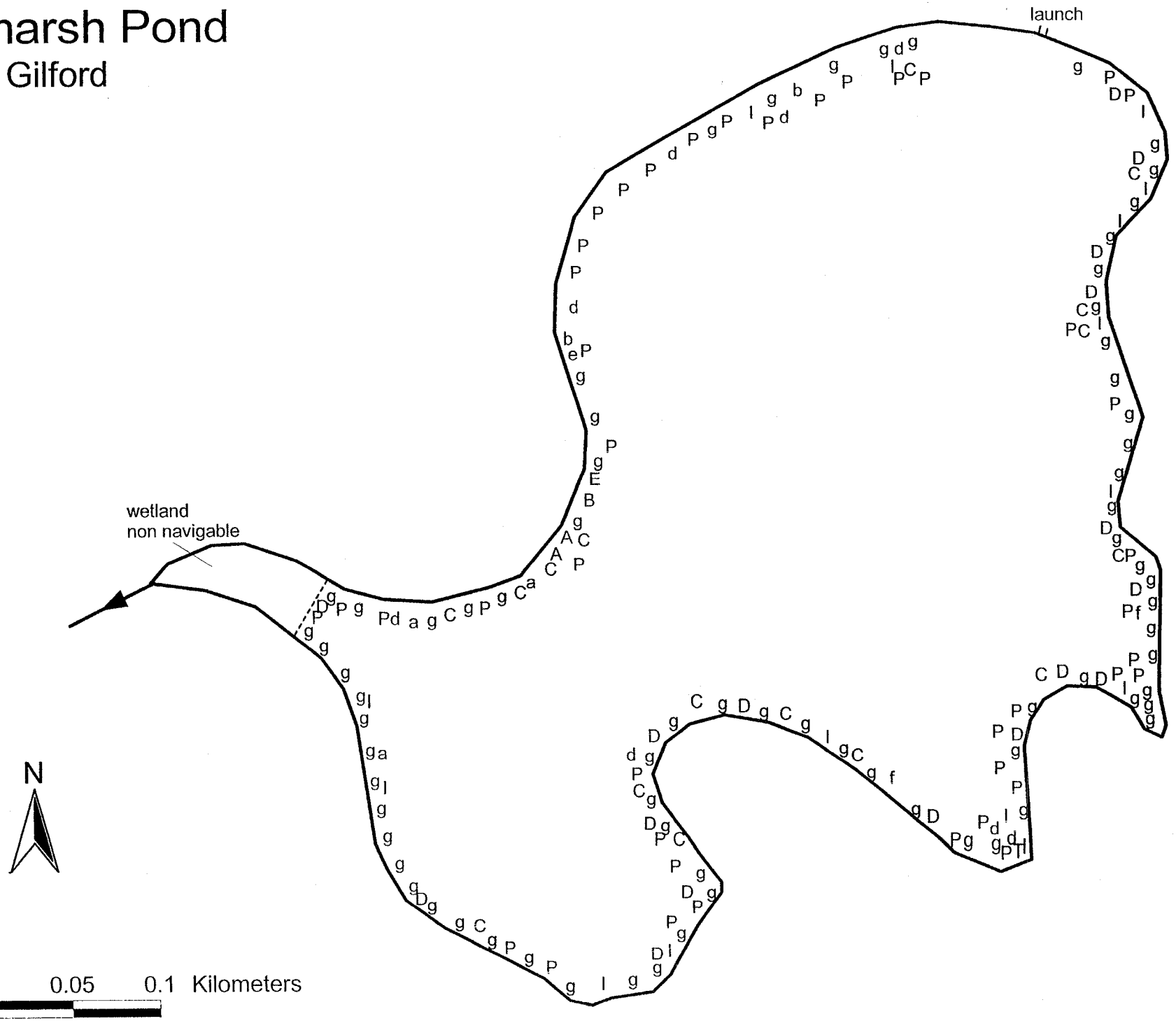
BOTTOM DEPTH (m) : 8.0

TIME: 1045

COMMENTS: Note the D.O. maxima on the thermocline at 5 meters.

Saltmarsh Pond

Gilford



AQUATIC PLANT SURVEY

LAKE: SALTMARSH POND **TOWN:** GILFORD **DATE:** 8/4/03

KEY	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
g	Myrica gale	Sweet gale	Scat/Common
C	Cyperaceae	Non-flowering sedge	Scat/Common
P	Pontederia cordata	Pickerelweed	Scat/Common
d	Dulichium arundinaceum	Three-way sedge	Scattered
I	Iris	Iris	Scattered
b	Scirpus	Bulrush	Scattered
e	Eleocharis	Spike rush	Sparse
A	Sagittaria	Arrowhead	Sparse
a	Peltandra virginica	Arrow arum	Sparse
D	Decodon verticillatus	Swamp loosestrife	Sparse
f	Polypodiaceae	Fern family	Sparse
T	Typha	Cattail	Sparse
E	Eupatorium perfoliatum	Boneset	Sparse
R	Alnus	Alder	Sparse

OVERALL ABUNDANCE : Common

GENERAL OBSERVATIONS :

1. Mostly rocky bottom with little bottom growth.
2. Dense, non-navigable plant growth was present in the outlet cove.

Dear Mr. McLaughlin -
Thank you for your phone call regarding Lily and Round ponds in Gilford. You mentioned the town is working on their Master Plan.
This email will be the first of two with the DES info I have available. Of course you may contact DES for anything they might have that is more current.

Attached is the info on Round Pond in Gilford. As I mentioned on the phone, there has been no stocking in recent history. I have the computerized records back to 1990 which shows nothing, but I asked for info from the "pre-computer" age at our headquarters. For Round Pond in Gilford there was only this notation:

Date: 6/28/1938
Game Fish Present: Brook Trout, Horned Pout.
Remarks & Recommendations: Warm water fish, horned pout.
Fish screen at outlet. Pond stocked with brook trout in 1933, 1934, 1935, 1936, but only fair results. Surveyed on cool day after rain. A week of hot weather would raise temp. of entire pond, probably beyond trout range.

I hope this is helpful. Another email will follow with the info on Lily Pond, Gilford.

Kristin Harmon, Executive Secretary
NH Fish & Game, Region 2
PO Box 417
New Hampton, NH 03256
603-744-5470

DEPARTMENT of ENVIRONMENTAL SERVICES
Water Supply & Pollution Control Division - Biology Bureau

LAKE TROPHIC DATA

MORPHOMETRIC:

Lake:	ROUND POND	Lake Area (ha):	7.49
Town:	GILFORD	Maximum depth (m):	3.3
County:	Belknap	Mean depth (m):	1.4
River Basin:	Merrimack	Volume (m^3):	101500
Latitude:	43°30'35" N	Relative depth:	1.1
Longitude:	71°20'36" W	Shore configuration:	1.13
Elevation (ft):	1643	Areal water load (m/yr):	2.89
Shore length (m):	1100	Flushing rate (yr^{-1}):	2.10
Watershed area (ha):	42.2	P retention coeff.:	0.75
% watershed ponded:	0.0	Lake type:	natural

BIOLOGICAL:		6 February 1996	5 September 1995
DOM. PHYTOPLANKTON (% TOTAL)	#1	TABELLARIA 35%	ANACYSTIS 40%
	#2	(ALL ALGAE SPARSE)	PERIDINIUM 15%
	#3		MELOSIRA 15%
PHYTOPLANKTON ABUNDANCE (units/mL)			
CHLOROPHYLL-A (µg/L)			38.41
DOM. ZOOPLANKTON (% TOTAL)	#1	KERATELLA 60%	KERATELLA 62%
	#2		CILIATE SPP. 27%
	#3		
ROTIFERS/LITER		14	192
MICROCRUSTACEA/LITER		6	18
ZOOPLANKTON ABUNDANCE (#/L)		20	295
VASCULAR PLANT ABUNDANCE			Common
SECCHI DISK TRANSPARENCY (m)			0.7
BOTTOM DISSOLVED OXYGEN (mg/L)		3.6	7.0
BACTERIA (E. coli, #/100 ml)	#1		10
	#2		
	#3		

SUMMER THERMAL STRATIFICATION:

not stratified

Depth of thermocline (m): None
Hypolimnion volume (m^3) : None
Anoxic volume (m^3) : None

CHEMICAL:

Lake: ROUND POND
Town: GILFORD

	6 February 1996		5 September 1995		
DEPTH (m)	1.0	2.5	1.0		2.0
pH (units)	5.0	4.8	6.5		6.6
A.N.C. (Alkalinity)	0.3	-0.1	2.0		2.2
NITRATE NITROGEN	0.06	0.07	< 0.10		< 0.10
TOTAL KJELDAHL NITROGEN	0.30	0.20	0.85		0.92
TOTAL PHOSPHORUS	0.011	0.009	0.024		0.026
CONDUCTIVITY (µmhos/cm)	24.9	26.0	21.8		21.7
APPARENT COLOR (cpu)	33	32	70		70
MAGNESIUM			0.28		
CALCIUM			2.0		
SODIUM			1.3		
POTASSIUM			< 0.40		
CHLORIDE	< 2	< 2	< 2		< 2
SULFATE			4		4
TN : TP	33	30	35		35
CALCITE SATURATION INDEX			4.2		

All results in mg/L unless indicated otherwise

TROPHIC CLASSIFICATION: 1995

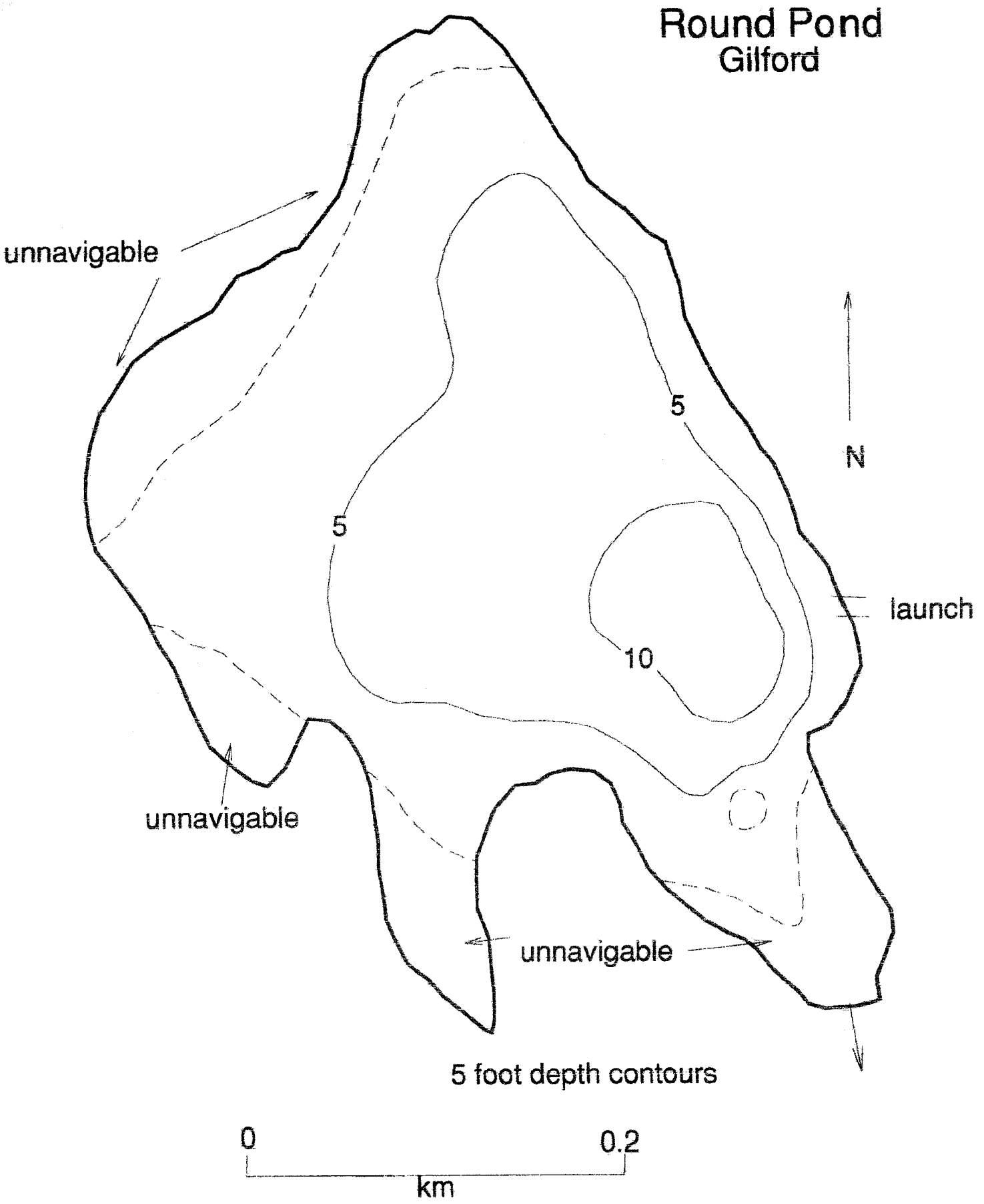
D.O.	S.D.	PLANT	CHL	TOTAL	CLASS
**	5	3	6	14	Eutro.

