BUFFER DELINEATION MODEL FOR NEW JERSEY PINELANDS WETLANDS

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EXECUTIVE SUMMARY

The Wetlands Management Program of the Pinelands Comprehensive Management Plan prohibits most types of development on Pinelands wetlands.[1] Further, to protect the upland to wetland transition and to reduce the potential for impacts on the wetland from upland development activities a buffer protection area is required under the Program. More specifically, development is not permitted within 300 ft of any wetland, unless the applicant can demonstrate that the proposed development will not have a significant adverse impact on the wetland. To aid in implementation of this buffer requirement, Roman and Good[2] proposed a model for determining the minimum site-specific buffer width needed to protect wetlands from impacts associated with upland development. The proposed model underwent a one year field test, followed by revisions based on the results.[3] The revised buffer delineation model is presented in this report.

This systematic and comprehensive approach to buffer delineation is based on an evaluation of wetland quality and on an assessment of potential impacts associated with the proposed development. In addition, the model is intended to function effectively within the regional planning and land allocation strategy as set forth in the Pinelands Comprehensive Management Plan. The objective of this model is to aid the Pinelands Commission staff, other resource managers, and applicants in determining site-specific situations when it would be appropriate to, a) maintain a buffer of at least 300 ft between wetland boundaries and proposed upland development, or b) reduce the buffer by some degree while still providing that no significant adverse impact to the wetland will occur. It is recommended that the model be periodically updated as new scientific findings and other pertinent information become available, and that a field monitoring program be initiated to determine the effectiveness of the model.

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[1] For a complete description of the Wetlands Management Program refer to; Article 1, Part 1, sections 6-101 through 6-114, In Comprehensive Management Plan for the Pinelands National Reserve (National Parks and Recreation Act, 1978) and Pinelands Area (New Jersey Pinelands Protection Act, 1979). NJ Pinelands Commission, New Lisbon, NJ. 446 p. (1980).

[2] Roman, C.T., and R.E. Good. 1983. Wetlands of the New Jersey Pinelands: values, functions, impacts and a proposed buffer delineation model. Division of Pinelands Research, Center for Coastal and Environmental Studies, Rutgers - the State University, New Brunswick, NJ. 123 p.

[3] Roman, C.T., and R.E. Good. 1984. Buffer delineation model for New Jersey Pinelands wetlands: Field Test. Division of Pinelands Research, Center for Coastal and Environmental Studies, Rutgers - the State University, New Brunswick, NJ. 68 p.

ACKNOWLEDGEMENTS

Development of this Pinelands wetlands buffer delineation model has encompassed a 3½-yr period, beginning in October 1981. From that time several individuals provided much guidance and helpful advice. The proposed buffer model, along with a report on wetland values, functions and impacts, was carefully reviewed by Leland Merrill and Beryl Rochichaud, of the Center for Coastal and Environmental Studies - Rutgers University, Charles Siemon of the law firm Siemon, Larsen and Purdy, and Ralph Tiner of the National Wetlands Inventory - US Fish and Wildlife Service. The proposed model was then field tested by several individuals each providing thoughtful comments from which to base appropriate revisions (Kevin Broderick, Robert Piel and Robert Tudor - NJ Dept. of Environmental Protection; Jeffrey Steen - US Army Corps of Engineers; John Schneider - Center for Coastal and Environmental Studies; Raymond Walker - Rider College; Lynn Brass, Richard Brown, Susan Hullings-Slim, Nancy Immesberger, Donna McBride, Joseph Pratzner and Robert Zampella - NJ Pinelands Commission). Norma Good provided helpful comments and editorial expertise since initiation of the project.

Special thanks are extended to the entire Pinelands Commission staff. Everyone was most cooperative; always sharing with us their background and experience related to wetland protection efforts in the Pinelands. William Harrison and John Stokes are thanked for their complete involvement, including review of numerous draft versions of the model. The efforts of Robert Zampella are especially acknowledged. His many suggestions, prompt and critical review of draft reports, and continuous support were always welcomed.

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INTRODUCTION

Cedar and hardwood swamps, pitch pine lowlands, inland and coastal marshes, bogs, lakes and ponds comprise about 35% of the 445,000 ha New Jersey Pinelands National Reserve (Fig. 1). The values and functions of Pinelands wetlands have been reviewed by Roman and Good (1983). In terms of regional water quality, the nutrient retention and removal function of wetlands is essential to the maintenance of high quality water resources which characterize the Pinelands. The food web support and closely related habitat values of Pinelands wetlands are recognized when considering the diversity of biota encountered, especially the region's significant number of unique, threatened and endangered wetland-dependent species. On a regional basis flooding is not a problem in the Pinelands due to the predominance of well-drained, sandy soils. However, within localized Pinelands areas where development is relatively intense, wetlands may play a significant role in flood control. Pinelands wetlands also provide a rich heritage in terms of recreation, education, scientific and aesthetic opportunities.

