KENNEBUNK'S WETLANDS:

FUNCTIONS, VALUES, AND RELATIONSHIP TO GROWTH

Prepared for

TOWN OF KENNEBUNK COMPREHENSIVE PLANNING COMMITTEE

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INTRODUCTION

This report was prepared by Normandeau Associates, Inc. (NAI) as part of the Town of Kennebunk's comprehensive planning process. The report includes an assessment of 49 of the most significant wetlands within the town, a review of wetland laws and ordinances, and recommendations to provide long-term protection of the most important wetland functions and values.

BACKGROUND

Wetlands Protection and Public Policy

During the 1980's a significant shift in public policy occurred which placed wetlands near the top of the environmental agenda. Many factors, some dating to the birth of the environmental movement in the 1970's, influenced these changes. Wetland inventories revealed that by the mid 1970's more than one half of the wetlands in the lower forty-eight states that existed prior to European settlement had been drained or filled for farming, urban development, or industry. Average annual losses for the 20 year period ending in the mid 1970's amounted to 400,000 to 500,000 acres per year. Recognizing these losses, Congress included wetland protection provisions in the Clean Water Act which was passed in 1972.

Public recognition of the wide range of wetland values and enforcement of the Clean Water Act's provisions grew during the late 1970's and 1980's. This increasing public concern led to wetland protection laws at the state and local levels. Maine passed the Freshwater Protection Act in the mid 1980's. During the 1980's the Town of Kennebunk included wetlands definitions in its zoning ordinance, although wetlands themselves were not specifically protected. In 1988 the State's Freshwater Protection Act regulations were amended to

include forested wetlands under the umbrella of the Natural Resources Protection Act. This action, a more active role by federal agencies in enforcing the Clean Water Act and a booming real estate market, helped to bring widespread public attention to wetlands issues in Maine.

What is a Wetland?

Wetlands are transition zones between terrestrial and aquatic ecosystems where the water table is at or near the surface or the land is covered by shallow water. The definition used by the Environmental Protection Agency (EPA), Army Corps of Engineers (COE), and State of Maine is as follows:

> Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands usually include swamps, marshes, bogs, and similar areas.
>
> (EPA, 40 CFR 230.3 and CE, 33 CFR 328.3)

Implicit in this definition are three parameters which characterize most wetlands. First, the land supports a plant community dominated by hydrophytes (water loving plants). Hydrophytes include obligate wetland species such as cattails as well as plants which are equally adaptable to wet or dry soils, such as red maple. Second, undrained hydric (wetland) soils are present. Hydric soils have colors or textures which indicate prolonged saturation during the growing season. Third, the soil is generally saturated at or near the surface for a week or more during the growing season.

Wetland Types

The definition of weltands includes a wide range of wetland types, ranging from deep marshes which are permanently covered with shallow water to stands of red maple and white pine which may have saturated soils for only a brief time during the growing season. The following types of wetlands may be found in Kennebunk.

Salt Marshes are coastal wetlands influenced by the daily rise and fall of tides. Salt marshes are found in the tidal sections of the Little River, Mousam River, Kennebunk River, and Lake Brook Creek.

Brackish and Tidal Fresh Marshes are usually dominated by freshwater species such as cattails or freshwater/saltwater transition species (including many rushes), but are still subject to tidal influence. Tidal fresh marshes and brackish marshes can be found just downstream of the sewage treatment plant on the Mousam River and on the Kennebunk River upstream from Kennebunk Landing to the upper limit of tidal influence.

Deep Fresh Marshes have standing water throughout the growing season and are usually dominated by cattails or other emergent vegetation. None of these marshes were evaluated during the current study, although a few examples may be found along the margins of ponds and rivers.

Shallow Fresh Marshes are also uncommon in Kennebunk. These marshes have standing water for a portion of the growing season and commonly support a mix of cattails, sedges, grasses, rushes, and scattered shrubs. This wetland type is found in the large wetland along upper Ward Brook southeast of Alewife Pond.

Wet Meadows are dominated by hydrophytic grasses, sedges, and rushes but seldom have standing water. Examples of small wet meadows can be found in poorly drained areas of farm fields and pastures in west Kennebunk.

Shrub Swamps are usually characterized by dense growth of alders, winterberry, highbush blueberry or several species of viburnum. Often transitional in wetness between marshes and forested wetlands, shrub swamps may be found along the margins of streams and as inclusions in forested wetlands.

Forested Wetlands range from red maple swamps which commonly have pools of standing water during the early growing season to dense stands of white pine and red spruce growing in sandy soils with a fluctuating water table. Forested wetlands are the most common wetland type in Kennebunk and can be found throughout the town. Punky Swamp, located northeast of Ross Road, is an example of a large forested wetland.

Bogs are nutrient poor wetlands characterized by sphagnum moss and many species of the heath family such as leatherleaf, rhodora, bog laurel, labrador tea, and cranberry. Insectivorous plants such as sudens and pitcher plants are also commonly found in bogs. No true bogs were evaluated during the study, but wetland 215 located west of Route 1 south of Kennebunk Village, has many bog species and is transitional between a coniferous forested wetland and a "classic" bog.

Wetland Functions and Values

Wetland protection regulations are based on the premise that wetlands provide many important economic and ecological benefits. These benefits usually fall into three broad but closely interrelated categories: biological productivity, water resources, and cultural values.

Biological benefits include fish and wildlife habitat or nutrient export which supports productive and diverse food webs. Tidal marshes and freshwater marshes which are interspersed with open water are examples of highly productive wetland ecosystems which are essential to many fish and wildlife species including waterfowl. The tidal marshes on the Little, Mousam, and Kennebunk Rivers are prime examples of high productivity wetlands. Other wetland types, such as shrub swamps and forested wetlands, provide habitat for fewer water-dependent species but probably support a greater diversity of songbirds than any other wetland type (Golet and Larsen, 1974). Although wetlands only comprise about 5% of the nation's lands, they provide critical habitat for almost 35% of all rare and endangered animal species (the Conservation Foundation, 1988).

Water resource values include groundwater discharge, stream flow maintenance, flood prevention, water quality maintenance, and shoreline protection. Wetland-groundwater interactions are highly complex and variable, and are influenced by many factors including soils, underlying geology, topography, and landscape position. In general, wetlands are are located in areas of groundwater discharge, although wetlands located on coarse sandy soils may be important recharge areas during summer months. Discharging groundwater helps sustain downstream aquatic ecosystems.

Wetlands help control flooding in two ways. Headwater wetlands act as storage basins which release water slowly to feeder streams, thus helping maintain even stream flows and temperatures. During storm events, wetlands help spread the peak flow volume over a longer period of time. This function is known as crest desynchronization. Large floodplain wetlands lower in the watershed also help prevent flooding by storing water as rivers spill over their banks. Dense vegetation within floodplain wetlands also tends to impede water movement, thereby increasing effective storage capacity.

Wetlands have been shown to be important in maintaining water quality. Nutrients and chemical contaminants in surface water and discharging groundwater may be taken up by wetland plants or settle out and become bound in wetland sediments. Sediments carried by surface water may settle in wetlands as stream flow slows or be filtered by sense vegetation. By reducing flood flow velocity, wetlands help prevent downstream erosion. Wetlands also help prevent erosion along rivers, lakes, and estuaries by reducing the force of waves and storm tides before reaching upland areas.

Humans directly use and receive many cultural and economic benefits from wetlands. Recreational uses, such as nature study, hunting, fishing, and boating are widely recognized. Public wetlands such as the Rachel Carson National Wildlife Refuge are designed to protect wetlands from overuse and development while providing controlled public access and use. Education and research are also important functions of public wetlands, while many privately held wetlands have current or potential future value for research and education.

Wetlands also provide open space and aesthetic values. Broad tidal marshes backed by protective dunes are an important feature of Kennebunk's landscape. While not offering impressive vistas, forested wetlands present the visitor with a rich mosaic of trees, shrubs, ferns and delicate wildflowers. Wetlands often provide open space buffers between developed areas in what otherwise might have become a continuously developed area. For example, extensive wetlands east of the Maine Turnpike have helped contribute to the growth of distinct neighborhoods separated by forest and open marshes.