COMMENTS:

1. This is a remote pond, located on the southwest shoulder of Belknap Mountain, that was surveyed jointly with the Fish and Game Department.

2. This is a naturally eutrophic pond that was green with algal growth, which reduced visibility to a little over two feet. The dominant phytoplankton was a blue-green alga.

3. The pond was acidic in the winter but the summer algal bloom caused an artificial rise in pH in the summer.


Round Pond
Gilford
unnavigable
5
5
10
N
launch
unnavigable
unnavigable
5 foot depth contours
0
0.2
km

FIELD DATA SHEET

LAKE: ROUND POND
DATE: 09/05/95

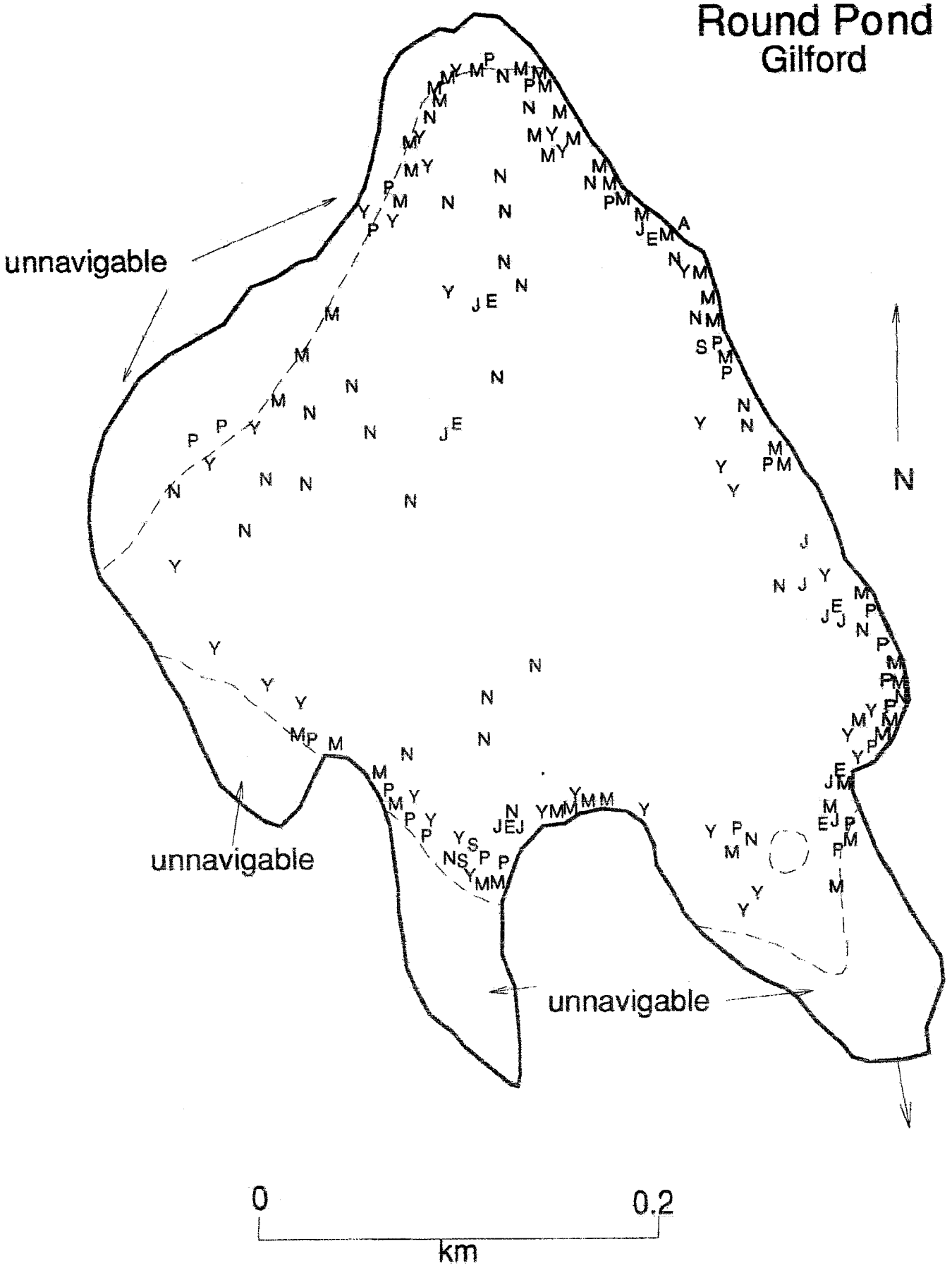
TOWN: GILFORD
WEATHER: CLOUDY & WARM; SLIGHT BREEZE

	DEPTH (M)	TEMP (°C)	*DISSOLVED OXYGEN	OXYGEN SATURATION
	0.1	19.9	8.9	94 %
	1.0	19.5	8.8	93 %
	2.0	19.0	8.3	89 %
	3.0	18.5	7.0	74 %

SECCHI DISK (m): 0.7
BOTTOM DEPTH (m): 3.3
TIME: 1100

COMMENTS:

*Dissolved oxygen values are in mg/L


Round Pond
Gilford
unnavigable
unnavigable
unnavigable
N
0
0.2
km

AQUATIC PLANT SURVEY

LAKE: ROUND POND TOWN: GILFORD DATE: 09/05/95

Key	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
P	Pontederia cordata	Pickerelweed	Scattered
N	Nymphaea	White water lily	Scattered
J	Juncus	Rush	Scattered
E	Eriocaulon septangulare	Pipewort	Scattered
Y	Nuphar	Yellow water lily	Scattered
M	Myriophyllum humile	Water milfoil	Common
S	Sparganium	Bur reed	Scattered
A	Sagittaria	Arrowhead	Sparse

OVERALL ABUNDANCE: Common

GENERAL OBSERVATIONS:

1. Plants were common in the pond proper but the coves were unnavigable due to dense woody growth (e.g., sweet gale and leatherleaf).

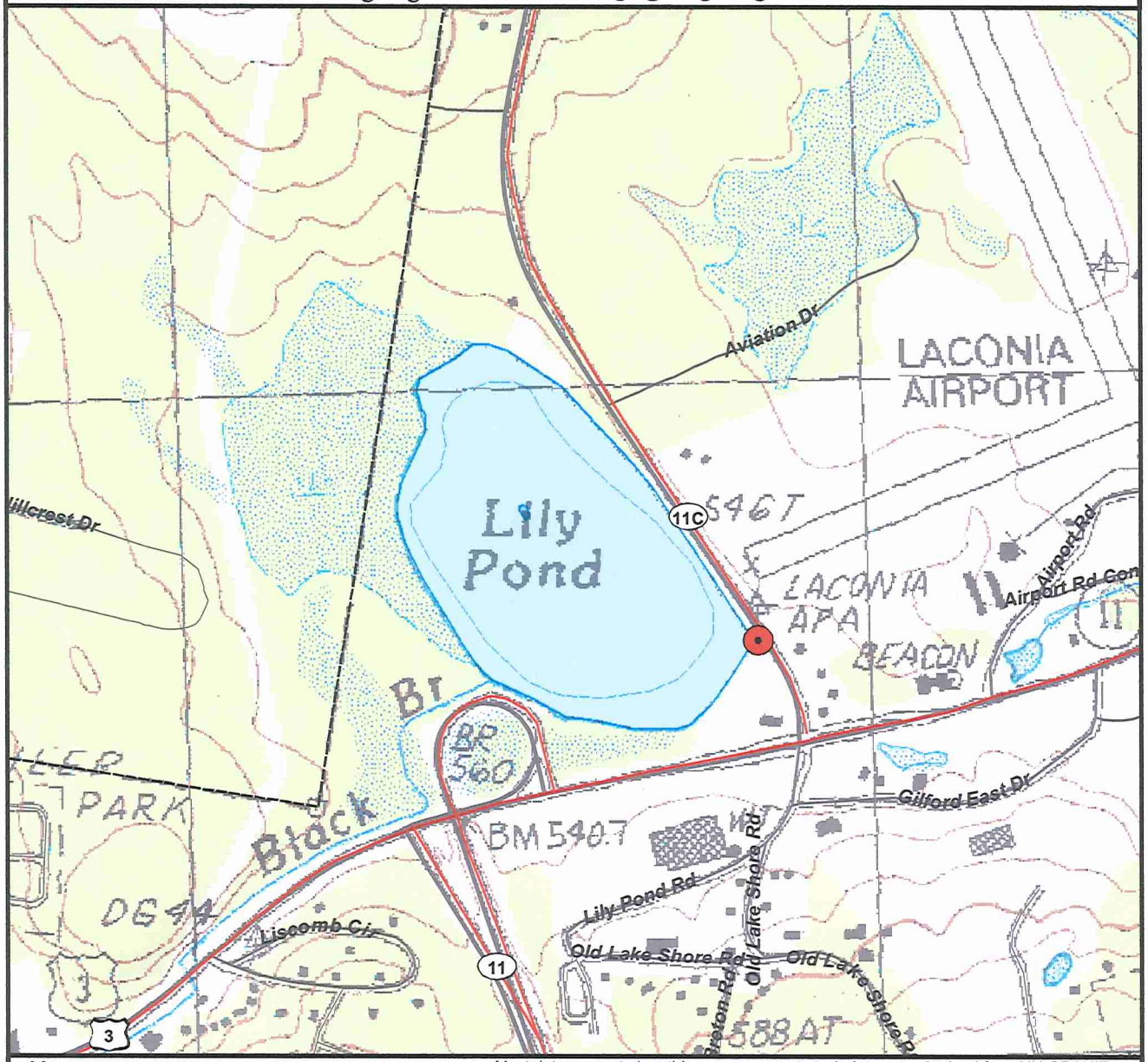
For regulation information, please refer to the NHFGD Freshwater Fishing Digest.

Contact: NHFGD Region 2 (Lakes Region), New Hampton
E-mail: reg2@nhfgd.org Phone: 603-744-5470

LILY POND
Gilford

FISHERY: Warmwater ACRES: 45
TROPHIC LEVEL: MESO
AVG DEPTH: 6 MAX DEPTH: 10
SPECIES: LMB,ECP,HP
ADDITIONAL INFO:
ACCESS: NHDOT shorebank access unimproved

Contact NH Dept of Safety, Marine Patrol Bureau for information regarding waterbody restrictions (603) 293-0091



Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT FOR NAVIGATION.

Water Access site (State, Federal, or Road-to-Public-Water)
Bathymetric contour

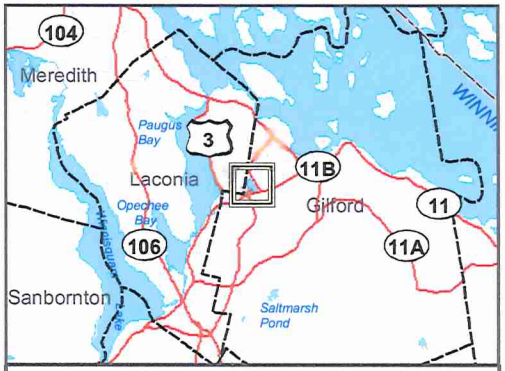
Bathymetry (depth in feet)

Less than 10	30 to 40
10 to 20	40 to 50
20 to 30	Greater than 50

Bathymetry data provided by the NH Department of Environmental Services, Watershed Mgt Bureau

Town boundary
Primary Route
Road or Street
Trail or other
Stream or Shoreline
Surface Water
Wetland
Conservation Land
Restricted Access Conservation

Cleared
Forest
Contour
Building
Source: USGS



Directions:

Mr. McLaughlin -

Again, as I mentioned on the phone, I show no stocking on Lily Pond in Gilford back to 1990. As for the historic data, the following is what they note on records that begin in 1946:

Lily Pond, Gilford
Game Fish present: Horned Pout, Pickerel, Yellow Perch
Remarks and Recommendations: warm water fish. Pickerel.

DATE	KIND	NO. PLANTED	SIZE	FROM/TO
1946	Horned Pout	1,200	6-12"	
1947	Horned Pout	25,000	Fry	
1959	Largemouth Bass	27	All sizes	
1964	Largemouth Bass	153	Yearling	7/1-12/31
1966	Largemouth Bass	3,330	All sizes	1/1-6/30
1979	Largemouth Bass	30	Adult	

If there are any other Fish & Game related questions, please do not hesitate to contact this office.