Appreciation for the values and functions of Pinelands wetlands, coupled with an awareness of potential impacts imposed by development activities, provided the incentives for protection of wetlands under the New Jersey Pinelands Comprehensive Management Plan (hereafter referred to as CMP; New Jersey Pinelands Commission 1980). The Wetlands Management Program (CMP; Article 6, Part 1, sections 6-101 through 6-114) prohibits most types of development on Pinelands wetlands. Regulated uses on wetlands include berry agriculture, horticulture, forestry, fish and wildlife management, low intensity recreational uses, water dependent recreational facilities and public utility improvements (CMP; Article 6, Part 1, sections 6-108 through 6-113 describes these regulated uses). Further, the requirement for a buffer protection area is included to preserve the natural upland to wetland transition and to reduce the potential for impacts from upland development activities. Development is not permitted within 300 ft of any wetland, unless the applicant can demonstrate that the proposed development will not have a significant adverse impact on the wetland (CMP; Article 6, Part 1, section 6-114).

To assist in implementation of the Wetlands Management Program's buffer requirement, Roman and Good (1983) proposed a model for determining the minimum site-specific buffer width required to protect wetlands from impacts associated with upland development. This systematic and comprehensive approach to buffer delineation is based on an evaluation of overall wetland quality, values and functions, and on an assessment of potential impacts associated with the proposed upland development. Further, the model is developed with the goal of functioning effectively within the regional planning and land allocation strategy as set forth in the CMP.

The proposed model was subjected to a one-year field test and verification program. Based on the test results and comments provided by the testing personnel and others, appropriate revisions to the model were made. Roman and Good (1984) present these revisions and complete results of the testing effort. Roman and Good (1984) concluded that the field tested and revised model, as presented herein, should function effectively as an aid to Pinelands Commission staff, other resources managers and applicants in determining site-specific situations when it would be appropriate to, a) maintain a buffer of at least 300 ft between wetland boundaries and proposed upland development, or b) reduce the buffer by some degree while still providing that no significant adverse impact to the wetland will occur.

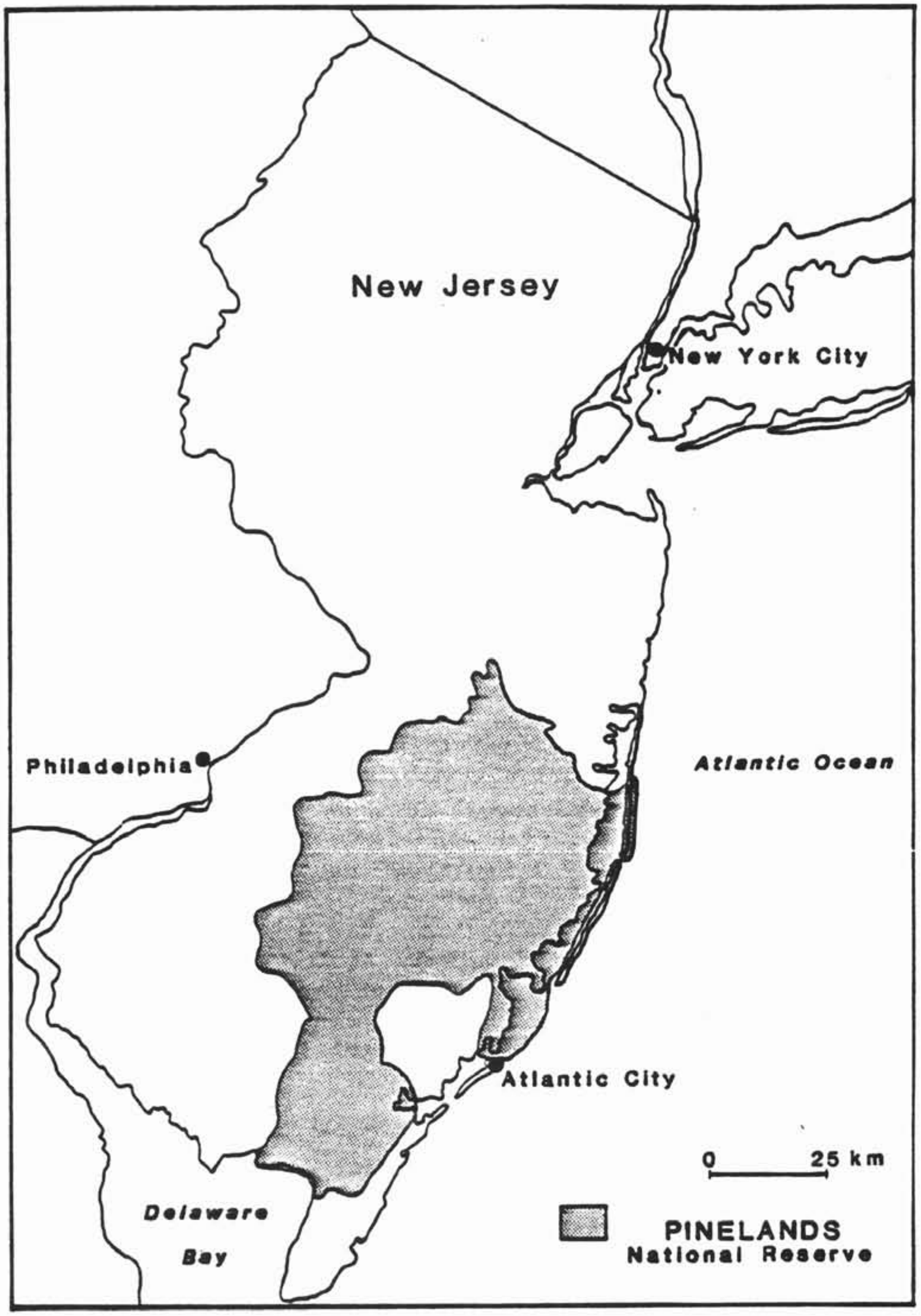

Fig. 1. Regional location of the Pinelands National Reserve in New Jersey.