Wetlands have historically provided important economic values. When agricultural economics dominated New England, wetlands were important for timber and hay production. Forested wetlands are still important producers of spruce-fir timber in northern New England but

generally produce lower value forest products such as firewood in the Kennebunk area. Natural wetland meadows and salt marshes were very valuable hay sources to the early settlers, and some wet meadows are still managed for hay production.

METHODS

NAI evaluated the functions of 49 wetlands in the Town of Kennebunk. Wetlands were selected for evaluation on the basis of size, potential value, location, and diversity. The largest and most valuable wetlands were selected first. While all of the Town's major wetlands were included in the study, the sample also included a variety of smaller wetlands located throughout Kennebunk which are representative of the range in wetland type and value.

Both updated National Wetland Inventory (NWI) maps and draft wetland maps provided by the Maine Geological Survey (MGS) were used to select the study areas. These maps provided information on wetland location, type, and size. U.S. Geological Survey topographic maps and county soil maps provided additional data. Representative points of each wetland were then visited by an NAI field crew where more data on plant communities, hydrology, topography, surrounding land use and access were collected. Data were then evaluated using NAI's wetland database system. The model results were interpreted by NAI's wetland scientists and general conclusions were drawn about the nature and significance of wetland values in Kennebunk.

The locations of the evaluated wetlands are shown on the wetlands map. The wetlands map was prepared by T.J. DeWan and Associates with assistance from NAI using the NWI and MGS wetland maps.

For the purposes of this study, it was not necessary for NAI scientists to delineate the wetland boundaries according to the criteria of state and federal regulatory agencies. If specific activities are proposed which would affect any of these wetlands, the boundaries would then have to be delineated.

The relative importance of a wetland is usually measured in terms of the degree to which it performs certain functions and values. Not all wetlands perform all functions to the same degree. For example, some wetlands provide wildlife habitat, while the key function of another might be flood water storage. Normandeau Associates, Inc. (NAI) uses the Hollands-Magee wetland assessment models (Hollands and Magee 1985 as revised 1987) to evaluate wetland benefits and their contribution to the public interest.

Ten wetland benefits are evaluated by the Hollands-Magee models. These include: 1) biological productivity and contribution to wildlife and fisheries, 2) hydrologic support for stream flow, 3) groundwater recharge, 4) flood control, 5) shoreline protection, 6) prevention of water pollution, 7) economic value, 8) recreation, 9) scenic value, and 10) educational value. Each model is designed to evaluate those biological and physical characteristics of a wetland (e.g., surface geology, vegetation type) that give rise to public benefit (e.g., flood storage, pollution control). Over 30 variables are considered by the models in assessing wetland benefits. Most of this data, with the exception of general watershed information, are gathered during the field evaluation. After analyzing the data, a computer then ranks the wetland for each benefit relative to other wetlands in the region. The ranking is accomplished by comparing the wetland's score to the scores obtained from several hundred other New England wetlands.

FINDINGS

Model Results

The results of the Hollands-Magee wetland assessments are presented in Appendix A. The rankings are best interpreted as the wetland's relative value in performing a particular function as compared with other wetlands.

The models were not designed to evaluate the water resource functions of tidal wetlands, thus "NA" (not applicable) is listed for several functions of wetlands 201, 210, 301, 303, 307, and 401. These functions include hydrologic ability to maintain flows, goundwater recharge, flood storage, and water quality protection. Since Wetland 210 is subject to only slight tidal influence, the water quality model provided a reliable assessment of this coastal wetland's ability to retain sediments and pollutants.

Two functions in particular must be interpreted with caution. The model results indicate many wetlands have a high ranking for groundwater recharge. This is primarily due to sandy soils and large wetland size, both of which increase a wetland's potential for recharge. This type of wetland is common in Kennebunk. While the relative value of Kennebunk's wetlands for groundwater recharge is higher than that of many other wetlands in New England (where compact glacial till or marine sediments predominate), their absolute value is probably much lower than in adjacent uplands. Typically, within a given wetland groundwater discharge value is greater than recharge value, even though the ranking for function #2 - hydrologic ability to maintain flows during dry periods (which includes an estimate of groundwater discharge) - may be lower than the ranking for groundwater recharge. This is particularly true with stream associated wetlands, where groundwater typically discharges through the wetland into the adjacent stream.

The second function which must be interpreted carefully is economic value. Although the model ranked many wetlands in Kennebunk high for economic value (primarily timber or hay production) relative to other New England wetlands, economic value for these crops is usually much lower in wetlands than adjacent uplands. Economic value (in absolute terms) is usually less important than the value of most other wetland functions, although when compared to the economic values of other wetlands the economic value may appear relatively high.

These two examples illustrate limitations inherent in a ranking system where wetlands are compared with each other on a function-by-function basis. On the other hand, this approach, when tempered with professional interpretation, gives a rapid, qualitative assessment of a wetland's relative value suitable for site-specific or community-wide planning (see discussion under Major Functions and Values).

Characteristics of Evaluated Wetlands

A wetland summary is presented in Table 1. This table shows NWI classification, state wetland classification, wetland size class (as used in the Hollands-Magee analysis), major functions, and protection priority for the 49 wetlands evaluated in this study.

NWI classification is the predominant vegetative community and hydrologic regime as indicated by the NWI maps. The classification was modified if the field inspection indicated mapping errors.

State wetland classification indicates the predominant wetland class as defined by the latest (1990) DEP rules. Two classes are shown where clearly evident. For example, the first 250 feet of a forested wetland which borders a salt marsh is a Class II wetland, while the remainder of the forested wetland is a Class III wetland. Wetlands which were given a single DEP classification may include smaller areas

Table 1. Town of Kennebunk Wetland Summary

WETLAND ID	SIZE	NWI CLASS	DEP CLASS	MAJOR FUNCTIONS & VALUES	PROTECTION PRIORITY
		MOUSAM RIVER WATERSHED			
201	L	E2E	I	1,5,8,9,10	1
202	M	PF01/4	II,III	3,6,8,9,10	2
203	M	PF04/1	II,III	3,6,8,9,10	2
204	L	PF04/1	III	1,2,3,6,7,8	2
205	S	PSS	III	3,6	3
206	M	PF01	III	3,6	3
207	L	PF04	III	1,2,3,6,7,8	2
208	L	PF04	III	1,2,3,6,7,8	2
209	M	PF01/SS	II	1,2,5,9	1
210	M	PEM1R	I	1,5,6,8,9,10	1
211	M	PF01	III	3,6,8	3
212	M	PF01/SS	II	2,6,8,9	1
213	S	PF01	III	2,6	3
214	L	PF04/SS	III	1,2,3,6,7,8	2
215	M	PF04	III	2,3,6,10	2
216	M	PF01/4	II	1,2,6	2
217	M	PSS	II	1,2,5,6,8,10	1
218	M	PSS	III	1,2,3,6	2
219	M	PF01	III	1,2,6	2
220	M	PF01	II	1,6,8,10	1
221	S	PF01	III	1,3	3
222	M	PF01	II	1,8	2
223	L	PF04	III	1,2,3,6,7	2
		KENNEBUNK RIVER WATERSHED			
301	L	E2E	I	1,5,8,9,10	1
302	M	PF04	II,III	8,9	2
303	S	E2E	I	1,8,9,10	1
304	S	PF01	III	2	3
305	M	PF01/SS	II	1,6,8	1
306	S	PSS	III	2,6	3
307	M	PEM1R	I	1,5,8,9,10	1
308	M	PF04	III	2,3,6,7,8	2
309	L	PF04/1/SS	III	1,2,3,6,7,8	2
310	M	PF01	III	2,4	3
311	S	PSS	II	1,2,6	2
312	M	PF01	II	8,9	2
313	M	PEM1/SS/F01	II	1,2,4,6,8	1
314	S	PF01	III	1,2	3
315	L	PF01/EM	II,III	1,2,4,6,8	1
316	M	PF04/SS	III	1,2,3,4,6,8	2
317	S	PF01	II	6,8,9	2
318	S	PF01	II	2,6	3
319	M	PF01	III	1,2,4,6,8	2
320	M	PF01	II	1,2,6	2
321	S	PSS	II	2,6	2
322	M	PF01	III	2,3,4	2
		BRANCH BROOK WATERSHED			
401	L	E2E	I	1,5,8,9,10	1
402	M	PF01	II	1,2,3,5,6,8,9,10	1
403	M	PF01	II	1,3,6,8	1
404	M	PF04	III	1,3	

LEGEND

SIZE*:
- S Less than 10 acres
- M 10 - 100 acres
- L Greater than 100 acres

* as indicated by NWI and MGS maps. Actual acreage may vary.