Kristin Harmon, Executive Secretary
NH Fish & Game, Region 2
PO Box 417
New Hampton, NH 03256
603-744-5470

jmsg:junomsg

10/17/2009

DEPARTMENT of ENVIRONMENTAL SERVICES
Water Supply & Pollution Control Division - Biology Bureau

LAKE TROPHIC DATA

MORPHOMETRIC:

Lake:	LILY POND	Lake Area (ha):	20.76
Town:	GILFORD	Maximum depth (m):	3.0
County:	Belknap	Mean depth (m):	1.8
River Basin:	Merrimack	Volume (m^3):	376000
Latitude:	43°34' N	Relative depth:	0.6
Longitude:	71°26' W	Shore configuration:	---
Elevation (ft):	531	Areal water load (m/yr):	3.76
Shore length (m):	1400	Flushing rate (yr^{-1}):	2.10
Watershed area (ha):	161.2	P retention coeff.:	0.71
% watershed ponded:	0.0	Lake type:	natural

BIOLOGICAL:	12 January 1988	16 July 1987
DOM. PHYTOPLANKTON (% TOTAL) #1	ASTERIONELLA 35%	DINOBRYON 40%
#2	MELOSIRA 30%	CHRYSOSPHAERELLA 25%
#3	VOLVOX 20%	MALLOMONAS 15%
PHYTOPLANKTON ABUNDANCE (cells/mL)		1485.0
CHLOROPHYLL-A (ug/L)		4.43
DOM. ZOOPLANKTON (% TOTAL) #1	KELLICOTTIA 26%	KERATELLA 61%
#2	CALANOID COPEPOD 26%	POLYARTHRA 17%
#3		NAUPLII LARVAE 12%
ROTIFERS/LITER	15	466
MICROCRUSTACEA/LITER	20	109
ZOOPLANKTON ABUNDANCE (#/L)	35	576
VASCULAR PLANT ABUNDANCE		Abundant
SECCHI DISK TRANSPARENCY (m)		2.9
BOTTOM DISSOLVED OXYGEN (mg/L)	10.6	0.2
BACTERIA (fecal col., #/100 ml) #1		< 10
#2		< 10
#3		

SUMMER THERMAL STRATIFICATION:

weakly stratified

Depth of thermocline (m): None
Hypolimnion volume (m^3): None

CHEMICAL:

Lake: LILY POND
Town: GILFORD

	12 January 1988		16 July 1987		
DEPTH (m)	1.0	2.0	1.0		2.0
pH (units)	6.3	6.5	6.8		6.8
A.N.C. (Alkalinity)	13.8	12.0	10.5		10.8
NITRATE NITROGEN	0.06	0.07	< 0.05		< 0.05
TOTAL KJELDAHL NITROGEN	0.63	0.31	0.62		0.36
TOTAL PHOSPHORUS	0.011	0.024	0.020		0.014
CONDUCTIVITY (μ mhos/cm)	164.9	163.7	134.9		133.2
APPARENT COLOR (cpu)	27	25	36		36
MAGNESIUM			1.47		
CALCIUM			4.7		
SODIUM			19.0		
POTASSIUM			1.20		
CHLORIDE	33	32	27		27
SULFATE	6	6	4		4
TN : TP	63	16	31		26
CALCITE SATURATION INDEX			2.8		

All results in mg/L unless indicated otherwise

TROPHIC CLASSIFICATION: 1987

D.O.	S.D.	PLANT	CHL	TOTAL	CLASS
5	2	3	0	10	Meso.

COMMENTS:

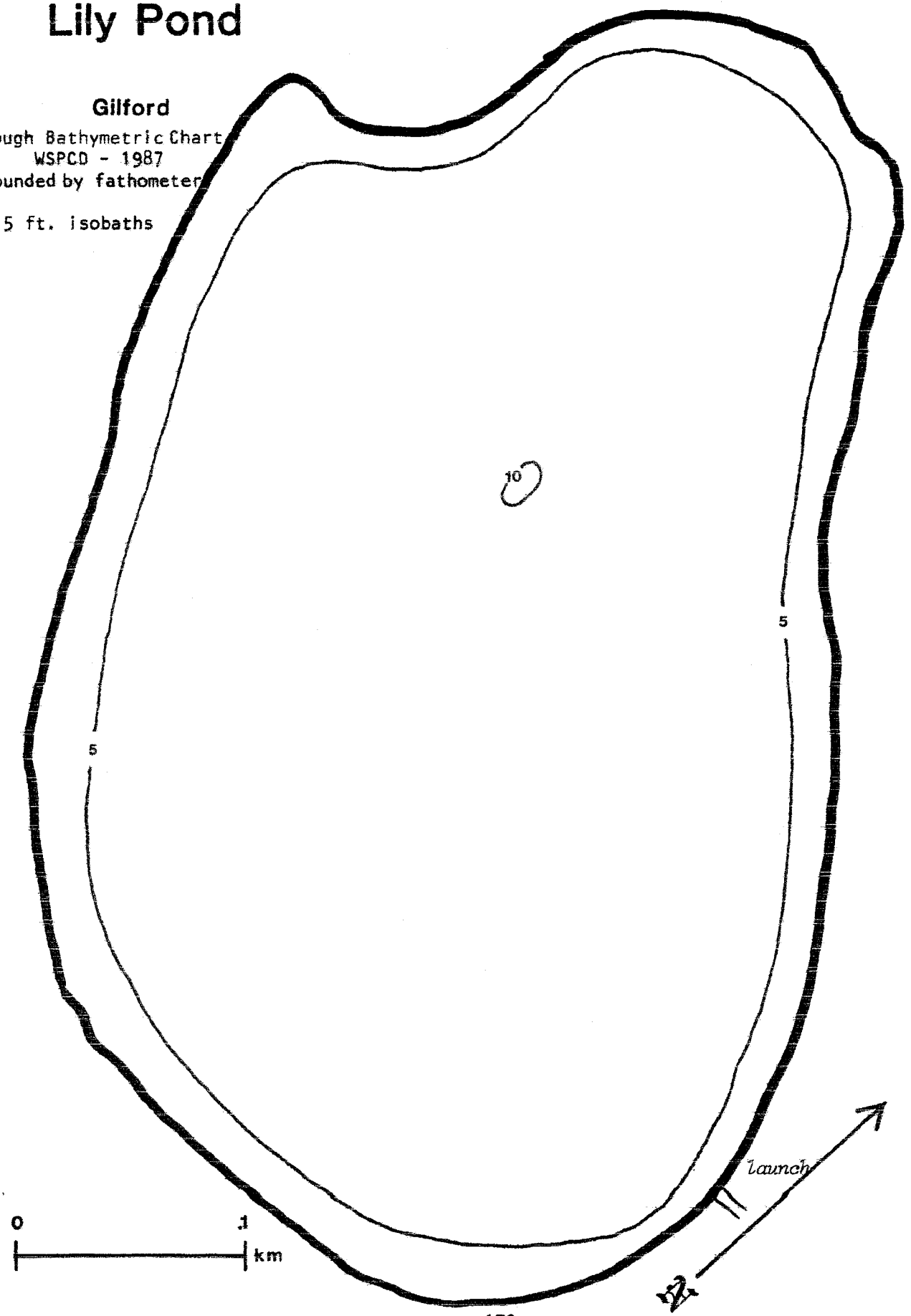
1. The whole-water phytoplankton was 50% greens and 35% cryptomonads. Dominant genera were tiny green flagellates (40%) and Chroomonas (25%).

Lily Pond

Gilford

Rough Bathymetric Chart
WSPCD - 1987
sounded by fathometer

5 ft. isobaths



FIELD DATA SHEET

LAKE: LILY POND
DATE: 07/16/87

TOWN: GILFORD
WEATHER: SUNNY, DRY & WARM

	DEPTH (M)	TEMP (°C)	*DISSOLVED OXYGEN	OXYGEN SATURATION
	0.1	25.8	7.3	88 %
	1.0	25.0	7.4	89 %
	2.0	24.8	7.0	83 %
	3.0	22.2	0.2	2 %

SECCHI DISK (m): 2.9

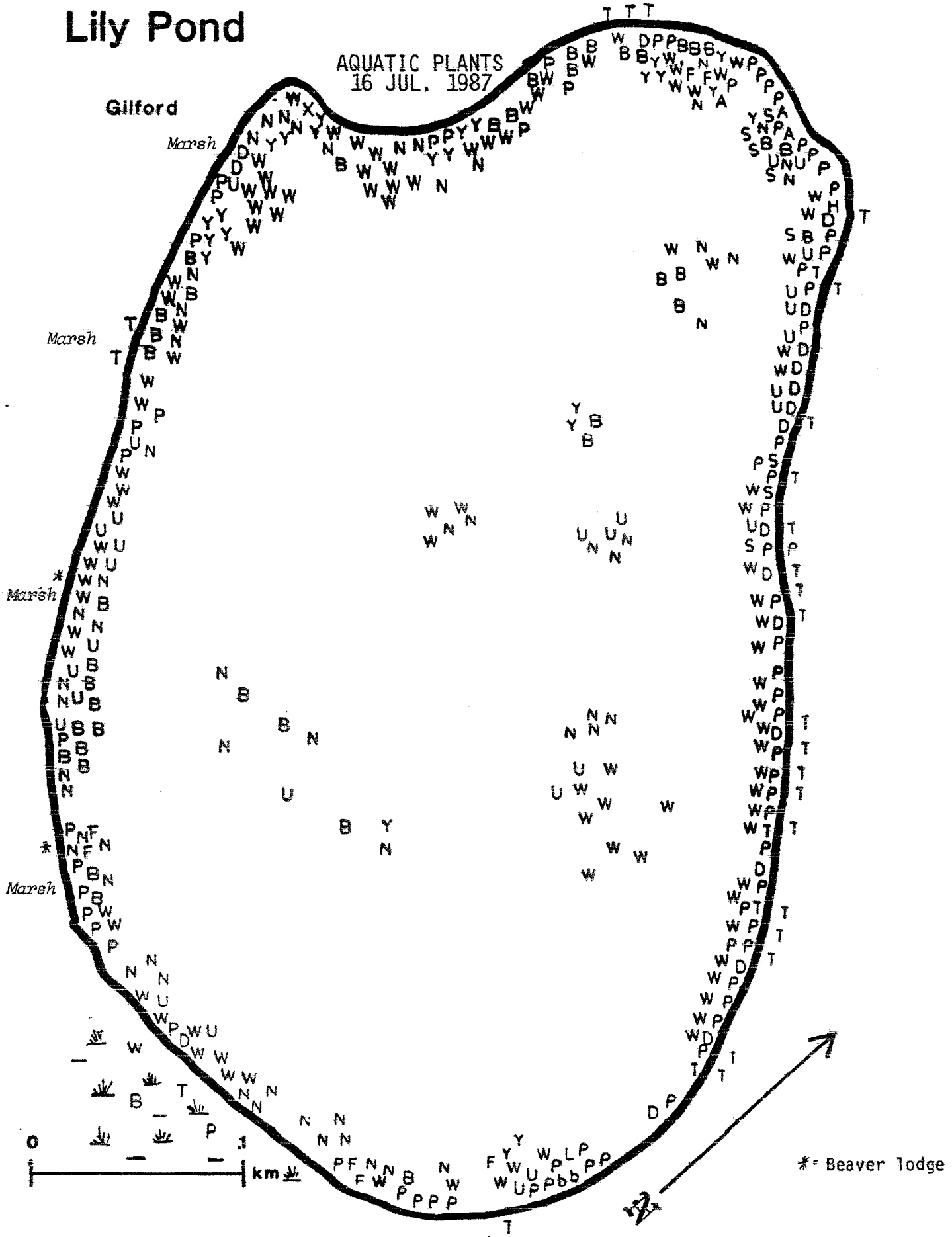
BOTTOM DEPTH (m): 3.3

TIME: 1140

COMMENTS:
A D.O. depletion occurred in the bottom waters despite the lack of a thermocline and hypolimnion.

*Dissolved oxygen values are in mg/L

Lily Pond


AQUATIC PLANTS
16 JUL. 1987
Gilford
Marsh
Marsh
Marsh
0
1
km
*= Beaver lodge

AQUATIC PLANT SURVEY

LAKE: LILY POND TOWN: GILFORD DATE: 07/16/87

Key	PLANT NAME		ABUNDANCE
	GENERIC	COMMON	
S	Sparganium	Bur reed	Sparse
U	Utricularia	Bladderwort	Scattered
P	Pontederia cordata	Pickerelweed	Common
N	Nymphaea	White water lily	Common
Y	Nuphar	Yellow water lily	Scattered
A	Sagittaria	Arrowhead	Sparse
H	Hypericum	St. John's-wort	Sparse
D	Dulichium arundinaceum	Three-way sedge	Sparse
W	Potamogeton	Pondweed	Common
B	Brasenia schreberi	Water shield	Common
F	Nymphoides cordatum	Floating heart	Scattered
T	Typha	Cattail	Common
L	Lythrum salicaria	Purple loosestrife	Sparse
b	Scirpus	Bulrush	Scattered
X		Sterile thread-like leaf	Scattered

OVERALL ABUNDANCE: Abundant

GENERAL OBSERVATIONS:

1. This is a shallow, weedy pond with a marsh along the entire western and southern shores. A fire tower practice area was located at the northern end.
2. Two beaver huts were observed.