It is recommended that verification of the model continue as a long-term process. Consideration should be given to periodically revising and updating the model as new scientific findings and other appropriate information become available. Long-term field monitoring studies should be initiated to determine the effectiveness of the model in assigning buffer protection areas.

PINELANDS WETLANDS BUFFER DELINEATION MODEL

SOME MODEL SPECIFICATIONS

The model was developed for application within the boundaries of the Pinelands Area, as designated by the state New Jersey Pinelands Protection Act of 1979. Further, the model is primarily intended for delineating buffer areas between proposed development and inland wetland boundaries of the Pinelands. As listed in the Wetlands Management Program (CMP; Article 6, Part 1, section 6-105) these inland wetlands include, but are not limited to, Atlantic White Cedar swamps, hardwood swamps, Pitch Pine lowlands, bogs, inland marshes, lakes, ponds, rivers and streams.

It is assumed that users of the model will have at least a general familiarity with the natural resources and ecology of the Pinelands ecosystem, and further, be knowledgeable in the field of wetlands ecology. Users must also be familiar with all aspects of the CMP, especially with respect to the Wetlands Management Program, the land allocation strategy, and the development review process.

GENERAL ORGANIZATION

PRELIMINARY DATA/INFORMATION GATHERING

Organization of the buffer delineation model is summarized in Fig. 2. To begin the model, the evaluator must gather preliminary data and information related to the proposed development activity and the wetlands in the vicinity of the proposed development. Such information would include the following;

<u>Site Plan</u> - The applicants site plan and associated materials (a detailed listing of application requirements is included in the CMP Article 4, Part 1, section 6-102).

<u>Aerial Photographs and Maps</u> - Aerial photographs, U.S. Geological Survey topographic maps (1:24,000), Pinelands Commission vegetation maps (1:24,000), U.S. Fish and Wildlife Service National Wetlands Inventory maps (1:24,000), U.S. Soil Conservation Service maps (1:24,000) and/or County Soil Surveys.

SPECIAL CASE BUFFER DELINEATION GUIDELINES

Upon gathering the appropriate preliminary data and information, the evaluator should proceed to the SPECIAL CASE BUFFER DELINEATION GUIDELINES. These five GUIDELINES relate to specific situations or special cases in the Pinelands that deserve particular attention. These GUIDELINES pertain to, 1) proposed development in the Preservation Area District, 2) resource extraction projects, 3) proposed development utilizing on-site domestic wastewater treatment systems, 4) infill-type development, defined as development of vacant lots within areas of existing dense residential development, and 5) proposed development adjacent to Atlantic White Cedar swamps. Statements clarifying the intent of the GUIDELINES and statements outlining the rationale for creating each GUIDELINE are presented. The evaluator should follow the GUIDELINES decision-making flow diagram (Fig. 3).