NWI CLASS:
- E2E Salt marsh
- PEM1 Shallow fresh marsh
- PEM1R Brackish marsh (tidal)
- PF01 Deciduous forested wetland
- PF04 Coniferous forested wetland
- PSS Shrub swamp

DEP CLASS:
As per 1990 wetland rules

MAJOR FUNCTIONS AND VALUES:
Interpretation of Hollands-Magee assessment results
1. Biological productivity, including biomass production and fish and wildlife value.
2. Hydrologic ability to maintain flows during dry periods.
3. Groundwater recharge.
4. Flood storage and crest desynchronization.
5. Shoreline buffering.
6. Water quality protection.
7. Economic value, primarily timber and hay.
8. Recreational value.
9. Aesthetic value.
10. Educational value.

PROTECTION PRIORITY:
1. High value and vulnerability.
2. High value/low or moderate vulnerability.
3. Moderate to low value.

of other classes. This may occur in a Class III forested wetland which has unmapped streams. The first 250 feet on each side of these streams is a Class II wetland while the remainder is Class III. Conversely, Class II wetlands following mapped streams may have Class III wetlands beyond the first 250 feet. Habitat for rare or endangered species was not incorporated into this analysis. Wetlands with rare or endangered species are Class I under the proposed rules. Under the State rules, Class I wetlands receive the most protection, Class III the least.

Major Functions and Values

Major functions and values for each wetland are indicated in Table 1. These values are based on NAI's interpretation of the Hollands-Magee results. It is essential to be aware that a model, no matter how complex, simply provides numbers or values that must be refined by professional judgment. Models such as the one used in this study are relatively simple frameworks designed to analyze very complex ecosystems. Models are designed to analyze a broad range of conditions; therefore the results need to be interpreted for the unique characteristics of the wetland under consideration.

NAI's estimate of major functions and values may vary from the model results for several reasons. The model rankings indicate the relative value of a particular wetland function compared to other wetlands in New England. In a local context, however, actual value may be more or less significant. The major functions and values listed in Table 1 indicate our estimate of actual value in a local, site-specific context, as based on interpretation of the model results and field observations. The following discussion highlights show specific values were interpreted from the model results.

1. Biologic value. The Hollands-Magee rankings generally provide an excellent estimate of biologic value. For some wetlands associated with

streams (e.g. Wetland 220) that have potential to be important wildlife travel corridors, biologic value was listed as a major function even though the model ranking was not exceptionally high.

2. Hydrologic ability to maintain flows during dry periods. Wetlands which appear to discharge directly to streams were usually interpreted to be important for stream flow maintenance, although the model may indicate moderate relative value for this function.

3. Groundwater recharge. As indicated previously (see "Model Results"), the model ranked Kennebunk's sandy wetlands as being of relatively high value for groundwater recharge. Recharge was generally not listed as a major function for stream-associated wetlands since recharge is much less important than discharge in these areas.

4. Flood storage and crest desynchronization. Large, nearly level wetlands have high capacity to store water, and thus were ranked above average by the model. However, the model was not designed to recognize an infinitely large storage basin such as the Atlantic Ocean. Thus, flood storage was not listed in Table 1 as a major function for wetlands which are located close to tidal areas even though the model may have given a relatively high ranking (e.g. Wetland 204).

5. Shoreline protection. The Table 1 listings for shoreline buffering were taken directly from the model results.

6. Water quality protection. The model rankings for water quality protection were generally found to be representative of the wetlands' value in the local context. Water quality protection offered by wetlands adjacent to small streams (e.g. Wetland 211) was listed as a major function although the model may not have given the wetland a high ranking.

7. Economic value. The model tends to rank medium and large forested wetlands and meadows high for economic value. As indicated earlier, however, economic value derived from harvesting wetland resources such as timber, hay, or peat is usually not an important consideration. Economic value was listed as a major function only for those forested wetlands which appear to have potential for commercial forestry, as indicated by the field inspection and review of cover type maps. Generally, these are large (greater than 100 acres) wetlands with a substantial softwood component.

8. Recreational value. Recreation value was interpreted to be a major function for larger wetlands which provide open space for nature study and walking as well as wetlands with hunting and fishing potential. This includes forested wetlands which may only provide hunting opportunities for upland game (e.g. Wetland 207) as well as those which provide more water-oriented recreation activities, such as the tidal marshes along the Mousam River.

9. Aesthetic value. Aesthetic value is the most subjective of the ten wetland functions evaluated. Aesthetic value was listed as a major function in Table 1 for those wetlands with scenic vistas or open water which is located near a point of public access from roads, trails, or water. The aesthetic value of Wetland 203 was listed as a major function since it is adjacent to a bridle path, whereas an ecologically similar wetland, Wetland 204, located in a less accessible location was not considered to be an important aesthetic resource.

10. Educational value. Educational value was listed as a major function of wetlands with high diversity of cover types and accessible aquatic habitat. All of the major tidal wetlands were included, as well as exceptional freshwater wetlands. For some wetlands (Wetland 214 for example), educational value was not listed as a major function even though ranked high by the model. This is because access is limited,

there is no aquatic or semi-aquatic habitat, and there are many similar wetlands throughout Kennebunk.

Two examples will serve to show how the results were interpreted. Wetland 220 is a long, narrow forested wetland bordering Upper Day Brook. The models ranked wetland 220 moderate for biological value, high for groundwater recharge, moderate for water quality protection, and high for timber (economic) value. Stream corridors are important wildlife travel lanes and this importance will increase as a town grows. Thus, wildlife value was interpreted to be a major function of this wetland. Although the model ranked the wetland high for groundwater recharge (due primarily to high permeability sandy soils), NAI's observations indicated that the water table was primarily discharging to the stream. Thus, groundwater recharge is not listed as a major function in Table 1. Although the narrow, sloping wetland cannot assimilate large quantities of water borne pollutants, we felt that the wetland provides an important buffering function to protect the waters of Day Brook from pollutants which might enter from nearby upland areas. Hence, we indicated that water quality protection was a major function of the wetland, though the model ranking was below the median. Upper Day Brook is small but easily accessible from two road crossings; therefore, the wetland has potential educational value as an example of freshwater stream and wetland ecology.

Wetland 202 is a medium sized forested wetland located east of the tidal marsh on the Mousam River and south of Route 9. Biological value, flood storage, aesthetic value, and educational value were ranked about average by the Hollands-Magee models. The remaining functions were ranked above average to high. Since the wetland is located adjacent to a tidal wetland, hydrologic ability to maintain flows was not listed as a major function in Table 1. Groundwater recharge received the highest possible ranking and therefore was included as a major function even though the area is served by town water. The

wetland is located between developed areas and the tidal marsh, thus water quality protection was listed as a major function. Recreation, aesthetic, and educational values were listed as important because the Wetland is easily accessible via the bridle path and provides a natural forest backdrop to the view of the Mousam River marshes from Route 9 and Parson's Beach.