Natural Resource Inventory

APPENDIX F: STORMWATER MANAGEMENT MODEL ORDINANCE

Model Language and Guidance for Implementation

PERMANENT (POST-CONSTRUCTION) STORMWATER MANAGEMENT MODEL ORDINANCE

I. PURPOSE

To protect, maintain and enhance the public health, safety, environment, and general welfare by establishing minimum requirements and procedures to control the adverse affects of increased post-development stormwater runoff, decreased groundwater recharge, and non-point source pollution associated with new development and redevelopment.

II. AUTHORITY

The provisions of this Article are adopted pursuant to RSA 674:16, Grant of Power, RSA 674:17, Purposes of Zoning Ordinance, and RSA 674:21, Innovative Land Use Controls.

III. APPLICABILITY

The requirements of this Article shall apply to land disturbance, development, and/or construction activities in all zoning district(s).

IV. DEFINITIONS

> Communities should review existing definitions sections prior to the adoption of any of the following definitions to avoid duplication or conflicting definitions.

Best Management Practice (BMP): Structural, non-structural and managerial techniques that are recognized to be the most effective and practical means to prevent and/or reduce increases in stormwater volumes and flows, reduce point source and non-point source pollution, and promote stormwater quality and protection of the environment.

Curve Number (CN): A numerical representation used to describe the stormwater runoff potential for a given drainage area based on land use, soil group, and soil moisture, derived as specified by the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS).

Developer: A person who undertakes or proposes to undertake land disturbance activities.

Development: For the purposes of this article, development refers to alterations to the landscape that create, expand or change the location of impervious surfaces or alters the natural drainage of a site.

Disconnected Impervious Cover: Impervious cover that does not contribute directly to stormwater runoff from a site, but directs stormwater runoff to on-site pervious cover to infiltrate into the soil or be filtered by overland flow so that the net rate and volume of stormwater runoff

from the disconnected impervious cover is not greater than the rate and volume from undisturbed cover of equal area.

Drainage Area: Means a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

Effective Impervious Cover: Impervious cover that is not disconnected impervious cover.

Erosion: The detachment and movement of soil, rock, or rock fragments by water, wind, ice or gravity.

Impervious Cover: A structure or land surface with a low capacity for infiltration, including but not limited to pavement, roofs, roadways, and compacted soils, that has a Curve Number of 98 or greater.

Infiltration: The process by which water enters the soil profile (seeps into the soil).

Land Disturbance or Land Disturbing Activity: For the purposes of this Article, refers to any exposed soil resulting from activities such as clearing of trees or vegetation, grading, blasting, and excavation.

Owner: A person with a legal or equitable interest in a property.

Pervious Cover: A land surface with a high capacity for infiltration.

Recharge: The amount of water from precipitation that infiltrates into the ground and is not evaporated or transpired.

Redevelopment: The reuse of a site or structure with existing man-made land alterations. A site is considered a redevelopment if it has 35 percent or more of existing impervious surface, calculated by dividing the total existing impervious surface by the size of the parcel and convert to a percentage.

Regulated Substance: A “regulated substance” as defined in Env-Ws 421.03(f) or successor rule, Env-Wq 401.03(h).

Sediment: Solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

Sensitive Area: For the purpose this Article include lakes, ponds, perennial and intermittent streams, vernal pools, wetlands, and highly erodable soils.

Sheet flow: Runoff that flows or is directed to flow across a relatively broad area at a depth of less than 0.1 feet for a maximum distance of 100 feet in such a way that velocity is minimized.

Site: The lot or lots on upon which development is to occur or has occurred.

Stormwater: Water resulting from precipitation (including rain and snow) that runs off the land’s surface, is transmitted to the subsurface, or is captured by separate storm sewers or other drainage facility.

Stormwater Runoff: Water flow on the surface of the ground or in storm sewers, resulting from precipitation.

Total Impervious Cover: The sum of Disconnected Impervious Cover plus Effective Impervious Cover.

Undisturbed Cover: A natural land surface whose permeability has not been altered by human activity.

Vegetation: Is defined to include a tree, plant, shrub, vine or other form of plant growth.

Wellhead Protection Area: As defined in RSA 485-C:2, XVIII, the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field.

V. STORMWATER MANAGEMENT PLAN

All developments disturbing greater than 20,000 square feet of area shall submit a permanent (post-construction) Stormwater Management Plan (SMP) with an application for subdivision or site plan review. The permanent SMP, which shall be prepared by a licensed New Hampshire, professional engineer, shall address and comply with the requirements set forth herein and as specified by the planning board.

> Each community should decide whether it wants to require a separate management plan and, if so, what size development or disturbed area is subject to this requirement. A community might also decide to restrict the applicability of additional provisions from this model ordinance to larger developments or developments in more sensitive

VI. PERMANENT STORMWATER MANAGEMENT REQUIREMENTS

All development activity must comply with the following provisions to reduce and properly manage stormwater post-construction:

A. Maximum effective impervious cover shall not exceed 10 percent of a site. Impervious cover may be disconnected from the stormwater drainage network, to reduce total effective impervious cover, through such techniques as infiltration or sheet flow over a pervious area.

> As noted in the definitions, Effective Impervious Cover is different from Impervious Cover. For example, to comply with this section, a site that creates 50 percent impervious cover must provide ample opportunities to capture and infiltrate stormwater to reduce the amount of stormwater leaving the site to be equivalent to having just 10 percent impervious cover (i.e., the site has 10 percent effective impervious cover).

B. BMP techniques shall be used to meet the conditions below for control of peak flow and total volume of runoff, water quality protection, and maintenance of on-site groundwater recharge.

1. Stormwater management practices shall be selected to accommodate the unique hydrologic and geologic conditions of the site.

> An example of a site condition that should be factored into the stormwater management approach is soil type. The areas of a site with the best soils for infiltration should be preserved to maintain natural infiltration or set aside to be used

2. The use of nontraditional and/or nonstructural stormwater management measures, including site design approaches to reduce runoff rates, volumes, and pollutant loads, are preferred and shall be implemented to the maximum extent practical. Such techniques include, but are not limited to, minimization and/or disconnection of impervious surfaces; development design that reduces the rate and volume of runoff; restoration or enhancement of natural areas such as riparian areas, wetlands, and forests; and use of practices that intercept, treat, and infiltrate runoff from developed areas distributed throughout the site (e.g. bioretention, infiltration dividers or islands, or planters and raingardens). Applicants shall demonstrate why the use of nontraditional and/or nonstructural approaches are not possible before proposing to use traditional, structural stormwater management measures (e.g., stormwater ponds, vegetated swales).
3. The applicant shall demonstrate how the proposed control(s) will comply with the requirements of this ordinance, including the control of peak flow and total volume of runoff, protection of water quality, and recharge of stormwater to groundwater. The applicant must provide design calculations and other back-up materials necessary.
4. At the discretion of the planning board, stormwater management systems shall incorporate designs that allow for shutdown and containment in the event of an emergency spill or other unexpected contamination event.

> Communities may wish to include a provision to require emergency shutdown and containment, particularly in commercial and industrial areas or in drinking water supply areas, as an added protection against contamination of surface waters or

5. Stormwater management systems shall not discharge to surface waters, ground surface, subsurface, or groundwater within 100 feet of a surface water within a water supply intake protection area.
6. Stormwater management systems shall not discharge within the setback area for a water supply well as specified in the following table:

> The NHDES Alteration of Terrain program provides for exemptions to the above standards (5) and (6) for stormwater management systems that discharge stormwater form areas less than 0.5 acres and that do not and will not receive stormwater from high-load area. The exemption is designed to encourage low impact development.

Well Type	Well Production Volume (gallons per day)	Setback from Well (feet)
Private Water Supply Well	Any Volume	75
Non-Community Public Water Supply Well	0 to 750	75
	751 to 1,440	100
	1,441 to 4,320	125
	4,321 to 14,400	150
Community Public Water Supply Well	0 to 14,400	150
Non-Community and Community Public Water Supply Well	14,401 to 28,800	175
	28,801 to 57,600	200
	57,601 to 86,400	250
	86,401 to 115,200	300
	115,201 to 144,000	350
	Greater than 144,000	400

7. BMPs shall be designed to convey a minimum design storm event, as described in the table below, without overtopping or causing damage to the stormwater management facility.

Treatment Practice	Design Storm Event
Stormwater Pond	50-year, 24-hour storm
Stormwater Wetland	50-year, 24-hour storm
Infiltration Practices	10-year, 24-hour storm
Filtering Practices	10-year, 24-hour storm
Flow through Treatment Swales	10-year, 24-hour storm

C. Protection of natural hydrologic features and functions.

1. Site disturbance shall be minimized. Vegetation outside the project disturbance area shall be maintained. The project disturbance area shall be depicted on site plans submitted as part of the site plan review process. The project disturbance area shall include only the area necessary to reasonably accommodate construction activities. The applicant may be

required to install construction fencing around the perimeter of the proposed project disturbance area prior to commencing land disturbance activities.

2. Soil compaction on site shall be minimized by using the smallest (lightest) equipment possible and minimizing travel over areas that will be revegetated (e.g., lawn areas) or used to infiltrate stormwater (e.g., bioretention areas). In no case shall excavation equipment be placed in the base of an infiltration area during construction.
3. Development shall follow the natural contours of the landscape to the maximum extent possible. A grading plan shall be submitted as part of the site plan review process showing both existing and finished grade for the proposed development.
4. Cut and fill shall be minimized. The maximum height of any fill or depth of any cut area, as measured from the natural grade, shall not be greater than 10 feet.
5. Any contiguous area of disturbance, not associated with the installation of a roadway, shall be limited to 20,000 square feet for residential development and to 100,000 square feet for other types of development. Contiguous areas of disturbance shall be separated by an area maintained at natural grade and retaining existing, mature vegetated cover that is at least 20 feet wide at its narrowest point.

Communities may decide to allow a larger contiguous area of disturbance overall or in certain areas where appropriate, such as in areas zoned for larger-scale commercial or

6. No ground disturbed as a result of site construction and development shall be left as exposed bare soil at project completion. All areas exposed by construction, with the exception of finished building, structure, and pavement footprints, shall be decompacted (aerated) and covered with a minimum thickness of six inches of non-compacted topsoil, and shall be subsequently planted with a combination of living vegetation such as grass, groundcovers, trees, and shrubs, and other landscaping materials (mulch, loose rock, gravel, stone).
7. Priority shall be given to maintaining existing surface waters and systems, including, but not limited to, perennial and intermittent streams, wetlands, vernal pools, and natural swales.
    a. Existing site hydrology shall not be modified so as to disrupt on-site and adjacent surface waters. The applicant must provide evidence that this standard can be achieved and maintained over time.
    b. Existing surface waters, including lakes, ponds, rivers, perennial and intermittent streams, wetlands, vernal pools, and natural swales, shall be protected by a 50 foot no disturbance, vegetated buffer.
    c. BMPs shall not be located within the 50 foot no disturbance, vegetated buffer or within 50 feet of steep banks (greater than 15 percent slope).

d. Where roadway or driveway crossings of surface waters cannot be eliminated, disturbance to the surface water shall be minimized, hydrologic flows shall be maintained, there shall be no direct discharge of runoff from the roadway to the surface water, and the area shall be revegetated post-construction.

e. Stream and wetland crossings shall be eliminated whenever possible. When necessary, stream and wetland crossings shall comply with state recommended design standards to minimize impacts to flow and animal passage. (See NH Fish and Game Department, 2008.)

The 50 foot buffer requirement under 7.b-. is meant as a bare-minimum standard for communities that do not have more specific buffer requirements. While a 50 foot buffer will provide some water quality benefits, it will not be adequate in all situations (e.g., particularly steep slopes) or sufficient to meet all the natural resource protection goals of a community. Communities should determine whether a broader buffer requirement is appropriate for their community to provide additional water quality and other benefits, such as wildlife habitat and corridor protection and human recreation opportunities. Other chapters in this series, particularly those pertaining specifically to the protection

D. Post-development peak flow rates and total runoff volumes.

1. The applicant shall provide pre- and post-development peak flow rates. Any site that was wooded in the last five years must be considered undisturbed woods for the purposes of calculating pre-development peak flow rates.

2. The two-year, 24-hour post-development peak flow rate shall be (a) less than or equal to 50 percent of two-year, 24-hour storm pre-development peak flow rate or (b) less than or equal to the one-year, 24-hour storm pre-development peak flow rate.

3. The 10-year, 24-hour post-development peak flow rate shall not exceed the 10-year, 24-hour pre-development peak flow rate for all flows off-site.

4. The 50-year, 24-hour post-development peak flow rate shall not exceed the 50-year, 24-hour pre-development peak flow rate for all flows off-site.

The NHDES Alteration of Terrain program provides for exemptions to the standards D.2, D.3, and D.4 for projects that directly discharge to a stream, waterbody, estuary, or tidal water and where the applicant has provided supporting off-site drainage calculations for the 10-year and 50-year, 24-hour storm showing that at a point immediately downstream from the project site the post-development peak flow rate from the site and the off-site contributing area does not exceed the pre-development peak flow rate at that point.