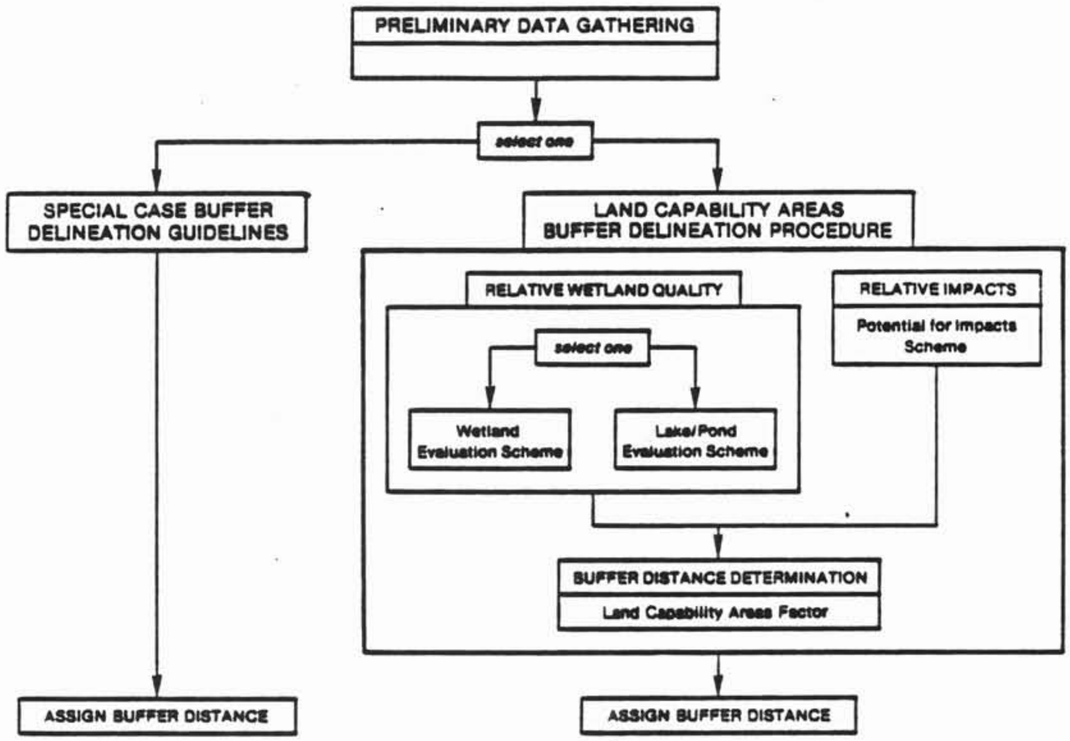

Fig. 2. Flow diagram of the Pinelands wetlands buffer delineation model.

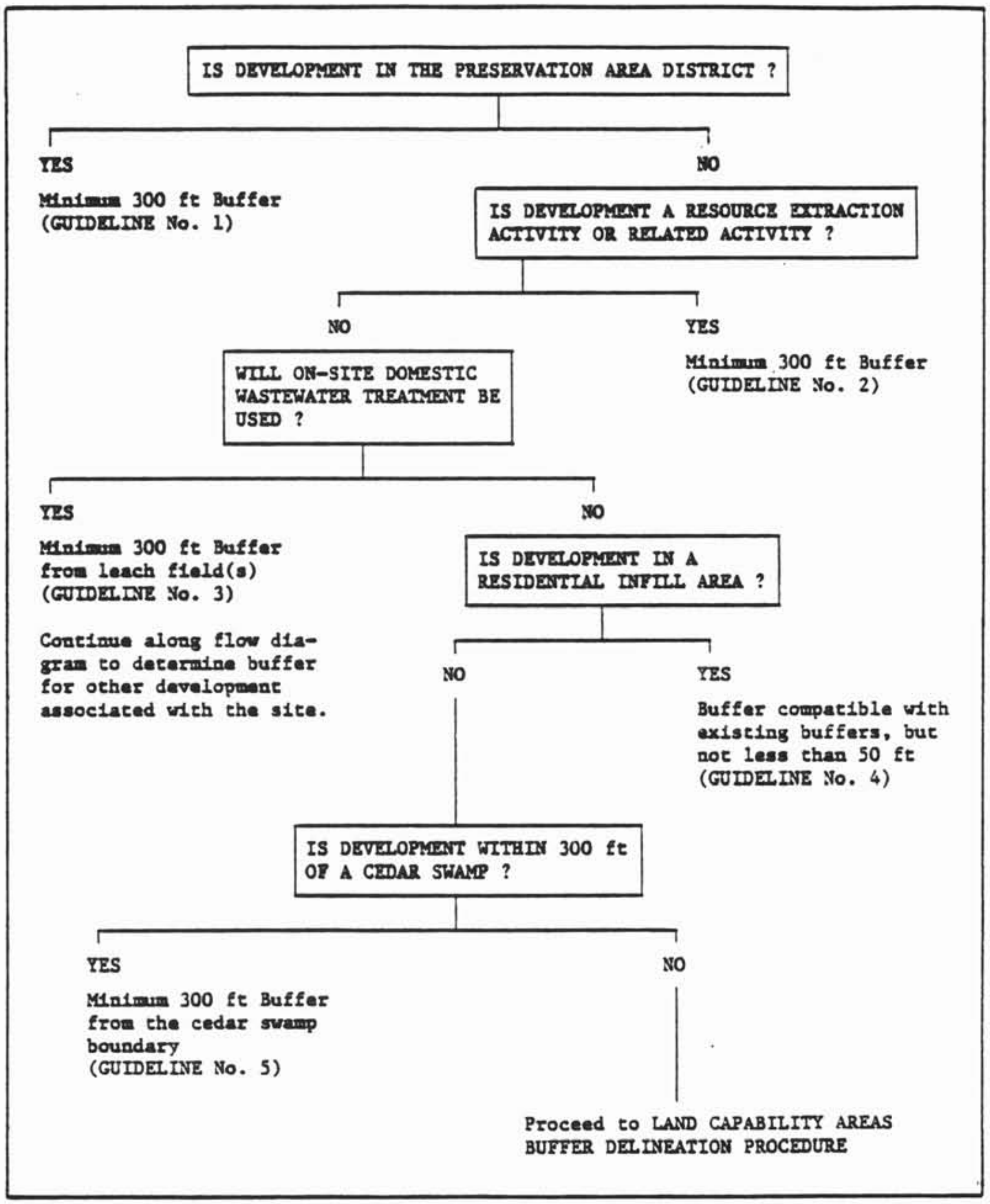

Fig. 3. Decision-making flow diagram for the Special Case Buffer Delineation Guidelines.

LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE

If none of the GUIDELINES pertain, then the evaluator is directed to the LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE. This PROCEDURE is basically a three step process. Fig. 4 summarizes the various components of the PROCEDURE.