Protection Priority

A protection priority rating is included in Table 1. This ranking combines an assessment of the wetland's overall value (a synthesis of the ten functions evaluated) with an indication of its vulnerability to the cumulative effects of development. All coastal wetlands were given the highest protection priority due to their extremely high value. Narrow stream corridors which are vulnerable to habitat fragmentation and incremental pollution increases from adjacent development were also given a high protection priority ranking. These areas will increase in value to wildlife as the town grows.

Larger forested wetlands, while often of high value, are less vulnerable to development. These wetlands tend to have a built-in buffering function. First, because of their large size, they are less vulnerable to development. Second, current methods of delineating wetland boundaries usually include a transition zone between permanently saturated soils and adjacent uplands. In larger forested wetlands, this transition zone is often broad, resulting in additional buffering capacity. These wetlands were generally ranked as Priority 2.

Wetlands with low to moderate overall values were given the lowest protection priority ranking. While development of these wetlands is generally not recommended, development adjacent to these wetlands will have lower impacts than development in or adjacent to Priority 1 and 2 wetlands.

Our field review found that wetlands are generally larger than shown on the wetland map, and that numerous narrow wetland drainages are not shown on the maps. Thus, total wetland area exceeds that shown on the wetland map.

Summary of Findings

1. The highest concentration of wetlands is located east of the Maine Turnpike. Twenty-eight (28) of the wetlands studied are located east of the turnpike. This includes eight (8) wetlands greater than 100 acres in size and sixteen (16) between 10 and 100 acres, as well as numerous small wetlands not included in the study. Of these wetlands twelve (12) are highest priority, twelve (12) are moderate priority, and four (4) are lowest priority. This represents 75% of the highest priority wetlands and 52% of the moderate priority wetlands.

2. Kennebunk's salt marshes have high regional and local significance. Salt marshes, which have exceptionally high wildlife, fisheries, recreational, aesthetic and educational values, are relatively uncommon in Maine. Kennebunk has two major salt marsh complexes (Little River and Mousam River/Back Creek) as well as smaller salt and brackish marshes associated with the Kennebunk River and Lake Brook Creek. These wetlands which are highly visible, are the "Crown Jewels" of Kennebunk's wetlands.

3. Wetlands within the Branch Brook watershed are highly valuable due to their contribution to the Wells-Kennebunk public water supply.

4. Stream associated wetlands provide high value wildlife and water quality benefits. Relatively narrow forested wetlands along stream corridors provide key habitat for animals which require aquatic habitat for all or part of their life cycle. These wetlands also serve as travel corridors between large blocks of undeveloped land. Forested

wetlands adjacent to streams also filter contaminants and sediments caused by human activities on nearby uplands. The narrow width of these wetlands is sometimes insufficient to provide water quality and wildlife habitat protection without added development setbacks in bordering uplands.

5. Medium and large forested wetlands are important for wildlife and water quality. Forested wetlands east of the Maine Turnpike wetlands comprise the majority of available wildlife habitat. These wetlands are primarily used by non water-dependent species such as white tailed deer and songbirds. For forest interior songbirds, large tracts of unbroken forest are essential. As growth pressures increase, these wetlands will become increasingly important as wildlife refuges. Forested wetlands west of the of the Turnpike, while still supporting a high diversity of species, are less critical as refuges. Forested wetlands also provide important water resource benefits by detaining and cleansing runoff and stormwater, discharging water and nutrients to downstream aquatic ecosystems, and seasonally recharging groundwater through coarse, sandy soils. As undeveloped areas, they also provide open space and recreational benefits for hunting, hiking, and nature study. The larger wetlands are less vulnerable to nearby site development but their value may be severely impacted if they are fragmented into smaller blocks by development or agriculture.

6. Linking wetlands is essential for long-term natural resource protection. Protecting isolated forested wetlands is insufficient to insure the future viability of wildlife populations. Many species, especially larger vertebrates, have large home ranges which may vary from day to day or season to season. Development which cuts up forests into smaller islands limits the value of wetlands to these species and can have long term impacts on genetic diversity. Increased predation by "edge" species such as skunks and cowbirds, as well as domestic animals,

is also a concern when wetland and forest habitat is fragmented by human activities (Brown, et al. 1987).

7. Small wetlands have a large cumulative value to the community's water resources. The loss of an individual small wetland may not have a measurable impact on the Town's water resources. While the cumulative impacts of small wetland loss or impact cannot be precisely predicted, long-term "nibbling" is likely to have a noticeable effect on water quality.

8. Both on-site and off-site activities can impact wetlands. On-site activities such as filling have direct impacts on wetlands. Off-site activities such as development adjacent to wetlands, can impact water quality and quantity, wildlife habitat, recreation potential, and aesthetics of wetlands. Buffer strips of undisturbed soil and vegetation adjacent to wetlands can mitigate the impacts of nearby human activities. These buffer strips provide a visual and acoustical barrier, maintain habitat continuity, and filter runoff from developed areas. While some activities such as limited timber harvesting and recreation are allowable in buffer strips, activities which expose soil and substantially reduce the diversity of vegetation should be prohibited.

9. Public education is necessary for local wetland protection. Public support for wetland protection depends to a large extent on educating the public about the importance of wetlands. An effort by the Conservation Commission or other appropriate town board is necessary to actively involve the public in understanding and helping to monitor wetland impacts.

ISSUES AND IMPLICATIONS

Growth patterns. Population growth pressures will continue to threaten the biological, water resource, and cultural values of wetlands in Kennebunk. These pressures have historically been greatest east of the Maine Turnpike, and decisions made at this time may have a pivotal role in where the bulk of future development will occur and what the long-term impact will be on wetland resources. Increased development to the east of the Turnpike through sewer line extensions or other incentives will put added pressure in areas of high value wetlands. The wetlands east of the Turnpike have above average wildlife value; accommodating growth without adversely affecting wildlife will be a difficult task. Development can be more easily accommodated to the west of the Turnpike without compromising wetland values due to extensive areas of undeveloped uplands.

Prioritizing Wetlands. Table 1 presents a wetland protection priority rating based on the overall wetland values of each wetland (a synthesis of the 10 functions evaluated) plus its vulnerability to impacts from development in adjacent uplands. Findings 1 and 2 discussed the prevalence of high priority wetlands east of the Turnpike. Assuring adequate protection of high priority wetlands (including buffers if necessary) and minimizing impacts to moderate priority wetlands will further limit growth options east of the Turnpike. Lack of adequate protection will have negative long-term natural resource impacts.

Regulatory considerations. Federal, state, and to some extent, local ordinances protect wetland resources. The latest federal delineation method (Federal Interagency Committee, 1989) was adopted in 1989. This methodology requires a comprehensive examination of a site's vegetation, soils, and hydrology, and when properly applied, results in a wetland boundary which includes much of what might traditionally be

described as the wetland-upland transition zone. Except for truly isolated wetlands with no outlet (uncommon), all coastal and freshwater wetlands fall under federal jurisdiction.

Wetlands protected under the State Natural Resources Protection Act (NRPA) include all coastal wetlands, freshwater wetlands greater than 10 acres in size, and freshwater wetlands adjacent to a great pond or within the floodplain of an intermittent stream. The state has adopted the federal method of wetland delineation. Kennebunk defines freshwater wetlands as having either hydrophytic (wetland) vegetation or hydric (wetland) soils. This procedure will result in a similar, but not identical, boundary to that which would be identified using the federal method. In general, the Kennebunk definition will include a larger area within the wetland boundary. Kennebunk's wetland definition is used to derive net developable area within a subdivision. There is no local wetland protection ordinance.

Overlapping jurisdictions create confusion over who is protecting how much wetland. While almost all wetlands are under federal jurisdiction, protection is not assured. Permits are routinely issued through the federal permit process. Staffing is another consideration. The Army Corps of Engineers (the Corps), charged with processing wetland permits, has a staff of three for the entire state of Maine. In addition to wetlands, the Corps is responsible for permitting of activities in navigable waters. The Corps does not require any buffers as conditions, nor does it review permits with regard to cumulative impacts.