5. Measurement of peak discharge rates shall be calculated using point of discharge or the down-gradient property boundary. The topography of the site may require evaluation at

more than one location if flow leaves the property in more than one direction. Calculations shall include runoff from adjacent up-gradient properties.

6. An applicant may demonstrate that a feature beyond the property boundary is more appropriate as a design point.
7. The applicant shall provide pre- and post-development total runoff volumes. Any site that was wooded in the last five years shall be considered undisturbed woods for the purposes of calculating pre-development total runoff volumes.
8. The post-development total runoff volume shall be equal to 90 to 110 percent of the pre-development total runoff volume (based on a two-year, 10-year, 25-year, and 50-year, 24-hour storms). Calculations shall include runoff from adjacent up-gradient properties.

E. Water Quality

1. If more than 35 percent of the total area of the site will be disturbed or the site will have greater than 10 percent effective impervious cover, the applicant shall demonstrate that their stormwater management system will:
    a. Remove 80 percent of the average annual load of total suspended solids (TSS), floatables, greases, and oils after the site is developed.
    b. Remove 40 percent of phosphorus.

Depending on the existing water quality of downstream receiving waters, in particular if a waterbody is impaired or designated as an "outstanding resource water," development projects requiring an Alteration of Terrain Permit or a 401 Water Quality Certification from the state may be subject to more stringent pollutant removal requirements than specified in Sections E. 1. a. and b.

2. Compliance with the recharge requirements under Section F, consistent with the pre-treatment and design requirements in Sections F.2 and F.3, shall be considered adequate to meet the treatment standards specified in VI.E.1.
3. Applicants not able to employ Section F must provide suitable documentation, including a pollutant loading analysis from an approved model, that the treatment standards specified in VI.E.1 will be met.

F. Recharge to Groundwater
Except where prohibited, stormwater management designs shall demonstrate that the annual average pre-development groundwater recharge volume (GRV) for the major hydrologic soil groups found on-site are maintained.

1. For all areas covered by impervious cover, the total volume of recharge that must be maintained shall be calculated as follows:
    a) REQUIRED GRV =
    (Total Impervious Cover) x (Groundwater Recharge Depth)

Where Total Impervious Cover is the area of proposed impervious cover that will exist on the site after development.

And where Groundwater Recharge Depth is expressed as follows:

USDA/NRCS Hydrologic Soil Group (HSG)	Groundwater Recharge Depth (inches)
A	0.40
B	0.25
C	0.10
D	not required

Example: Applicant proposes 30,000 square foot parking lot over C soils.
REQUIRED GRV = 30,000 X 0.10
REQUIRED GRV= 250 ft3

b. Where more than one hydrologic soil group is present, a weighted soil recharge factor shall be computed.

2. Pre-Treatment Requirements

a. All runoff must be pretreated prior to its entrance into the groundwater recharge device to remove materials that would clog the soils receiving the recharge water.

b. Pretreatment devices shall be provided for each BMP, shall be designed to accommodate a minimum of one-year's worth of sediment, shall be designed to capture anticipated pollutants, and be designed and located to be easily accessible to facilitate inspection and maintenance.

The use of below-ground pre-treatment devices should be discouraged because of the added difficulty in assessing their function and performing regular inspections and

3. Sizing and design of infiltration (recharge) BMPs

a. All units shall be designed to drain within 72 hours from the end of the storm.

This design requirement addresses concerns about infiltration BMPs contributing to mosquito problems. Requiring such facilities to drain within 72 hours will prevent mosquitoes from successfully breeding.

b. The floor of the recharge device shall be at least three feet above the seasonal high water table and bedrock.

c. Soils under BMPs shall be scarified or tilled to improve infiltration.

d. Infiltration BMPs shall not be located in areas with materials or soils containing regulated or hazardous substances or in areas known to DES to have contaminants in groundwater above ambient groundwater quality standards or in soil above site-specific soil standards.

4. Infiltration may be prohibited or subject to additional pre-treatment requirements under the following circumstances:

   a. The facility is located in a well-head protection area or water supply intake protection area; or

   b. The facility is located in an area where groundwater has been reclassified to GAA, GA1 or GA2 pursuant to RSA 485-C and Env-Dw 901; or

   c. Stormwater is generated from a "high-load area," as described under Section G.

G. Land Uses with Higher Potential Pollutant Loads

1. The following uses or activities are considered "high-load areas," with the potential to contribute higher pollutant loads to stormwater, and must comply with the requirements set forth in subsections 2, 3, and 4 below:

   a. Areas where regulated substances are exposed to rainfall or runoff; or

   b. Areas that typically generate higher concentrations of hydrocarbons, metals, or suspended solids than are found in typical stormwater runoff, including but not limited to the following:

      i. Industrial facilities subject to the NPDES Multi-Sector General Permit (MSGP); not including areas where industrial activities do not occur, such as at office buildings and their associated parking facilities or in drainage areas at the facility where a certification of no exposure will always be possible [see 40CFR122.26(g)].

      ii. Petroleum storage facilities.

      iii. Petroleum dispensing facilities.

      iv. Vehicle fueling facilities.

      v. Vehicle service, maintenance and equipment cleaning facilities.

      vi. Fleet storage areas.

      vii. Public works storage areas.

      viii. Road salt storage and loading facilities.

      ix. Commercial nurseries.

      x. Non-residential facilities having uncoated metal roofs with a slope flatter than 20 percent.

      xi. Facilities with outdoor storage, loading, or unloading of hazardous substances, regardless of the primary use of the facility.

xii. Facilities subject to chemical inventory under Section 312 of the Superfund Amendments and Reauthorization Act of 1986 (SARA).

xiii. Commercial parking areas with over 1,000 trips per day.

c. If a high-load area demonstrates, through its source control plan, the use of best management practices that result in no exposure of regulated substances to precipitation or runoff or release of regulated substances, it shall no longer be considered a high-load area.

Information on the Multi-Sector General Permit for commercial and industrial sites is available at http://cfpub.epa.gov/ npdes/stormwater/swppp-msgp.cfm.

The uses listed under 1.b.ii – 1.b.xiii are generally not subject to the MSGP, unless associated with another use or specific activity that is covered under the MSGP. A municipality may decide not to regulate one or more of these types of uses, or to cover additional types of uses that may represent a threat to water quality in their community (e.g., auto recyclers/salvage yards; marina service areas).

2. In addition to implementation of BMPs for designing site-specific stormwater management controls, uses included under subsection G.1 shall provide a stormwater pollution prevention plan (SWPPP, see margin note below), describing methods for source reduction and methods for pretreatment.

Example Stormwater Pollution Prevention Plans (SWPPP) are available at http://cfpub.epa.gov/npdes/ stormwater/ swppp-msgp. cfm.

3. Infiltration of stormwater from high-load areas, except commercial parking areas, is prohibited. Infiltration, with appropriate pre-treatment (e.g., oil/water separation) and subject to the conditions of the SWPPP, is allowed in commercial parking areas and others areas of a site that do not involve potential "high-load" uses or activities (e.g., where a certification of "no exposure" under the MSGP will always be possible).

4. For high-load areas, except commercial parking areas, filtering and infiltration practices, including but not limited to, sand filters, detention basins, wet ponds, gravel wetlands, constructed wetlands, swales or ditches, may be used only if sealed or lined.

H. Parking

1. Snow may not be plowed to, dumped in, or otherwise stored within 15 feet of a wetland or waterbody, except for snow that naturally falls into this area. Snow storage areas shall be shown on the site plan to comply with these requirements.

2. At the discretion of the planning board, parking spaces may be allowed, or required, to be constructed of a pervious surface (i.e. grass, pervious asphalt, pervious pavers).

3. Infrequently used emergency access points or routes shall be constructed with pervious surfaces (i.e. grass, pervious asphalt, pervious pavers).

I. Redevelopment or Reuse

1. Redevelopment or reuse of previously developed sites must meet the stormwater management standards set forth herein to the maximum extent possible as determined by the planning board. To make this determination the planning board shall consider the benefits of redevelopment as compared to development of raw land with respect to stormwater.

2. Redevelopment or reuse activities shall not infiltrate stormwater through materials or soils containing regulated or hazardous substances.

3. Redevelopment or reuse of a site shall not involve uses or activities considered "high-load areas" unless the requirements under Section G. are met.

J. Easements

1. Where a site is traversed by or requires construction of a watercourse or drainageway, an easement of adequate width may be required for such purpose.

2. There shall be at least a ten foot wide maintenance easement path on each side of any stormwater management system element. For systems using underground pipes, the maintenance easement may need to be wider, depending on the depth of the pipe.

K. Performance Bond

1. To ensure that proposed stormwater management controls are installed as approved, a performance bond shall be provided as a condition of approval in an amount determined by the planning board.

2. To ensure that stormwater management controls function properly, a performance bond shall be required, as a condition of approval, which may be held after final certificate of occupancy is issued.

L. Operation and Maintenance Plan

1. All stormwater management systems shall have an operations and maintenance (O&M) plan to ensure that systems function as designed. This plan shall be reviewed and approved as part of the review of the proposed permanent (post-construction) stormwater management system and incorporated in the Permanent Stormwater Management Plan, if applicable. Execution of the O&M plan shall be considered a condition of approval of a subdivision or site plan. If the stormwater management system is not dedicated to the city/town pursuant to a perpetual offer of dedication, the planning board may require an applicant to establish a homeowners association or similar entity to maintain the stormwater management system. For uses and activities under Section G, the O&M plan shall include implementation of the Stormwater Pollution Prevention Plan (SWPPP).

2. The stormwater management system owner is generally considered to be the landowner of the property, unless other legally binding agreements are established.

3. The O&M plan shall, at a minimum, identify the following:

    a. Stormwater management system owner(s), (For subdivisions, the owner listed on the O&M plan shall be the owner of record, and responsibilities of the O&M plan shall be conveyed to the party ultimately responsible for the road maintenance, i.e. the Town should the road be accepted by the Town, or a homeowners association or other entity as determined/required under Section VI.L.1 above.)

    b. The party or parties responsible for operation and maintenance and, if applicable, implementation of the Stormwater Pollution Prevention Plan (SWPPP).

    c. A schedule for inspection and maintenance.

    d. A checklist to be used during each inspection.

    e. The description of routine and non-routine maintenance tasks to be undertaken.

    f. A plan showing the location of all stormwater management facilities covered by the O&M plan.

    g. A certification signed by the owner(s) attesting to their commitment to comply with the O&M plan.

4. Recording:

    a. The owner shall provide covenants for filing with the registry of deeds in a form satisfactory to the planning board, which provide that the obligations of the maintenance plan run with the land.

    b. The owner shall file with the registry of deeds such legal instruments as are necessary to allow the city/town or its designee to inspect or maintain the stormwater management systems for compliance with the O&M plan.

5. Modifications:

    a. The owner shall keep the O&M plan current, including making modifications to the O&M plan as necessary to ensure that BMPs continue to operate as designed and approved.

    b. Proposed modifications of O&M plans including, but not limited to, changes in inspection frequency, maintenance schedule, or maintenance activity along with appropriate documentation, shall be submitted to the planning board for review and approval within thirty days of change.

    c. The owner must notify the planning board within 30 days of a change in owner or party responsible for implementing the plan.

    d. The planning board may, in its discretion, require increased or approve decreased frequency of inspection or maintenance or a change in maintenance activity. For a reduced frequency of inspection or maintenance, the owner shall demonstrate that

such changes will not compromise the long-term function of the stormwater management system.

e. The planning board shall notify the owner of acceptance of the modified plan or request additional information within 60 days of receipt of proposed modifications. No notification from the planning board at the end of 60 days shall constitute acceptance of the plan modification. The currently approved plan shall remain in effect until notification of approval has been issued, or the 60 day period has lapsed.

M. Record Keeping

1. Parties responsible for the operation and maintenance of a stormwater management system shall keep records of the installation, maintenance and repairs to the system, and shall retain records for at least five years.

2. Parties responsible for the operation and maintenance of a stormwater management system shall provide records of all maintenance and repairs to the [_____ *i.e. Code Enforcement Officer, Board of Selectmen*], during inspections and/or upon request.

N. Enforcement

When the responsible party fails to implement the O&M plan, including, where applicable, the SWPPP, as determined by the Code Enforcement Officer or Board of Selectmen, the municipality is authorized to assume responsibility for their implementation and to secure reimbursement for associated expenses from the responsible party, including, if necessary, placing a lien on the subject property.

VII. AUTHORIZATION TO ISSUE A SPECIAL USE PERMIT

A. Authority is hereby granted to the planning board, as allowed under RSA 674:21 II, to issue a special use permit to allow variations from the requirements and restrictions set forth in this section upon the request of the applicant provided the development design and proposed stormwater management approach satisfy the following conditions:

1. Such modifications are consistent with the general purpose and standards of this section and shall not be detrimental to public health, safety or welfare;

2. The modified design plan and stormwater management approach shall meet the performance standards under sections VI.D-VI.F of this ordinance; and

3. The modified design plan and stormwater management approach shall satisfy all state and/or federal permit requirements, as applicable.