1) The evaluator must determine the relative quality of the site-specific wetland and surrounding wetlands which are associated with the proposed development. If the wetland adjacent to the proposed development site is a forested, shrub-dominated or herbaceous wetland, then the evaluator follows the Wetland Evaluation Scheme. If the wetland is a lake or pond, then the Lake/Pond Evaluation Scheme is followed. A relative numerical value index is derived from each of these Schemes.

2) Next, the evaluator must determine the potential for the proposed development to cause site-specific, cumulative and watershed-wide impacts. The Potential for Impacts Scheme is followed to derive a relative numerical index.

3) The numerical value index and the impacts index are averaged to derive a buffer delineation index. Based on the land capability area in which the development is proposed, the evaluator derives an actual buffer distance from a buffer index to buffer distance conversion table.

APPLICATION OF THE MODEL

The model is organized according to a sequential, step-by-step process (Fig. 2). Often, the evaluator will follow the model and derive one buffer distance which is appropriate for the entire area where wetlands are adjacent to the proposed development. However, at other sites, several components of the model may be applicable. For example, there may be a proposed development site in the Forest Area with adjacent wetlands including a cedar swamp, pond and hardwood swamp. In this case the evaluator would apply the cedar swamp GUIDELINE, and both the Lake/Pond and Wetland Evaluation Schemes. Thus, the possibility exists for an evaluator to derive and assign varying buffer distances at one proposed development site.

The evaluator should complete the Office/Field Data Forms while proceeding through the model (Appendix). Utilizing these forms will provide for consistent documentation of wetland and development site characteristics as they pertain to the model. Four forms are provided; Preliminary Data/Information Gathering Form, Special Case Buffer Delineation Guidelines Form, Land Capability Areas Buffer Delineation Form, and Buffer Delineation Model Summary Form.

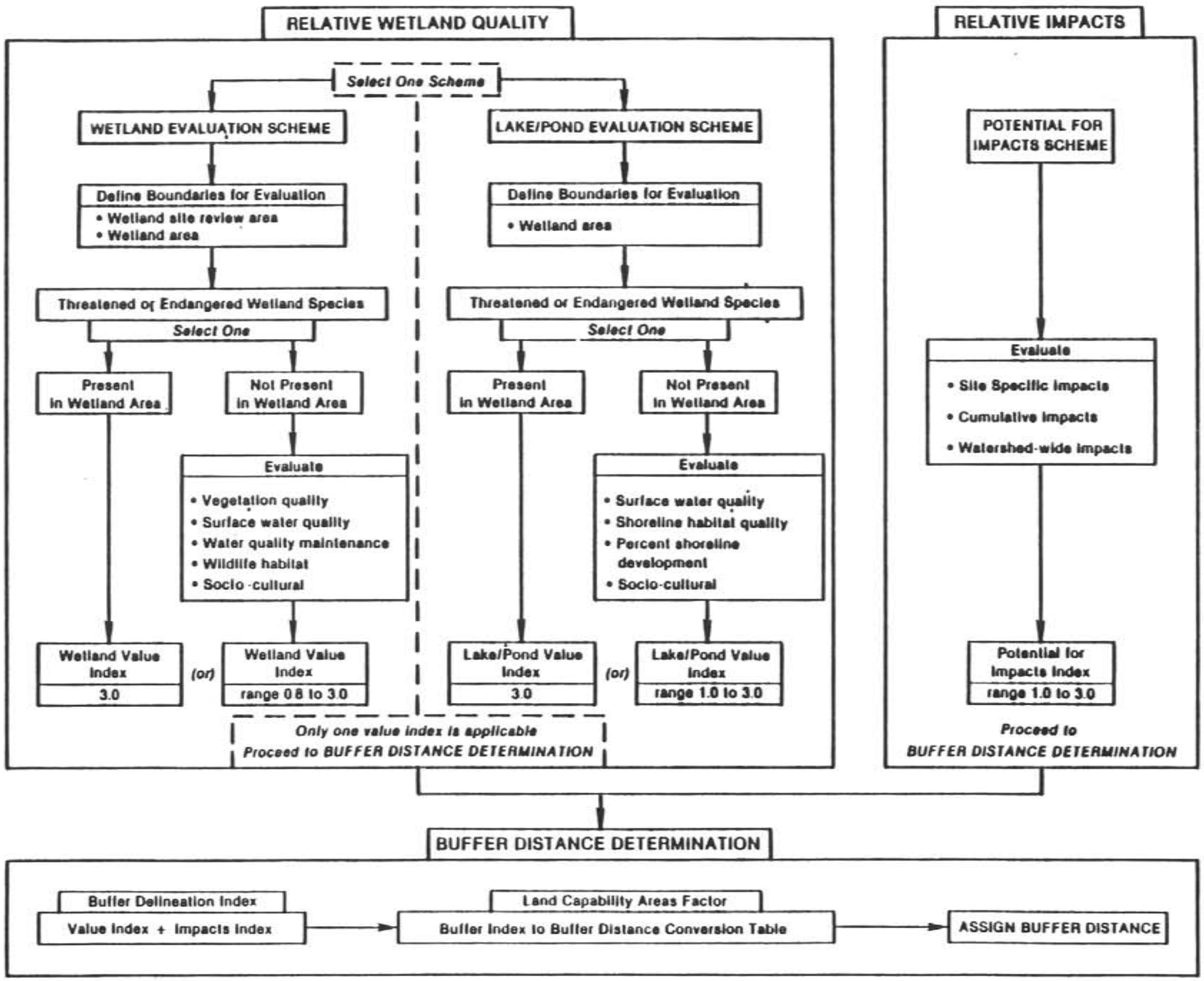

Fig. 4. Flow diagram for the Land Capability Areas Buffer Delineation Procedure.