New state wetland rules will give modest protection to most forested wetlands greater than 10 acres in size (Class III), relatively stringent protection to wetlands along streams, with open water, or adjacent to coastal wetlands (Class II), and strict protection of coastal wetlands or wetlands adjacent to a great pond (Class I).

Undisturbed buffers up to 100 feet are required under the Permit-by-Rule standards. In considering the degree of wetland protection desired by the Town, it is important to consider that: 1) not all wetlands are regulated by the State; 2) the State's classification system is similar to, but not equivalent to the protection priority ratings proposed in this report; 3) the State does not consider cumulative wetland impacts when issuing permits; and 4) staffing and enforcement of State wetland rules are limited.

The presence of rare and endangered species or other unique natural features may affect wetland value. Likewise, existing or proposed facilities such as roads and utilities may impact wetlands, and local ordinances may need to adapt to these public interest projects.

State and federal laws have agricultural and forestry exemptions which could result in significant wetland impact. A local wetland protection ordinance should recognize existing uses (e.g. agriculture) but prohibit future activities which will further degrade wetlands (e.g. clearing and draining a forested wetland for agriculture). Some forestry activities (e.g. selective cutting curing winter months) may be allowable if soil is not disturbed.

If the Town considers wetland protection a high priority issue, the adoption of a local wetlands protection ordinance is essential. Local eyes and ears are the most reliable method of wetland protection and enforcement. In such cases, adoption of wetland definitions consistent with state and federal policy will minimize confusion for future applicants. State and federal wetland definitions and regulations are in a state of flux; thus, town ordinances (especially definitions) need to be flexible enough to accommodate changes in these regulations.

Incorporating wetland protection into the comprehensive plan is an opportunity to develop an integrated landscape approach to natural resource protection.

POLICY OPTIONS

In deciding whether the Town wishes to pursue a policy of wetland protection, a range of policy options may be considered. Three possible strategies are outlined below.

Option 1. Maintain the status quo. If the Town does not wish to emphasize wetland protection, reliance on existing federal and state laws will provide the minimum allowable wetland protection. However, the Town will relinquish local control over activities in and adjacent to wetlands. Long-term wetland losses in terms of area and function may result. Short-term (10 ± years) losses are likely to be insignificant.

Option 2. Protect wetlands at the local level on the basis of value and vulnerability to impact. The protection priority ratings developed by NAI can be used as the basis for developing a wetland protection system. This system could be used as is or modified to address local concerns. See Appendix B for a discussion of wetland protection ordinances used in other communities and states. One possible wetland system is proposed below.

A) Redefine wetlands using the current state/federal definition.

B) Protection

1. Priority 1 Wetlands. Establish a wide (100-300 foot) critical edge buffer to protect high priority wetlands. Buffer widths might vary depending on resource value, surrounding slope, nature of proposed activity, and surrounding land use (e.g., there is little to be protected by imposing a 300 foot setback on building lot if the adjacent

development is much closer to the wetland edge.) The first 100 feet of the buffer should remain entirely undeveloped, while light development might be allowed within the next 150 - 200 feet.

2. Priority 2 Wetlands. Establish moderate buffers (25-100 feet) depending on slope, nature of the proposed activity, and surrounding land use. Consider as a minimum, state standards set by NRPA Permit-by-Rule requirements and the revised (1990) Shoreland Zoning rules. Augment these rules as necessary to include all Priority 2 wetlands.

   COMMENT: As indicated earlier, most Priority 2 wetlands have built-in buffers due to large size and the nature of the current federal delineation procedure. Buffers tied to slope (i.e. buffer width increasing with slope) would help protect wetlands where there is an abrupt wetland/upland boundary which often occurs at the base of steep slopes.

3. Priority 3 Wetlands. Establish minimal or no buffers (0 - 25 feet). Priority 3 wetlands could be protected outright by the Town or their fate left to the whims of state and federal regulators.

4. Establish criteria to prioritize wetlands not reviewed by this study. DEP wetland classification criteria could be used to prioritize the remaining wetlands in town. Buffers might also be considered for other water resources (e.g., headwater streams) not protected by Shoreland Zoning.

Option 3. Establish a uniform buffer for all wetlands. Some towns have established uniform buffers (e.g., Kittery, 100 feet) for all wetlands greater than 1 acre in size. This system is simple to administer, but has drawbacks. A uniform buffer would be insufficient to protect wildlife values in critical habitat areas, but may place an unfair burden on landowners whose properties contain low value wetlands or wetlands with a "built-in" buffer.

CONCLUSION

A wide variety of wetland ecosystems are found within the Town of Kennebunk. Broad salt marshes flank the dunes and tidal inlets near the shore, while forested wetlands, shrub swamps, wet meadows, and riverine marshes are found throughout town. These wetlands provide many important benefits to humans, while some are critical to the survival of wildlife. Recognition of these resource values and a policy of wetland protection should be an integral part of the comprehensive plan. Wetland policies can be tied to other natural resource consideration to preserve green corridors for wildlife travel, recreation, and open space. Extensive wetlands may limit future development east of the Maine Turnpike. Wetland values vary, and policies for protection should be tied to resource value and vulnerability to human impacts. As long as the human population and level of industrialization continue to grow, pressures on wetlands and other natural resources will increase. Wetland protection and local comprehensive planning cannot address the root causes of the global environmental crisis, of which local problems such as polluted clam flats and high ozone levels are minor symptoms. However, the Town can develop a stewardship plan to assure appropriate use and protection of wetlands for the benefit of future generations.

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APPENDIX A

HOLLANDS-MAGEE ASSESSMENT RESULTS

APPENDIX A: HOLLANDS-HAGEE WETLAND ASSESSMENT RESULTS

These wetland functional models were developed in 1981 to meet the requirements of the state of Wisconsin in protecting ten benefits which accrue to the public from wetlands. They were published in 1981 as part of a site review for Exxon Minerals Co., Rhinelander, WI, and later in a conference proceedings (Hollands & Hagee, 1985, Association of State Wetlands Managers, Portland).

The models were modified to fulfill the requirements of wetlands laws in New England, although they still contain the elements originally specified by the Wisconsin models. The software was designed as a resource management tool, to sort and compare groups of wetlands by Wet ID.

Each model relates the physical and biological characteristics of a wetland to a numerical score between 0 and 100. The scores do not represent the actual value of a wetland in performing each function, however they can be used as relative values to compare one wetland against another on a function-by-function basis. After the raw score is calculated, the score is compared to those of over 800 other New England freshwater wetlands, and its rank is established to the nearest ten percent (decile). A rank of 1 indicates a relatively low value compared to other wetlands in the database, while a rank of 10 indicates a relatively high value. A summary table of wetland function rankings for each watershed and individual wetland summaries follow.

HOUSAH RIVER WATERSHED

WETLAND ID NO.	NO. AND NAME OF BENEFIT MODEL 1 Biol	2 Hydro	3 GrWat	4 Flood	5 ShLi*	6 WQual	7 Econ	8 Recr*	9 Aest*	10 Educ*
Model ranking by decile										
ZY201	10	**	**	**	10	**	10	10	9	10
ZY202	5	8	10	4	0	8	10	8	4	5
ZY203	6	8	10	7	0	8	10	8	5	8
ZY204	8	9	10	9	0	9	10	10	5	8
ZY205	6	4	8	4	0	8	3	2	4	6
ZY206	5	6	10	4	0	7	10	7	4	5
ZY207	9	9	10	5	0	9	10	9	5	9
ZY208	9	10	10	6	0	10	10	10	8	9
ZY209	7	6	10	2	0	6	7	7	2	5
ZY210	9	**	**	**	10	8	7	10	10	8
ZY211	4	6	10	4	0	6	10	7	4	2
ZY212	5	7	10	2	0	8	10	7	5	4
ZY213	4	6	8	4	0	6	7	5	4	5
ZY214	8	10	10	7	0	10	10	10	7	9
ZY215	5	9	10	7	0	9	10	7	5	6
ZY216	9	6	10	2	0	7	7	8	4	8
ZY217	10	8	8	2	10	8	1	8	5	7
ZY218	9	9	10	6	0	10	7	8	6	9
ZY219	6	7	9	3	3	6	10	10	4	6
ZY220	7	3	10	2	0	4	10	8	4	6
ZY221	4	3	8	2	0	1	3	3	1	1
ZY222	10	4	10	3	3	5	7	8	4	8
ZY223	7	6	10	4	0	7	10	8	5	8

* Model modified from Wisconsin original
** Model not applicable to tidal wetlands

SITE: ZY201 ECOLOGICAL SUMMARY Hichener Software 07/21/90

Normandeau Associates Inc.