VIII. ENGINEERING REVIEW

A. The applicant shall submit a fee, as determined by the planning board, with their application for subdivision or site plan review to cover the cost of outside engineering review of their proposed permanent post-construction stormwater management system(s), and the separate Permanent Post-Construction Stormwater Management Plan (SMP) and Stormwater Pollution Prevention Plan (SWPPP), if applicable.

B. Additional copies of all plans, engineering studies, and additional information as requested by the planning board describing the proposed permanent post-construction stormwater management system shall be provided as necessary to allow for a thorough outside engineering review.

Municipalities have the option of granting the planning board the authority to issue a special use permit (also known as a conditional use permit) as a means of giving the planning board and applicants greater flexibility to meet the requirements of this section. The advantage of allowing a special use permit option is that the planning board can work with an applicant to modify a plan when it is in the best interest of the community, while still ensuring compliance with the intent of the ordinance, without forcing the applicant to pursue a zoning variance.

Natural Resource Inventory

APPENDIX G: HABITAT SENSITIVE SITE DESIGN MODEL ORDINANCE

Model Language and Guidance for Implementation

HABITAT SENSITIVE SITE DESIGN AND DEVELOPMENT PRACTICES

These practices may be used in three ways:

1. As an educational tool for citizens and developers to encourage voluntary practices for habitat sensitive site design.
2. As a checklist for conservation commissions and planning boards in reviewing applications and suggesting voluntary alternative site designs and development practices at the planning stage.
3. As elements of a performance zoning ordinance that awards density bonuses or requires compliance with the checklist items as a condition of subdivision approval.

A pre-application review meeting between the developer and planning staff to discuss the checklist elements is strongly encouraged.

MODEL LANGUAGE FOR SUBDIVISION AND SITE PLAN REVIEW REGULATION AND CHECKLIST

I. PURPOSE

The purposes of this section are:

A. To protect and maintain the natural environment.

B. To provide for green spaces of adequate proportions.

C. To provide a habitat for wildlife.

D. To minimize soil erosion, lessen air pollution, conserve energy, and protect the quality of groundwater.

E. To provide for the harmonious and aesthetically pleasing development of the municipality and its environs.

F. To protect the public benefits of habitat protection, including flood control, water recharge, carbon sequestration, food web integrity, and nutrient cycling.

II. APPLICABILITY

This regulation applies to all applications for new development requiring site plan review and applications for the subdivision of land.

> Option: A municipality might choose to limit the applicability of these requirements to certain areas of the community (e.g., an overlay zone consisting of those areas identified as important habitat within a natural resource inventory or open space plan) or to parcels of a certain size (e.g., any parcel greater than 10 acres). An overlay zone would be established through a separate zoning action.

III. AUTHORITY

A. **RSA 674:16 II. Subdivision Regulations.** The power to adopt a zoning ordinance under this subdivision expressly includes the power to adopt innovative land use controls which may include, but which are not limited to, the methods contained in RSA 674:21.

B. **RSA 674: 21 (j)**. **Innovative Land Use Controls/ Environmental Characteristics.** An innovative land use control to protect specific natural resources or features based on scientific evidence and community input may be adopted under RSA 674:21 when supported by the master plan and contains within it the standards that shall guide the person or board which administers the ordinance.

C. **RSA 674**: **21(h) Innovative Land Use Controls/ Performance Standards.** An innovative land use control to control the physical characteristics and operations of a proposed use may be adopted under RSA 674:21 when supported by the master plan and contains within it the standards and criteria against which the development will be evaluated.

D. **RSA 674**: **17 (h) and (i) Purposes of Zoning Ordinances.** To assure proper use of natural resources and other public requirements and to encourage the preservation of agricultural lands and buildings.

IV. FINDINGS AND PRINCIPLES

It is the finding of this board that, in order to achieve the purposes above, the following principles will significantly enhance the protection of wildlife habitat at the site level and contribute to the protection of habitat at the watershed and regional level by:

- Maintaining the ability of ecological systems to provide ecosystem functions necessary to maintain wildlife habitat and the multiple benefits to wildlife and humans provided by such habitat.
- Maintaining unfragmented habitat blocks.
- Connecting habitat patches, facilitating wildlife movement through the area.
- Protecting wildlife from the negative impacts of development, including not only negative impacts to the habitat itself, but also to animal behavior and life cycle activities.
- Requiring site-specific habitat assessment and other practices described more fully below to protect wildlife from the negative impacts of development.

V. DEFINITIONS

Deer Wintering Area: An area used by deer during winter for shelter. Also called a deer yard. Deer wintering areas are typically comprised of dense softwood cover with a crown closure greater than 60 percent.

Habitat: An organism's home, including the area used in all parts of its life cycle, such as feeding, breeding, egg laying, or bearing young.

Mast Stand: An area of woody plants, such as oak, hickory, beech, maple, and various pines, that produce dry fruit (mast), which is a food source for a variety of mast-dependent wildlife such as deer, turkey, and squirrels.

Riparian: Related to or adjacent to a stream or watercourse, or having a high water table because of proximity to an aquatic ecosystem or subsurface water. Although originally associated with rivers and streams, this term is now also sometimes used to describe wetland areas not necessarily associated with rivers or streams.

Vernal Pool: A confined basin depression that is covered by shallow water usually for at least two months in the late winter, spring, and summer, but may be dry during much of the year.

Wetland: An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support and that under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include, but are not limited to, swamps, marshes, bogs and similar areas.

VI. HABITAT-PROTECTION SITE PLAN AND SUBDIVISION REVIEW CHECKLIST

The following checklist shall be utilized in the review of all site plan and subdivision applications. The board shall determine, on a case-by-case basis, and as applicable, whether the applicant's proposed development is consistent with these principles:

A. Does the applicant conserve rare and outstanding landscape features, including unique or critical habitats, by directing development to other areas?

   Yes _____ No _____

   Required action:

   - Conduct a site assessment of existing resources, identify areas for protection and associated buffers, and demonstrate methods that will be utilized for protection in the construction sequence section of the plan set.
   - Development is directed away from habitat types that are rare statewide or to a particular geographic region.
   - Development should be directed away from salt marshes, riparian areas, vernal pools, emergent wetlands, large wetland complexes (i.e., wetlands greater than five acres or clusters of wetlands), south-facing slopes, open fields, agricultural lands, and mast stands.
   - Building envelopes are specified to control the location of future development.
   - Avoid locating roads within or near important habitat or forage areas such as mast stands, deer wintering areas, or vernal pools.

B. Does the applicant maintain significant buffers of undeveloped land between important habitat areas and developed area?

   Yes _____ No _____

   Required actions: Applicant must maintain appropriate buffers for the protection of habitat areas on the parcel as follows:

   - Maintain vegetated buffers for wetlands and surface waters including riparian buffer areas. The most effective buffer strips will consist of a series of vegetation of different heights beginning with a grassy strip graduating to a strip of shrubs, and ending with a forested strip along the stream bank. The multiple series approach provides multiple

benefits including stream bank stabilization. A generally accepted width for a buffer for wildlife habitat is 300 feet; for water quality, a buffer of 50 to 100 feet is recommended for most situations. Where high sediment loads or steep slopes exist, the water quality buffer should be expanded about five feet for every 1 percent increase in slope. (Connecticut River Joint Commission 2000; J.C. Klapproth 2000; Wenger 1999; Hodgman 2006).

- Maintain at least 200 feet of buffer from the perimeter of core areas of identified deer wintering areas.
- Maintain a minimum 300 feet of buffer from other significant habitat areas identified by the municipality, local or regional open space or habitat protection plan, or during site plan or subdivision plan review.
- Maintain a buffer of 400 feet around existing vernal pools and maintain a mostly closed canopy of trees within 100 feet of any vernal pool.
- Avoid construction of houses within 300 feet of important mast stands and avoid construction of paved roads within 200 feet of important mast stands.
- Avoid fragmentation of connecting areas between habitat areas and buffer areas.
- Mark areas of vegetated buffers and soft (graduated) edges of conservation areas with permanent monuments or signage indicating that the area is
  A NO CUT/ NO DISTURB VEGETATED BUFFER.

C. Does the applicant identify and conserve wildlife corridors of a minimum width of 300 feet through the property to facilitate wildlife movement within and across developed areas?

Yes _____ No _____

Required action:

- Conduct a site-specific wildlife assessment to identify appropriate corridors through a property or reference the town's Natural Resource Inventory or other local or regional assessment identifying appropriate corridors.
- Construct adequately sized underpasses or tunnels across roadways at known reptile and amphibian crossing sites and overpasses or underpasses across roadways along wildlife corridors.

D. Does the applicant maintain the structure and function of aquatic systems?

Yes _____ No _____

Required actions:

- Layout of development eliminates or minimizes stream and wetland crossings by roadways and driveways.
- Use a bridge span to cross river, streams or wetlands whenever possible.
- Stream and wetland crossings are eliminated whenever possible. When necessary, stream and wetland crossings shall comply with state recommended design standards to

minimize impacts to flow and animal passage. (See NH Fish and Game Department, 2008.

- Maintain a 300-foot vegetated buffer on either side of a stream crossing.
- Stormwater management practices are used to prevent the direct discharge of stormwater to aquatic systems, including wetlands and small streams.

E. Does the applicant minimize the clearing, grading, and compaction of soil during construction activities?

Yes _____ No _____

Required actions:

- Cut and fill is minimized, with the maximum height of any fill or depth of any cut area, as measured from the natural grade, not greater than 10 feet, and is preferably limited to four to six feet.
- Development follows the natural contours of the landscape to the maximum extent possible to minimize grading.
- The smallest feasible equipment is used during construction and every effort is made to minimize travel over the area.
- Soils are re-aerated after construction is complete and prior to seeding and landscaping.
- Provide for six to10 inches of top soil post-construction to any areas previously disturbed prior to seeding and landscaping these areas.

F. Does the applicant provide for the protection of vegetated buffers, stands of mature trees, and other vegetation to be preserved during and after construction?

Yes _____ No _____

Required actions:

- Important mast stands and other vegetation to be protected during construction are clearly marked, including area out to the drip line of the tree.
- Not allow construction materials to be stored over the root zone of trees.
- Mark areas of vegetated buffers and soft edges of conservation areas with permanent monuments or signage indicating that the area is a no cut/ no disturb vegetated buffer.
- Submit a tree clearing plan, indicating areas of trees to be cleared, and areas to be protected, and retain, at the applicant's expense, a qualified natural resources professional to review the applicant's plan.

G. Does the applicant attempt to mimic features of the local natural landscape in developed areas?

Yes _____ No _____

Required actions:

- Maintain existing foliage height diversity, to provide a range of habitat through layers of vegetation, such as ground covers, shrubs, and trees.
- Minimize edge effects by creating soft edges between developed areas and conservation areas using a graduation of smaller shrubs to larger shrubs to small trees to larger trees.
- Utilize native, non-invasive species in landscaping.
- Minimize the amount of area per lot converted from existing vegetation to lawn.
- Provide a stormwater management approach that maintains the natural peak flow and total volume of flow off-site pre- and post-development by providing for best management practices that capture, treat, and infiltrate stormwater in smaller-scale management areas throughout the development.

H. Does the applicant minimize the negative effects of development on wildlife and discourage human-wildlife conflicts by using such methods including but not limited to: directing light away from stands of trees, fencing gardens, pet food areas, and covering and fencing trash disposal areas?

Yes _____ No _____

Required actions:

- The homeowners association's documents should include the specific measures that will be used to ensure that the development will minimize potential negative effects on wildlife and habitat, and that human-wildlife conflicts such as predation or nuisance animal incidents will be discouraged by ensuring that garbage, pet food areas, and small pets do not serve as a food source to area wildlife. The documents should also address landscaping and discourage the introduction of invasive species and excessive use of nitrates and phosphates.
- Some areas of the development near homes may require fencing or other measures to deter wildlife from gardens and yards.
- Lighting must be fully shielded and directed away from stands of trees or other habitat areas so as not to disrupt animal behavior.

Natural Resource Inventory

APPENDIX H: EROSION AND SEDIMENT CONTROL MODEL ORDINANCE

Model Language and Guidance for Implementation

The following regulation is based on several existing models and handbooks, including those prepared by DES and the N.H. Association of Conservation Districts. Model language for pre-application land disturbance was derived from a presentation entitled "Storm Water Phase II-Developing Construction & Post Construction Programs Fees and Funding" given by attorney Stephen C. Buckley, Hodes, Buckley, McGrath & LeFevre, PA, in the spring of 2005 at a workshop hosted by the US EPA, Region 1.

MODEL SUBDIVISION AND SITE PLAN REGULATION

EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

I. TITLE AND AUTHORITY

A. **Title**
The title of this Site Plan and Subdivision Regulation for the Town/City of [NAME], shall be known as the "Erosion and Sediment Control During Construction."