SPECIAL CASE BUFFER DELINEATION GUIDELINES

The GUIDELINES are presented below. Included with each GUIDELINE are, a) a buffer distance recommendation, b) a statement clarifying the intent of the recommendation, and c) a statement which briefly outlines the rationale for the buffer recommendation and the basis on which it was founded. Additional information supporting these rationale statements is found throughout an earlier report on wetland values, functions and impacts (Roman and Good 1983).

Special Case Buffer Delineation Guideline No. 1, PRESERVATION AREA DISTRICT

It is recommended that a minimum 300 ft buffer be maintained between wetland boundaries and any permanent development activities proposed for adjacent upland areas in the Pinelands Preservation Area District.

Clarifying Conditions: Permanent development refers to structures, private roads, driveways, parking lots, on-site wastewater treatment systems, clearing for right-of-ways, lawns and other development-related practices with the potential to cause long-term alteration of the landscape.

Rationale: The Preservation Area District represents an extensive, contiguous and mostly undeveloped portion of the Pinelands. This area is characterized by undisturbed watersheds, with wetland complexes providing critical habitat for a diversity of flora and fauna, including numerous threatened and endangered species. Headwaters of several Pinelands watersheds, including Cedar and Rancocas Creeks, and the Wading, Batsto and Mullica Rivers are within this inner core area. Extensive berry production areas are within the Preservation Area and are dependent upon adequate supplies of high quality water. In short, the Preservation Area District exemplifies the essential ecological, cultural, economic and aesthetic character of the Pinelands and is deserving of the highest priority for protection. All efforts possible should be adopted to protect this Pinelands core area from man-induced development impacts, thereby insuring the maintenance of a relatively undisturbed ecosystem -- a unique entity within the intensively developed Northeast.

It is recommended that a minimum 300 ft buffer area be maintained between wetland boundaries and proposed upland development activities in the Preservation Area District. This will aid in the maintenance and protection of wetlands within this Pinelands inner core ecosystem. As set forth by the state legislation and supported with adoption of the CMP, the Preservation Area District is recognized as an exceptionally valuable entity of the Pinelands and must be given utmost protection from environmentally degrading impacts. In keeping with this legislative intent, wetlands of the Preservation Area District should be afforded maximum protection, and thus a minimum 300 ft buffer is recommended.

Special Case Buffer Delineation Guideline No. 2, RESOURCE EXTRACTION

It is recommended that minimum 300 ft buffer areas be maintained between all Pinelands wetlands and any resource extraction activity.

Clarifying Conditions: Resource extraction is defined as those activities covered under the CMP's resource extraction management program (Article 6, Part 6, Sections 6-601 through 6-607); and other similar activities. In brief, resource extraction is defined as dredging, digging, extraction, mining and quarrying of sand, gravel or minerals. Included with this recommendation are activities associated with resource extraction such as wash plant areas, sedimentation ponds, topsoil storage areas, equipment storage areas, heavy equipment operation, structures, roads and parking areas.

Rationale: Associated with resource extraction is the potential for severe environmental impacts to be imposed on Pinelands wetlands. The areal extent of resource extraction operations in the Pinelands National Reserve is extensive. From an analysis of 1979 aerial photographs it was estimated that active and recently abandoned sand/gravel excavation sites occupied nearly 10,000 acres of the Reserve (CMP). Individual operations probably average 200 - 300 acres, while the larger excavation sites can encompass over 1000 acres. Considering the regional extent of resource extraction in the Pinelands (i.e., about 1% of the Reserve's total area) and the large-scale of individual operations, environmental impacts on wetlands are undoubtedly significant.

The most immediate and noticeable impact associated with resource extraction is the removal of vegetation and soil, thereby resulting in the direct loss of habitat. Hydrologically, the potential for impacts is significant. For instance, commercial excavation activities can extend to a depth of "...65 ft below the natural surface of the ground existing prior to excavation unless it can be demonstrated that a depth greater than 65 ft will result in no significant adverse impact relative to the proposed final use or on off-site areas" (CMP; Article 6, Part 6, Section 6-606). The natural upland to wetland flow of both surface and groundwater would be altered, with the potential for changing seasonal flow patterns, accelerating surface water runoff and changing water table levels in wetlands (Darnell 1976). Coupled with increased runoff, there is the potential for increased siltation of wetlands and streams. In addition, resource extraction operations would have a significant impact on the microclimate of surrounding areas. Havens (1979) suggests that with removal of Pinelands natural vegetation, air and soil temperatures would increase with the transfer of this heat to surrounding areas (such as wetlands). Also, with the loss of evapotranspiration, combined with the high air temperatures, Havens (1979) states that relative humidity would decrease locally.