Location: COASTAL WETLANDS OF HOUSAT R
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	: NA :
3 Ground Water recharge through wetland	: NA :
4 Flood storage by crest desynchronization	: NA :
5 Shoreline, protection from erosion	:*****:*****:
6 Water Quality protection by treatment of pollutants	: NA :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:**** :
10 Educational value, public access to wetland ecology	:*****:*****:

NA: Model not applicable to tidal wetlands

SITE: ZY202 ECOLOGICAL SUMMARY Hichener Software 07/21/90

Normandeau Associates Inc.

Location: OLD RR GRADE SW OF FOUR CORNERS
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****: :
2 Hydrologic ability to maintain flows in dry periods	:*****:*** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*** :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:*****: :

SITE: ZY203 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.
Location: OLD RR GRADE, NW OF 4 CORNERS, BRIDLEPATH
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:* :
2 Hydrologic ability to maintain flows in dry periods	:*****:*** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*** :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:*****: :
10 Educational value, public access to wetland ecology	:*****:*** :

SITE: ZY204 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.
Location: S OF HEATH RD
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*** :
2 Hydrologic ability to maintain flows in dry periods	:*****:**** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:**** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:**** :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****: :
10 Educational value, public access to wetland ecology	:*****:*** :

SITE: ZY205 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: S OF INTERSECTION OF HEATH RD & K'BUNK BEACH RD
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	***** *
2 Hydrologic ability to maintain flows in dry periods	****
3 Ground Water recharge through wetland	***** ***
4 Flood storage by crest desynchronization	****
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	***** ***
7 Economic values, primarily timber or hay	***
8 Recreational values, access to nature, fish or game	**
9 Aesthetic values, primarily scenic appeal	****
10 Educational value, public access to wetland ecology	***** *

SITE: ZY206 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: SW OF SEA RD
Field Date: 05/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	*****
2 Hydrologic ability to maintain flows in dry periods	***** *
3 Ground Water recharge through wetland	***** *****
4 Flood storage by crest desynchronization	****
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	***** **
7 Economic values, primarily timber or hay	***** *****
8 Recreational values, access to nature, fish or game	***** **
9 Aesthetic values, primarily scenic appeal	****
10 Educational value, public access to wetland ecology	*****

SITE: ZY207 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: E OF RTE 1, S OF FERNALD BROOK
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	:*****:**** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****: :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:**** :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:**** :
9 Aesthetic values, primarily scenic appeal	:*****: :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY208 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: N OF RTE 9, W OF BROWN ST
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	:*****:*****:
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:* :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*****:
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:*** :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY209 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: LOWER FERNALD BROOK
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING, HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:** :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:** :
9 Aesthetic values, primarily scenic appeal	:** : :
10 Educational value, public access to wetland ecology	:*****: :

SITE: ZY210 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: MARSH ON MOUSAM R, E OF VILLAGE, SEWER PLANT
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	: NA :
3 Ground Water recharge through wetland	: NA :
4 Flood storage by crest desynchronization	: NA :
5 Shoreline, protection from erosion	:*****:*****:
6 Water Quality protection by treatment of pollutants	:*****:*** :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:*****:
10 Educational value, public access to wetland ecology	:*****:*** :

NA: Model not applicable to tidal wetlands

SITE: ZY211 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: W OF BROWN ST NEAR K'BUNK VILLAGE
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:**** : :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:** :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:** : :

SITE: ZY212 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: LOWER DAY BROOK
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****: :
2 Hydrologic ability to maintain flows in dry periods	:*****:** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*** :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:** :
9 Aesthetic values, primarily scenic appeal	:*****: :
10 Educational value, public access to wetland ecology	:**** : :

SITE: ZY213 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: SEA RD, RR STATION
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:**** : :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:*** :
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****: :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:*****: :

SITE: ZY214 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: E OF SEA RD, W OF RTE 35
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*** :
2 Hydrologic ability to maintain flows in dry periods	:*****:*****:
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*****:
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:** :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY215 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: W OF RTE 1, S OF FERNALD BROOK
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	*****
2 Hydrologic ability to maintain flows in dry periods	***** ****
3 Ground Water recharge through wetland	***** *****
4 Flood storage by crest desynchronization	***** **
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	***** ****
7 Economic values, primarily timber or hay	***** *****
8 Recreational values, access to nature, fish or game	***** **
9 Aesthetic values, primarily scenic appeal	*****
10 Educational value, public access to wetland ecology	***** *

SITE: ZY216 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: TRIBUTARY TO DAY'S BROOK
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	***** ****
2 Hydrologic ability to maintain flows in dry periods	***** *
3 Ground Water recharge through wetland	***** *****
4 Flood storage by crest desynchronization	**
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	***** **
7 Economic values, primarily timber or hay	***** **
8 Recreational values, access to nature, fish or game	***** ***
9 Aesthetic values, primarily scenic appeal	****
10 Educational value, public access to wetland ecology	***** ***

SITE: ZY217 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: HOUSAH R NE OF SPILLER DR
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE HODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*****:
2 Hydrologic ability to maintain flows in dry periods	:*****:*** :
3 Ground Water recharge through wetland	:*****:*** :
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion	:*****:*****:
6 Water Quality protection by treatment of pollutants	:*****:*** :
7 Economic values, primarily timber or hay	:* : :
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:*****: :
10 Educational value, public access to wetland ecology	:*****:** :

SITE: ZY218 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: N OF DAY BROOK, W OF OLD RR
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE HODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	:*****:**** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:* :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*****:
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:*****:* :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY219 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.
Location: NE OF JUNCTION RTE 99 & WAKEFIELD RD
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:* :
2 Hydrologic ability to maintain flows in dry periods	:*****:** :
3 Ground Water recharge through wetland	:*****:**** :
4 Flood storage by crest desynchronization	:*** : :
5 Shoreline, protection from erosion	:*****:*** :
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:*****:* :

SITE: ZY220 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.
Location: UPPER DAY BROOK, W OF MAINE TURNPIKE
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:** :
2 Hydrologic ability to maintain flows in dry periods	:*** : :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:**** : :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:*****:* :

SITE: ZY221 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: S OF RTE 99, W OF WAKEFIELD RD
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	****
2 Hydrologic ability to maintain flows in dry periods	***
3 Ground Water recharge through wetland	***** ***
4 Flood storage by crest desynchronization	**
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	*
7 Economic values, primarily timber or hay	***
8 Recreational values, access to nature, fish or game	***
9 Aesthetic values, primarily scenic appeal	*
10 Educational value, public access to wetland ecology	*

SITE: ZY222 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: COLD WATER BROOK
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	***** *****
2 Hydrologic ability to maintain flows in dry periods	****
3 Ground Water recharge through wetland	***** *****
4 Flood storage by crest desynchronization	***
5 Shoreline, protection from erosion	***** ***
6 Water Quality protection by treatment of pollutants	*****
7 Economic values, primarily timber or hay	***** **
8 Recreational values, access to nature, fish or game	***** ***
9 Aesthetic values, primarily scenic appeal	****
10 Educational value, public access to wetland ecology	***** ***

SITE: ZY223 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: UPPER FERNALD BROOK, NW OF RTE 1
Field Date: 06/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:** :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:** :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:*****: :
10 Educational value, public access to wetland ecology	:*****:*** :