B. **Authority**
This regulation is adopted pursuant to RSA 674:16, Grant of Power, RSA 674:17, Purposes of Zoning Ordinance, and RSA 674:21, Innovative Land Use Controls, Environmental Characteristics. The corresponding section of the Zoning Ordinance is found at section [_____].

Towns adopting these regulations should add a section to the zoning ordinance authorizing the adoption of stormwater regulations during construction based on the RSA sections listed above. The findings listed in this regulation should be considered for addition to the master plan natural resources chapter.

II. PURPOSE

Based on the findings above, the purpose of this regulation is to develop standards for design, installation, and maintenance of stormwater management measures during construction for the following reasons:

- To control the quantity and quality of runoff.
- To prevent soil erosion and sedimentation resulting from site construction and development.
- To prevent the pollution of runoff from construction sites.
- To protect natural resources including wildlife habitat.
- To protect other properties from damage that could be caused by erosion and sedimentation or the quantity or quality of runoff.
- To reduce public expenditures in maintenance of stormwater drainage systems such as removing sediment from systems, repairing or replacing failed systems, restoring degraded

natural resources, and to prevent damage to town infrastructure caused by inadequate controls.

III. FINDINGS

The planning board has made the following findings concerning the need to address sediment and erosion control during construction.

A. **Land development alters hydrologic response.**
Land development projects and other land use conversions and their associated changes to land cover can alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, which in turn increase flooding, stream channel erosion, and sediment transport and deposition, and decrease groundwater recharge by creating impervious surface such as pavement and buildings, and compacting pervious surfaces.

B. **Small storms account for 90 percent of runoff.**
Over 90 percent of runoff and associated pollutants loads result from very small storms, thus traditional methods of preparing stormwater control plans must be revisited take into consideration not only larger, less frequent storms, but also small storms to ensure that water supplies do not become polluted by these small storms and that designs for larger, less frequent storms resulting in large downstream flows can be reduced so as not to cause significant stream channel erosion and other environmental damage.

C. **Cumulative effects.**
The cumulative effects of several storms on a particular project, and the erosion and sediment contributions from several projects create a significant cumulative effect on water quality, hydrologic response of local watersheds, and alter or destroy wildlife habitat.

D. **Land development contributes to increased nonpoint source pollution.**
Land development projects and other land use conversions contribute to increased nonpoint source pollution and degradation of receiving waters due to the addition of petroleum products, fertilizers and pesticides, construction waste, and other substances to runoff from construction sites.

E. **Land development causes significant environmental damage to wildlife and wildlife habitat.**
Land development projects cause significant damage to trees and other wildlife habitat through compaction of soils due to construction vehicle traffic, stripping of vegetation during grading and other site preparation activities, and increased turbidity in water supplies that may damage the habitat of aquatic species.

F. **Stormwater runoff related to development adversely affects health, safety, welfare, and the environment.**
The impacts of stormwater runoff related to development can adversely affect public safety, public and private property, surface water supplies, groundwater resources, drinking water, aquatic and non-aquatic wildlife habitats, fish and other aquatic life, property values, and the potential for other uses of land and water.

G. **Best management practices can minimize adverse impacts.**
These adverse impacts can be controlled and minimized through the application of best

management practices during construction activities, low impact development practices post construction, and periodic inspections before, during and after construction to ensure that erosion and sediment control practices are functioning effectively.

H. **Federal law requires regulations to manage stormwater runoff from construction sites.** Federal law requires small MS4 operators to develop, implement, and enforce a program to reduce pollutants in any storm water runoff from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of storm water discharges from construction activity disturbing less than one acre must be included in the program if that construction is part of a large common plan or development or sale that would disturb one acre or more.

   It is therefore in the public interest of health, safety, welfare, and environmental protection to minimize the impacts associated with land development and to regulate stormwater runoff during construction in order to address the adverse impacts to public health, safety, welfare, and the environment detailed in the above section.

IV. APPLICABILITY

The requirements of this regulation shall apply to land disturbance, development, and or any construction activities in all zoning districts where the disturbance, development, or construction activity will disturb greater than 20,000 square feet or that is within a critical area as defined below.

V. DEFINITIONS

Best Management Practice (BMP): A proven or accepted managerial, structural, non-structural, or vegetative measure to prevent or reduce increases in stormwater volumes or flow; to reduce erosion, sediment, peak storm discharge, and point-source and non-point-source pollution; and to improve stormwater quality and protection of the environment.

Critical Areas: Disturbed areas of any size within 75 feet of stream, intermittent stream, bog, water body, or poorly or very poorly drained soils; disturbed areas of any size within 50 feet of a property line; disturbed areas exceeding 2,000 square feet in highly erodible soils; or disturbed areas containing slope lengths exceeding 25 feet on slopes greater than 15 percent.

Developer: Any person or legal entity that undertakes or proposes to undertake activities that cause land disturbance.

Development: Any activity involving land grading, or alteration of terrain or landscape, other than for agricultural purposes or silvicultural purposes where best management practices for agriculture or timber harvesting as defined by New Hampshire law are utilized.

Disturbed area: An area where the natural vegetation has been removed exposing the underlying soil or where vegetation has been covered by soil.

Drainage Area: A geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

Effective Impervious Cover: Impervious surfaces that contribute to stormwater runoff leaving a site. Effective impervious cover can be reduced by capturing and directing stormwater runoff

generated by the impervious surface to an on-site retention, treatment and infiltration management device or practice.

Erosion: The detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

Highly Erodible Soils: Any soil with an erodibility class (K factor) greater than or equal to 0.43 in any layer or listed below or as found in Table 3-1 of the "Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire" Rockingham County Conservation District, 1992.

Impervious Surface: Land surface with a low capacity for soil infiltration, including but not limited to pavement, roofs, roadways, or other structures, paved parking lots, sidewalks, driveways (compacted gravel or paved) and patios. Total impervious surface cover shall be calculated by determining the total area of all impervious surfaces on a site as described above, regardless of whether the impervious surfaces are contiguous or non-contiguous.

Land Disturbance or Land Disturbing Activity: For the purposes of this regulation, refers to any exposed soil resulting from activities such as clearing of trees or vegetation, grading, blasting, and excavation.

Low Impact Development Techniques: Alternative designs for the treatment and management of stormwater that minimize disturbance to the natural drainage patterns on the landscape and require high standards for water quality discharge and recharge. These techniques include treatment of stormwater runoff on residential lots using low-maintenance methods such as vegetated swales, rain gardens and subsurface infiltration devices.

Openness Ratio: A ratio calculated by dividing a culvert's cross-sectional area by its length (OR = cross sectional area / length).

Owner: A person with a legal or equitable interest in a property.

Pervious Surface: Any material of structure on or above the ground that permits water to infiltrate into the underlying soil. Naturally pervious surfaces may become less pervious through the process of compaction.

Qualified Professional: A person knowledgeable in the principles and practice of stormwater management and erosion and sedimentation control, including Certified Professional in Erosion and Sediment Control (CPESC), Certified Professional in Storm Water Quality (CPSWQ), licensed soil scientist, licensed engineer, or someone with experience in the principles and practices of stormwater management and erosion and sedimentation control working under the direction and supervision of a licensed engineer and in consultation with a person qualified to construct a project as per design and in compliance with regulatory requirements.

Recharge: The amount of water from precipitation that infiltrates into the ground and is not evaporated or transpired.

Redevelopment: The reuse of a site or structure with existing man-made land alterations. A site which currently has 35 percent or more of existing impervious surface, calculated by dividing the total existing impervious surface by the size of the parcel and converted to a percentage before the project begins would be considered a redevelopment. [*Note: This definition is distinct from*

other requirements a town may have as to maximum impervious surface allowed in the completed project.]

Regulated Substance: Oil, as defined pursuant to RSA 146-A or a substance listed in 40 CFR 302, with the following exclusions: ammonia, sodium hypochlorite, sodium hydroxide, acetic acid, sulfuric acid, potassium hydroxide, and potassium permanganate.

Sediment: Solid material, either mineral or organic, that is in suspension, is transported, or has been moved from its site of origin.

Sensitive Area: For the purposes of this regulation, lakes, ponds, perennial and intermittent streams, vernal pools, wetlands, floodplains, floodways and areas with highly erodible soils.

Sheet flow: Runoff that flows or is directed to flow across a relatively broad area at a depth of less than 0.1 feet for a maximum distance of 100 feet.

Site: The lot or lots upon which development is to occur or had occurred.

Stabilization: The condition in which all soil-disturbing activities at a site have been completed and a uniform, perennial vegetative cover with a density of 85 percent has been established or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

Stormwater: Water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate storm sewers or other man-made or natural drainage facilities.

Stormwater runoff: The water from precipitation that is not absorbed, evaporated, or otherwise stored within the contributing drainage area.

Stream: Areas of flowing water that occur for sufficient time to develop and maintain defined channels but which may not flow during dry portions of the year. Includes but is not limited to all perennial and intermittent streams located on U.S. Geological Survey Maps.

Turbidity: A condition of water quality characterized by the presence of suspended solids and/or organic material.

Undisturbed Cover: A land surface that has not been significantly altered by human activity.

Vegetation: Is defined to include a tree, plant, shrub, vine, or other form of plant or fungal growth.

Water Supply Intake Protection Area: Designated protection area for a surface water intake used a source by a public water system.

Well Head Protection Area: As defined in RSA 485-C:2, the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such well or well field.

VI. CONSTRUCTION INSPECTIONS, PHASING, AND THE PLANNING PROCESS

A. **Inspections/Frequency.** Periodic inspections of stormwater management structures or techniques shall be conducted periodically by the town's engineering consultant or a qualified professional; the cost of such inspections shall be included in the escrowed funds

paid by the developer for the purpose of reimbursement to the town for the payment of fees to town engineering and planning consultants reviews and inspections. At a minimum, inspections shall be conducted at the site prior to commencement of land clearing activities, after every storm event during construction, periodically during construction, at the completion of construction activities and removal of any temporary BMPs, and as specified thereafter in an agreed-upon inspection schedule proposed by the developer in consultation with either the contractor who will build the project or a consulting contractor and approved by the planning board and the planning board's consulting engineer, to insure that stormwater management structures or techniques are performing effectively.

B. **Inspections/documentation.** All inspections shall be documented and written reports prepared by the town's compliance officer or compliance consultant that contain the following information:

   1. Date and location of the inspection.
   2. Date of last storm event.
   3. Whether construction is in compliance with the approved stormwater management plan.
   4. Variations from approved construction specifications.
   5. Photographic documentation of each erosion and sediment control BMP and any other site level techniques employed pursuant to this regulation, such as but not limited to seeding of fill piles, marking of root zone areas of trees, disposal of construction debris, and implementation of any state or federal level record-keeping or reporting procedures related to erosion and sediment control.
   6. Recommended actions for replacement, repair, or substitution of BMPs, that are not functioning properly.

   Copies of reports and labeled photographs shall be provided to the planning board.

C. **Phases of Inspection.** The schedule for inspections should include the following phases:

   1. **Initial site inspection** prior to plan approval, which shall include a site walk by the developer or developer's engineer and contractor, the town's consulting engineer and/or compliance officer, and a member of the planning board.
   2. **Erosion control inspection t**o ensure erosion control techniques or structures have been properly installed, and are in accord with the developer's submitted plan.
   3. **During and post-storm event inspection.** The town's consultant shall inspect the site during and within 48 hours after the first storm event and subsequent storm events to ensure that erosion and sediment control techniques and drainage structures are functioning properly.
   4. **Stormwater management system inspection.** This inspection will include inspection of temporary measures to be employed only during construction, as well as semi-permanent and permanent measures designed to remain for some time period after construction is completed but which may be completed before all construction of the site is completed. The inspector will also note whether construction debris is being disposed of properly

and whether other erosion and sediment control measures in addition to those in the approved plan must be instituted by the developer to protect water resources.

4. **Final inspection and storm performance inspection.** The town's consultant shall inspect the system after the system has been constructed and before the surety has been released. This inspection shall also evaluate the effectiveness of the system during and after the first actual storm. No surety will be released until the inspector certifies both the final inspection and the storm performance inspection.

D. **Phasing.** The developer shall submit a phasing plan to the planning board to be reviewed by the town's engineering consultant to ensure compliance with all applicable federal and state level laws and regulations pertaining to stormwater management. The phasing plan shall specify areas of the development to be completed in sequence and shall specify that all necessary infrastructure to support each phase shall be in place prior to the issuance of permits for certificates of occupancy for that phase.

E. **The Planning Process.** All developers must adhere to the four-step process as set forth below and demonstrate this in writing in developing their stormwater management plan during construction and thereafter.

Step 1: Planning. Plan the development to fit the existing site features, including topography, soils, drainage ways, and natural vegetation.

Step 2: Scheduling of Operations. Schedule grading and earthmoving operations to expose the smallest practical area of land for the shortest possible time.