To maintain the integrity of wetlands within the vicinity of resource extraction operations, it is recommended that minimum 300 ft buffer areas be maintained between wetland boundaries and resource extraction activities. The buffer should aid in the maintenance of wetland wildlife habitat and food web functions, natural hydrologic links, function to filter excess suspended sediments associated with resource extraction operations and ameliorate microclimate alterations.

Special Case Buffer Delineation Guideline No. 3, ON-SITE DOMESTIC WASTEWATER TREATMENT

It is recommended that a minimum 300 ft buffer be maintained between the wetland boundary and the septic leach field of on-site wastewater treatment systems.

Clarifying Conditions:

1) Included with this recommendation are activities such as wastewater spray irrigation and land application of sewage and septage.

2) This recommendation refers only to location of the septic leach field, spray field or sewage/septage application area relative to the wetland boundary. To determine an appropriate buffer for other development activities at the proposed site (i.e., structures, roads, etc.), the evaluator should refer to other sections of the proposed buffer delineation model. For septic leach fields, it is suggested that the dwelling unit be located adjacent to, or upgradient from, the leach field. If the dwelling unit is downgradient of the leach field, then there will be a necessity to pump wastewater upgradient to the leach field.

Rationale: Pinelands surface and groundwaters are characterized by low nutrients and low pH. Pinelands wetland and aquatic ecosystems have adapted to this regime. In order to maintain the typical and unique biota of the Pinelands, the existing undisturbed water quality must be preserved. In terms of contamination of this water resource, the Pinelands soils are generally chemically inert, poorly buffered, and highly permeable, and thus, are often considered ineffective at renovating pollution inputs.

An effective way to minimize surface and goundwater contamination by septic leachate, wastewater spray irrigation or sewage/septage leachate is to insure adequate dilution by infiltrating precipitation, and nutrient uptake by vegetation. Based on an areal dilution model (Brown et al. 1980) which takes into account soil drainage characteristics, nitrogen loading, precipitation input, and surface area of a conventional-type septic leach field, it is predicted that a lot of 3.2 acres is needed to insure that the average concentration of nitrate exiting a given parcel of land or entering Pinelands surface waters will not exceed 2 mg NO_3-N/l. A similar areal dilution model for the Pinelands was developed independently by Trela and Douglas (1979).

These areal dilution models assume that the contaminated water and diluted water will be completely mixed, yielding an average concentration of the contaminant throughout the property limits (i.e., 2 mg NO_3-N/l throughout a 3.2 acre parcel). However, upon contact with the groundwater, contaminants from a diffuse point source, such as a septic leach field, generally do not mix completely, but rather, the contaminants flow as a plume in the direction of the hydraulic gradient (Brown et al. 1980).

Accounting for this hydraulic coupling of septic discharges with groundwater hydrodynamics and dilution by groundwater recharge, Harlukowicz and Ahlert (1978) have developed a model, intended for application in the Pinelands, to predict the travel distance necessary for contaminated groundwater to reach acceptable levels. Depending on the model input variables, the predicted distances to acquire a minimum 2 mg NO_3-N/l concentration, range from 325 ft to 600 ft (Table 1).[1] As noted, it is predicted that a deforested site would require a shorter distance for nitrate dilution (other factors remaining equal), than for a forested site. It is assumed that in deforested sites more

[1]The Harlukowicz and Ahlert (1978) model assumes that the typical septic system serves a household of 5 people. According to Brown et al. (1980) and Trela and Douglas (1979) a more appropriate figure is 3.5 people. Assuming a household of 3.5 people, would decrease the wastewater output by 30%, thereby decreasing the predicted attenuation distances as calculated by Harlukowicz and Ahlert (1978; see Table 1).

Table 1. Selected results from the Harlukowicz and Ahlert (1978) model for predicting attenuation of groundwater nitrate contamination by dilution processes (adapted from Tables 6.6 and 6.7 in Harlukowicz and Ahlert 1978). Distances hydrologically downgradient from septic leach fields which are necessary for attenuation of groundwater nitrate contamination to an acceptable 2 mg/l level are listed. Major input variables include, varying background nitrate levels and forested vs. completely deforested landscapes downgradient of the leach field. Other model assumptions are included as footnotes[1].

Minimum Distances (ft) Predicted to Attenuate Groundwater NO_3-N levels to 2 mg/l	Input Variables: Background NO_3-N in Groundwater (mg/l)	Input Variables: Vegetation Cover
600	0.0	Forested
325	0.0	Deforested
425	0.5	Deforested

[1]Assumptions: Average precipitation; household with five people; Wastewater output (75 gal/capita/day); Leach field area (1200 ft^2); Nitrate loading concentration at leach field (27 mg/l); Soil permeability (0.2 in/hr); Groundwater flow velocity (0.38 ft/day).

precipitation is available as recharge-dilution water. In forested sites, a percentage of the input precipitation is intercepted or transpired by vegetation, with less water available for recharge-dilution; and thus, greater attenuation distances are needed. However, Harlukowicz and Ahlert (1978) state that this conclusion is premature since plant uptake of nitrogen is not included in the model. The previously discussed areal dilution model (Brown et al. 1980) assumes that from 4.5 - 9% (depending on soil type) of the nitrogen input from the septic leach field is taken-up by vegetation. Finally, the Harlukowicz and Ahlert (1978) model is sensitive to the presence of background nitrate in the recharge groundwater, which results in an increased distance for dilution of contaminated groundwater. However, the 0.5 mg NO_3/l background level used by Harlukowicz and Ahlert (1978) is uncharacteristicly high. While the Harlukowicz and Ahlert (1978) model represents an excellent approach to predicting nitrate dilution of contaminated groundwater plumes, the model's assumptions must be carefully assessed for their appropriateness in the Pinelands and extensive field studies must be conducted in order to verify the model predictions.