KENNEBUNK RIVER WATERSHED

WETLAND ID NO.	NO. 1 Biol	AND 2 Hydro	NAME 3 GrWat	OF 4 Flood	BENEFIT 5 ShLi*	6 WQual	7 Econ	MODEL 8 Recr*	9 Aest*	10 Educ*
Model ranking by decile										
ZY301	10	**	**	**	10	**	10	10	9	10
ZY302	5	4	10	2	0	4	10	7	4	2
ZY303	9	**	**	**	5	**	5	10	9	9
ZY304	4	4	2	2	0	4	7	5	4	5
ZY305	6	3	8	1	0	3	10	8	5	8
ZY306	6	6	5	4	0	9	1	1	1	2
ZY307	10	**	**	**	10	**	7	10	10	10
ZY308	3	7	9	4	0	6	10	7	4	2
ZY309	9	10	10	8	0	10	10	10	8	9
ZY310	5	6	6	7	0	4	7	5	1	2
ZY311	6	4	5	4	0	6	3	3	3	5
ZY312	3	2	8	1	0	1	2	8	6	5
ZY313	10	8	8	9	0	10	5	9	8	9
ZY314	3	3	9	2	0	1	3	3	1	1
ZY315	10	9	10	10	0	10	10	10	7	9
ZY316	9	7	10	6	0	6	7	8	5	9
ZY317	4	3	7	1	0	1	1	5	6	6
ZY318	1	3	5	2	0	2	7	3	2	3
ZY319	6	6	6	7	0	6	7	6	1	3
ZY320	7	6	8	2	0	7	7	9	1	3
ZY321	8	4	6	4	0	6	3	3	4	8
ZY322	4	7	9	9	0	4	10	7	4	2

* Model modified from Wisconsin original
** Model not applicable to tidal wetlands

SITE: ZY301 ECOLOGICAL SUMMARY Michener Software 07/21/90

Normandeau Associates Inc.

Location: LAKE BROOK, TIDAL CREEK W OF BEACH ST
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*****:
2 Hydrologic ability to maintain flows in dry periods	: NA :
3 Ground Water recharge through wetland	: NA :
4 Flood storage by crest desynchronization	: NA :
5 Shoreline, protection from erosion	:*****:*****:
6 Water Quality protection by treatment of pollutants	: NA :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:**** :
10 Educational value, public access to wetland ecology	:*****:*****:

NA: Model not applicable to tidal wetlands

SITE: ZY302 ECOLOGICAL SUMMARY Michener Software 07/21/90

Normandeau Associates Inc.

Location: W OF FAIRFIELD DR AND BEACH ST
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****: :
2 Hydrologic ability to maintain flows in dry periods	:**** : :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:**** : :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:** :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:** : :

SITE: ZY303 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: LOWER K'BUNK RIVER
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	*****;****
2 Hydrologic ability to maintain flows in dry periods	NA
3 Ground Water recharge through wetland	NA
4 Flood storage by crest desynchronization	NA
5 Shoreline, protection from erosion	*****
6 Water Quality protection by treatment of pollutants	NA
7 Economic values, primarily timber or hay	*****
8 Recreational values, access to nature, fish or game	*****;*****
9 Aesthetic values, primarily scenic appeal	*****;****
10 Educational value, public access to wetland ecology	*****;****

NA: Model not applicable to tidal wetlands

SITE: ZY304 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: E OF OLD PORT RD
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	****
2 Hydrologic ability to maintain flows in dry periods	****
3 Ground Water recharge through wetland	**
4 Flood storage by crest desynchronization	**
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	****
7 Economic values, primarily timber or hay	*****;**
8 Recreational values, access to nature, fish or game	*****
9 Aesthetic values, primarily scenic appeal	****
10 Educational value, public access to wetland ecology	*****

SITE: ZY305 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: SE OF HEATH RD/ SW OF RTE 35
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	***** *
2 Hydrologic ability to maintain flows in dry periods	***
3 Ground Water recharge through wetland	***** ***
4 Flood storage by crest desynchronization	*
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	***
7 Economic values, primarily timber or hay	***** *****
8 Recreational values, access to nature, fish or game	***** ***
9 Aesthetic values, primarily scenic appeal	*****
10 Educational value, public access to wetland ecology	***** ***

SITE: ZY306 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: BEHIND STORE AT KENNEBUNK LANDING
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	***** *
2 Hydrologic ability to maintain flows in dry periods	***** *
3 Ground Water recharge through wetland	*****
4 Flood storage by crest desynchronization	****
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	***** ****
7 Economic values, primarily timber or hay	*
8 Recreational values, access to nature, fish or game	*
9 Aesthetic values, primarily scenic appeal	*
10 Educational value, public access to wetland ecology	**

SITE: ZY307 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: K'BUNK R - TIDAL FRESH TRANSITION
Field Date: 05/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*****:
2 Hydrologic ability to maintain flows in dry periods	: NA :
3 Ground Water recharge through wetland	: NA :
4 Flood storage by crest desynchronization	: NA :
5 Shoreline, protection from erosion	:*****:*****:
6 Water Quality protection by treatment of pollutants	: NA :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:*****:
10 Educational value, public access to wetland ecology	:*****:*****:

NA: Model not applicable to tidal wetlands

SITE: ZY308 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: E OF ROSS RD
Field Date: 06/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*** : :
2 Hydrologic ability to maintain flows in dry periods	:*****:** :
3 Ground Water recharge through wetland	:*****:**** :
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:** :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:** : :

SITE: ZY309 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: PUNKY SWAMP
Field Date: 06/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	:*****:*****:
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:*** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*****:
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:*** :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY310 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: SW OF RTE 35 & OLD RR GRADE
Field Date: 06/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****: :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:* :
4 Flood storage by crest desynchronization	:*****:** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:**** : :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****: :
9 Aesthetic values, primarily scenic appeal	:* : :
10 Educational value, public access to wetland ecology	:** : :

SITE: ZY311 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: E OF THOMPSON RD
Field Date: 06/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:* :
2 Hydrologic ability to maintain flows in dry periods	:**** : :
3 Ground Water recharge through wetland	:*****: :
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*** : :
8 Recreational values, access to nature, fish or game	:*** : :
9 Aesthetic values, primarily scenic appeal	:*** : :
10 Educational value, public access to wetland ecology	:*****: :

SITE: ZY312 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: WARD BROOK
Field Date: 06/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-HAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*** : :
2 Hydrologic ability to maintain flows in dry periods	:** : :
3 Ground Water recharge through wetland	:*****:*** :
4 Flood storage by crest desynchronization	:* : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:* : :
7 Economic values, primarily timber or hay	:** : :
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:*****:* :
10 Educational value, public access to wetland ecology	:*****: :

SITE: ZY313 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: WARD BROOK TRIBUTARY,W OF THOMPSON RD, N OF ALFRED RD
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*****:
2 Hydrologic ability to maintain flows in dry periods	:*****:*** :
3 Ground Water recharge through wetland	:*****:*** :
4 Flood storage by crest desynchronization	:*****:**** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*****:
7 Economic values, primarily timber or hay	:*****: :
8 Recreational values, access to nature, fish or game	:*****:**** :
9 Aesthetic values, primarily scenic appeal	:*****:*** :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY314 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: S OF RTE 135, N OF WARD BROOK, NE ALEWIFE POND
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*** : :
2 Hydrologic ability to maintain flows in dry periods	:*** : :
3 Ground Water recharge through wetland	:*****:**** :
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:* : :
7 Economic values, primarily timber or hay	:*** : :
8 Recreational values, access to nature, fish or game	:*** : :
9 Aesthetic values, primarily scenic appeal	:* : :
10 Educational value, public access to wetland ecology	:* : :