Step 3: Soil Erosion Control. Apply soil erosion control practice and any other techniques as specified in the stormwater management plan to achieve the purposes set forth in this regulation.

Step 4: Inspections and Maintenance. Implement a thorough maintenance program and schedule inspections in conjunction with the town's consultant, to be reviewed by the planning board.

VII. PROCEDURES FOR CONSIDERATION OF INFORMATION SUBMITTED BY THE PUBLIC

A. The planning board shall consider any information submitted by the public concerning the stormwater management plan or site conditions or erosion and sediment control measures before and during construction. The board shall develop a short form to allow citizens to submit information concerning these measures. The board shall consider such information at a properly noticed public hearing even if the application to which the information relates has already been closed. All such information shall be either submitted in writing or as

This section relates to federal law requirements for small MS4 operators to develop procedures to receive public input. Municipalities may wish to develop a standard form for such information.

testimony in a properly noticed public hearing.

VIII. DESIGN STANDARDS

A. **Strategies to Be Employed**

To ensure that all sources or soil erosion and sediment on the construction site are adequately controlled, the following strategies shall be employed:

1. **Minimize the areas of disturbed soil.** Limit site preparation activities such as grading and clearing to where they are absolutely necessary and consistent with the phasing plan and the daily schedule of construction activities.
2. **Maximize the protection and on-site use of native vegetation.** Protect all vegetation not intended for removal by adequately marking, fencing around the drip line of trees, protectively wrapping and temporarily transplanting as necessary.
3. **Reduce the time that soil is left disturbed.** Utilize construction management and by phasing; soil disturbed by construction activities shall be stabilized within 14 days of ceasing disturbance.
4. **Stabilize soil** with seeding and mulch as soon as possible after disturbance. Minimize soil disturbance between October 15 and May 1.
5. **Control water at upslope site perimeters.** Prevent stormwater from entering areas of disturbed soil from outside the site and from other parts of the site. Utilize diversion swales and vegetated strips to reduce the amount of water entering a construction site.
6. **Control water on-site.** On the site water must be controlled and kept to low velocities so that erosion is minimal. This can be achieved through immediate seeding and mulching or the application of sod, as well as the use of structural measures including silt fences, check dams, mulch filter socks, and mechanical tracking of hillsides.
7. **Control sediment on site.** Reduce the amount of sediment produced from areas of disturbed soils, and control the sediment produced on site through seeding and mulching and structural measures.
8. **Control sediment at the down slope site perimeters.** Prevent the off-site transport of all sediment produced on the construction site using vegetated strips, diversion dikes, and swales, sediment traps and basins, stabilized construction entrances, and silt fences or mulch filter socks.
9. **Utilize biological or recyclable materials.** To the extent possible, developers should utilize natural biological materials or recyclable materials as temporary measures that can remain on-site after the completion of construction such as mulch berms or other methods as opposed to silt fences, which must be removed and disposed after the completion of construction activities in order to reduce waste and reduce costs of removal.

B. **Design Standards**

The following standards shall be applied in planning for stormwater management and erosion control:

1. Stormwater management and erosion control designs shall not conflict with minimum N.H. Department of Environmental Services requirements for Alteration of Terrain or other environmental permits required.

2. Measures shall be designed and installed to control the post-development peak rate of runoff so that it does not exceed pre-development runoff for the two-year, 10-year, and 25-year/24-hour storm event and for additional storm event frequencies as specified in the design criteria of the N.H. Stormwater Management Manual.
3. Emergency spillways and down slope drainage facilities shall have capacity to accommodate a 100-year/24-hour storm.
4. All measures in the plan shall meet as a minimum the best management practices set forth in the N.H. Stormwater Management Manual.
5. Stormwater management practices shall be selected to accommodate the unique hydrologic and geologic conditions of the site.
6. The use of low impact development techniques are preferred to intercept, treat, and infiltrate runoff from developed areas distributed throughout the site, as are techniques that restore, enhance, or protect natural areas such as riparian areas, stream channels, wetlands, and forests.
7. Stormwater management systems shall not discharge to surface waters, ground surface, subsurface, or groundwater within 100 feet of surface water within a water supply intake protection area.
8. Any contiguous area of disturbance, not associated with the installation of a roadway, shall be limited to 20,000 square feet.
9. Contiguous areas of disturbance shall be separated by at least 20 feet of area maintained at natural grade and retaining existing, mature vegetated cover that is at least 20 feet wide at its narrowest point.
10. Roadway and driveway crossings over streams shall meet the following design criteria to accommodate high flows, minimize erosion, and support aquatic habitat and wildlife passage:
    a. Natural stream bottoms.
    b. Sized for 1.2 times bank-full stream width, i.e. the width of the stream during the 1.5-year flow event.
    c. Bridges and culverts shall have an openness ration of greater than or equal to 0.25 (calculated in meters) for perennial streams.
    d. Passageways under roads shall be designed to maintain water velocity at a variety of flows that is comparable to flows in upstream and downstream segments of the natural stream.
    e. Culverts shall have a trough or narrow channel in the bottom running the full length of the culvert to maintain sufficient water depth during low-flow periods to support fish passage.
    f. Round culverts must be imbedded at least 25 percent.

The above section is intended to provide some overlap with the chapter on Permanent (Post-Construction) Stormwater Management given that the use of techniques designed for the construction phase may overlap with other techniques that remain after construction activities are completed.

In some cases, design of culverts or other wildlife crossings that may be impacted by temporary or permanent stormwater control methods will require the review of such practices by a wildlife biologist who can assess the site's wildlife habitat and recommend practices that will minimize the adverse impact of stormwater control methods on existing wildlife crossing areas. The town may wish to add a provision allowing this limited review and providing for reimbursement of this expense by the developer. Alternatively, the Conservation Commission

IX. CONSTRUCTION SITE METHODS

A. **Responsibility of the applicant.** The applicant shall bear final responsibility for the installation, construction, inspection, and disposition of all stormwater management and erosion control measures required by the provisions of this regulation.

B. **Daily log of installations, inspections, modifications, rainfall, and repairs or reinstallations.** Construction site operators shall be responsible to ensure erosion and sedimentation control measures approved for the site are installed as designed. A daily log of erosion control measures, inspections, modifications required, rainfall events and erosion observed shall be submitted weekly to the town's engineering consultant, or public works department, or the planning board, at the discretion of the planning board.

C. **Estimate required.** A detailed estimate including unit pricing of temporary and permanent erosion control methods in a form acceptable to the planning board shall be submitted for review by the town's engineering consultant prior to any construction work.

D. **Construction site inspections.** In addition to the general inspections outlined above, the qualified professional serving as the town's consultant shall verify proposed limits of site disturbance and limits of tree removal, including the marking of root zones of trees to be retained, the location of temporary parking of construction vehicles, the location of stockpiles of construction materials, the location of earth stockpiles, and the proposed methods for daily removal of construction waste and debris from the site.

E. **Test upgradient and downgradient waters for turbidity levels**. Both to ensure they meet allowable state and federal standards and to compare these levels in order to evaluate sediment capture through the site.

F. **Pre-construction meeting.** A pre-construction meeting shall take place in which the applicant, town's consultant, site engineer, site contractor, road agent, and any other key town personnel as necessary attend to discuss the site, the development plans, and all aspects of site construction.

G. **Pre-winter meeting.** A pre-winter meeting shall be held not later than September 15 of each year prior to the acceptable completion of site work, in order that town staff, the

applicant, the contractor, the site engineer, the town's consultant, and other involved parties specify measures to secure the site for the winter season.

H. **Documentation.** Copies of all required permits and permit applications relative to the site, such as Site Specific Permit, and the Stormwater Pollution Prevention Plan shall be provided to the planning board and shall be considered as necessary for any conditional approval.

I. **Installation of erosion and sediment control devices**. Erosion and sedimentation control devices shall be installed prior to site disturbance or tree removal that would create erosion and sediment control issues.

J. **Certification.** No building permit shall be issued by the town until the town's consultant has certified that the site construction has proceeded in accordance with stormwater management and erosion and sedimentation control standards, plans, and specifications, and that the relevant portion of the site has been reasonably stabilized, and until the town's consultant has certified that all utilities, drainage and stormwater management measures and roadway base course of paving have been satisfactorily installed on the site.

K. **Surety.** An estimate shall be developed for the construction period, which shall include all erosion control costs. The applicant may request periodic release of such surety for work completed and verified by the town's consultant. At the completion of the construction and final acceptance by the town, the applicant may request up to 85 percent of escrow funds. The remaining escrow shall be held for two years after the completion of construction and acceptance by the town at which time the town's consultant will certify all temporary erosion controls that should be removed have been removed and all permanent measures have been installed and are functioning and have been maintained as intended. The site engineer shall develop and submit a maintenance plan for permanent erosion control and sedimentation and an estimate of annual maintenance costs. The plan shall include any necessary easements or other legal documents necessary to allow periodic inspection for a period of two years after completion of the project. Upon receipt of the certification and maintenance plan and legal review of easements or other legal documents as described herein, the town shall release the remaining funds.

X. CONSTRUCTION PRACTICES

A. Natural vegetation shall be retained, protected or supplemented to the extent practical. The stripping of vegetation shall be done in a manner that minimizes soil erosion.

B. Excavation equipment shall not be placed in the base of an infiltration area during construction. Excavation or other construction vehicles shall not be placed in the root zone areas of trees to be retained during construction.

C. Construction equipment and materials shall be stored at a distance greater than 25 feet from drainage channels, streams, lakes or wetlands.

D. Onsite wastes generated during the course of construction, including, but not limited to discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste shall be removed from the site daily to the extent feasible or at a regular interval as

specified in the construction sequence and schedule of daily activities for the project and disposed of properly.

E. No ground disturbed as a result of site construction and development shall be left as exposed bare soil. All areas exposed by construction, with the exception of finished building, structure, and pavement footprints, shall be decompacted (aerated) and covered with a minimum thickness of six inches of non-compacted topsoil, and shall be subsequently planted with a combination of living vegetation such as grass, groundcovers, trees, and shrubs, and other landscaping materials such as mulch, loose rock, gravel or stone. Native, non-invasive species as defined or listed on the New Hampshire DES Shoreland Protection List of Native Shoreland and Riparian Buffers Plantings in New Hampshire.

XI. REQUIRED SUBMISSIONS IN STORMWATER MANAGEMENT PLANS FOR APPLICATION REVIEW

A. In addition to any information generally required by the town for subdivision or site plan application, the applicant must submit the following items to the planning board for review:

1. Existing and proposed conditions including the following elements

a. Local map showing property boundaries.
b. North arrow, scale, and date of plan and plan amendments.
c. Surveyed property lines.
d. Structures, roads, utilities, earth stockpiles, equipment storage, and stump disposal.
e. Records of any timbering activities within the past five years.
f. Topographic contours at two-foot intervals.
g. Critical areas relating to natural resources as defined at a regional level, state level, or local level by a regional, state, or local level natural resource inventory.
h. Stockpile areas, and staging areas.
i. Within the project area, within 400 feet of project boundary, and upgradient within the watershed or appropriate portions thereof, all surface waters, waterbodies, streams, intermittent streams, ephemeral streams, wetlands, vernal pools, and drainage patterns and watershed boundaries.
j. Identified wildlife corridors if referenced in a local, regional, or state level natural resources plan
k. Vegetation, including description of species.
l. Extent of the 100-year flood plain when applicable.
m. Soil information from a National Cooperative Soils Survey soil series map or a High Intensity Soil Map.
n. Easements or covenants.
o. Areas of soil disturbance or remediation areas.
p. Areas of cut and fill.

q. Areas of poorly or very poorly drained soils, including any portion to be disturbed or filled.
r. Location of all structural, non-structural, and vegetative stormwater management and erosion control BMPs.
s. Detail sheet showing each BMP.
t. Phasing plan.
u. Inspection schedule.
v. Construction schedule.
w. Earth movement and grading schedule.
x. Construction Erosion and Sediment Control Plan that complies with the provisions of this regulation.
y. An operations and maintenance plan.
z. Spill prevention plan and emergency management plan for spills of potentially hazardous materials.
aa. Surety.
bb. Identification of alternatives in the drainage system design that provide for contingencies during storm events, for instance, and alternative for water flow in case a critical culvert becomes blocked by debris.
cc. Design calculations for all temporary and permanent BMPs and a narrative description of each measure, its purpose, construction sequence, and installation timing.
dd. Drainage report with inclusion of more frequent small storms as well as traditional calculations.
ee. Landscaping Plan (unless required by other sections of the regulations).
ff. Notation of soil types (unless required by other sections of the regulations).

XII. PRE-CLEARING

The applicant shall provide pre and post development peak flow rates in stormwater calculations. Any site that was wooded in the last five years must be considered undisturbed woods for the purposes of calculating pre-development peak flow rates.

XIII. ENFORCEMENT

The planning board may pursue any remedies authorized in the New Hampshire Revised Statutes Annotated for non-compliance with the specifications of an approved plan including revocation of the recorded plan.