SITE: ZY315 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: WARD BROOK HEADWATER, E OF ALEWIFE POND
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*****:
2 Hydrologic ability to maintain flows in dry periods	:*****:**** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:*****:
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*****:
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:** :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY316 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: HEADWATERS OF SUCKER BROOK, W OF COLE RD
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	:*****:** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*****:* :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:*** :
9 Aesthetic values, primarily scenic appeal	:*****: :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY317 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: SUCKER BROOK, E OF COLE RD
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:**** : :
2 Hydrologic ability to maintain flows in dry periods	:*** : :
3 Ground Water recharge through wetland	:*****:** :
4 Flood storage by crest desynchronization	:* : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:* : :
7 Economic values, primarily timber or hay	:* : :
8 Recreational values, access to nature, fish or game	:*****: :
9 Aesthetic values, primarily scenic appeal	:*****:* :
10 Educational value, public access to wetland ecology	:*****:* :

SITE: ZY318 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: E OF KIMBALL LANE
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:* : :
2 Hydrologic ability to maintain flows in dry periods	:*** : :
3 Ground Water recharge through wetland	:*****: :
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:** : :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*** : :
9 Aesthetic values, primarily scenic appeal	:** : :
10 Educational value, public access to wetland ecology	:*** : :

SITE: ZY319 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: E OF KIMBALL LANE
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:* :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:* :
4 Flood storage by crest desynchronization	:*****:** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:* :
9 Aesthetic values, primarily scenic appeal	:* : :
10 Educational value, public access to wetland ecology	:*** : :

SITE: ZY320 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: W OF PERKINS RD, N OF RTE 35
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:** :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:*** :
4 Flood storage by crest desynchronization	:** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:** :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:**** :
9 Aesthetic values, primarily scenic appeal	:* : :
10 Educational value, public access to wetland ecology	:*** : :

SITE: ZY321 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: IN ALEWIFE VILLAGE, S OF RTE 35
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*** :
2 Hydrologic ability to maintain flows in dry periods	:**** : :
3 Ground Water recharge through wetland	:*****:* :
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*** : :
8 Recreational values, access to nature, fish or game	:*** : :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:*****:*** :

SITE: ZY322 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.

Location: W OF COLE RD, N OF SUCKER BROOK, PARTLY IN LYMAN
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:**** : :
2 Hydrologic ability to maintain flows in dry periods	:*****:** :
3 Ground Water recharge through wetland	:*****:**** :
4 Flood storage by crest desynchronization	:*****:**** :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:**** : :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:** :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:** : :

BRANCH BROOK WATERSHED

WETLAND ID NO.	NO. AND NAME OF BENEFIT MODEL									
	1	2	3	4	5	6	7	8	9	10
	Biol	Hydro	GrWat	Flood	ShLi*	WQual	Econ	Recr*	Aest*	Educ*
Model ranking by decile										
ZY401	10	**	**	**	10	**	10	10	9	10
ZY402	9	8	10	1	10	5	10	9	8	9
ZY403	8	4	10	3	0	8	7	7	6	8
ZY404	5	6	10	4	0	6	10	6	4	5

* Model modified from Wisconsin original
** Model not applicable to tidal wetlands

SITE: ZY401 ECOLOGICAL SUMMARY Hichener Software 07/21/90

Normandeau Associates Inc.

Location: LITTLE RIVER MARSH, RACHEL CARSON
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*****:
2 Hydrologic ability to maintain flows in dry periods	: NA :
3 Ground Water recharge through wetland	: NA :
4 Flood storage by crest desynchronization	: NA :
5 Shoreline, protection from erosion	:*****:*****:
6 Water Quality protection by treatment of pollutants	: NA :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:*****:
9 Aesthetic values, primarily scenic appeal	:*****:**** :
10 Educational value, public access to wetland ecology	:*****:*****:

NA: Model not applicable to tidal wetlands

SITE: ZY402 ECOLOGICAL SUMMARY Hichener Software 07/21/90
Normandeau Associates Inc.

Location: BRANCH BROOK, LOWER
Field Date: 05/15/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:**** :
2 Hydrologic ability to maintain flows in dry periods	:*****:*** :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:* : :
5 Shoreline, protection from erosion	:*****:*****:
6 Water Quality protection by treatment of pollutants	:*****: :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:**** :
9 Aesthetic values, primarily scenic appeal	:*****:*** :
10 Educational value, public access to wetland ecology	:*****:**** :

SITE: ZY403 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: UPPER BRANCH BK, W OF OLD RR, W OF TURNPIKE
Field Date: 06/11/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****:*** :
2 Hydrologic ability to maintain flows in dry periods	:**** : :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:*** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:*** :
7 Economic values, primarily timber or hay	:*****:** :
8 Recreational values, access to nature, fish or game	:*****:** :
9 Aesthetic values, primarily scenic appeal	:*****:* :
10 Educational value, public access to wetland ecology	:*****:*** :

SITE: ZY404 ECOLOGICAL SUMMARY Michener Software 07/21/90
Normandeau Associates Inc.
Location: E OF HARRISECKET RD
Field Date: 06/14/90 Report Date: 07/24/90 Observer: RRB

RESULTS OF RANKING HOLLANDS-MAGEE MODEL COMPUTATIONS

Benefit Description	Decile Rank: 1 - - - - 10
1 Biological function, incl. productivity & wildlife	:*****: :
2 Hydrologic ability to maintain flows in dry periods	:*****:* :
3 Ground Water recharge through wetland	:*****:*****:
4 Flood storage by crest desynchronization	:**** : :
5 Shoreline, protection from erosion: No open water	
6 Water Quality protection by treatment of pollutants	:*****:* :
7 Economic values, primarily timber or hay	:*****:*****:
8 Recreational values, access to nature, fish or game	:*****:* :
9 Aesthetic values, primarily scenic appeal	:**** : :
10 Educational value, public access to wetland ecology	:*****: :

APPENDIX B

WETLAND PROTECTION ORDINANCES

Kittery, Maine

Defines wetlands using higher of hydric soil or hydrophytic vegetation lines. A 100 foot buffer is required around all wetlands greater than one acre in size and 50 feet around smaller wetlands. Buildings are not allowed within the buffer, but parking areas are an allowed use.

Kittery is in the process of revising its wetland ordinance to adopt the federal/state wetland definition and to adopt a critical edge buffer tied to wetland value.

York, Maine

A permit is needed for fill in all wetlands.

Great wetlands (greater than 4 acres) generally require a 100 foot setback.

Lebanon, Maine

Wetlands are keyed to soil maps and reviewed by the Codes Enforcement Officer when issuing permits.

Setbacks are required for storage of hazardous waste, salt, underground fuel tanks, etc.

Allowed uses include recreation, agriculture, and forestry. Other uses (except those requiring setbacks) may be allowed by permit review.

Cape Elizabeth, Maine

Wetlands are defined as the higher of hydric soils, wetland vegetation, or hydrology.

A 250 foot critical wetland zone is required around

a) very poorly drained soils greater than 1 acre in size
b) plant communities greater than 1 acre in size dominated by obligate wetland species
c) tidal marshes
d) wetlands greater than 10 acres in size identified by Maine DEP. (As interpreted, 250 foot setback only applies to very poorly drained portions of these wetlands.)

A 100 foot protection zone around all other wetlands.

An intensive soil map prepared by a certified soil scientist and a plant cover map prepared by a qualified botantist are required.

New Jersey Pinelands *

A 50 - 300 foot buffer is required based on wetland values and potential impacts.

Projects are reviewed on a case-by-case basis.

The method is qualitative and repeatable and is based on a simple assessment procedure.

New York State Wetlands Protection Act *

A 100 foot buffer is required around all wetlands 12.4 acres or greater in size and may be extended if necessary for wetland protection.

Massachusetts Wetlands and Floodplain Protection Act *

Permits may be required for activity within 100 feet of a wetland. Local conservation commissions review projects and make determination on need for state permits.

Rhode Island Coastal Resource Management Program *

A 50 - 180 foot setback is required from coastal wetlands, beaches, and shores.

* Source: Brown, et al. 1987