Along with models, field studies can be conducted to determine distances from septic leach fields at which nitrate levels will reach specified or acceptable concentrations. Walker et al. (1973) examined groundwater flow characteristics and monitored nitrate concentrations at several locations relative to septic leach fields (i.e. downgradient, upgradient, lateral). This study was conducted in Wisconsin, yet the results are somewhat comparable to the Pinelands, considering location of the study sites in areas of unconsolidated "sandy" glacial lake deposits and relatively flat topography. Based on downgradient nitrate concentrations from one of the Wisconsin field sites, a best-fit curve was derived to predict nitrate concentrations vs. distance from the septic leach field (Division of Water Resources, NJ Department of Environmental Protection, personal communication).[2] From this curve, it is predicted that a distance of 505 ft downgradient of the septic leach field is needed to reach a nitrate concentration of 2 mg/l in the contaminated groundwater plume. Considering that only three points from just one site were used to derive this curve, it is probable that there is a substantial error associated with the predicted 505 ft value. Therefore, this value should not be interpreted as an absolute buffer distance for application in the Pinelands, but rather, as evidence supporting the contention that in sandy soils there is a significant potential for nitrate contamination of surface waters/wetlands by conventional on-site wastewater treatment systems.

In summary, a comprehensive study is needed to first, develop a detailed linear dilution model (i.e., possibly an expansion of the Harlukowicz and Ahlert model) and then, calibrate the model with extensive field monitoring of hydrologic parameters and nitrate concentration. Until such a study is undertaken, assigning appropriate buffer distances between septic leach fields and wetland boundaries must be based on the available data. Therefore, it seems that a buffer of <u>at least</u> 300 ft between septic system leach fields and wetland boundaries is warranted in order that nitrate concentrations entering Pinelands surface waters do not exceed the 2mg/l standard. As additional studies are conducted in the Pinelands, it may be appropriate to require a minimum buffer of greater, or possibly less, than 300 ft, between septic system leach fields and wetland boundaries.

Special Case Buffer Delineation Guideline No. 4, INFILL-TYPE RESIDENTIAL DEVELOPMENT

<u>If a proposed residential development site is considered an infill-type development then it is recommended that the assigned buffer be compatible with adjacent and nearby existing buffers, but not be less than 50 ft.</u>

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[2]The Division of Water Resources used data from the <u>System 4</u> field site (Walker et al. 1973) to derive the curve. The concentration immediately adjacent to the <u>System 4</u> septic leach field was 40 mg NO_3-N/l (identical to the value used in the Brown et al. model) and decreased to approximately 10 mg NO_3-N/l at 230 ft downgradient. From these end points, and one intermediate point, the following curve was derived:

$$y = ae^{-0.0194x}$$

where y is the concentration at distance x (meters) from the septic leach field, and a is the initial nitrate concentration at point of entry (40 mg NO_3-N/l).

Clarifying Conditions: To determine if a particular lot, or developed residential area, should be considered infill-type development, the evaluator should follow these general guidelines:

a) Only residential areas which are predominantly developed should be considered for infill.
b) The maximum infill lot size should be 1.0 acre.
c) All infill lots must have direct access to a paved public road.
d) All infill lots must be serviced by a municipal wastewater treatment system.
e) Infill areas should be limited to areas within Pinelands Villages/Towns and Regional Growth Areas.

Rationale: From a regional planning perspective, allowing similar types of development within existing developed areas represents an efficient land use strategy. The Pinelands Commission supports this strategy. So that the opportunity for implementing this infill planning strategy is not restrained, it is recommended that wetland-upland buffer requirements be somewhat relaxed. Since this recommendation refers only to infill within existing intensively developed areas, the adjacent wetland may already be impacted and a limited amount of additional development will not add appreciably to the cumulative impacts on the site-specific wetland or regionally within the watershed or subwatershed. Therefore, it is recommended that in designated infill areas, assigned buffers be compatible with adjacent and nearby existing buffers, but not be less than 50 ft.

Special Case Buffer Delineation Guideline No. 5, ATLANTIC WHITE CEDAR SWAMPS

It is recommended that minimum 300 ft buffer areas be maintained between all Pinelands Atlantic White Cedar Swamp boundaries and any permanent development which is proposed for adjacent uplands.

Clarifying Conditions:

1) Cedar swamps are defined as; a) those wetlands of 1 acre or more which are mapped as cedar swamp on the Pinelands Commission vegetation maps (1: 24,000); or b) wetlands of 1 acre or more which are not mapped as cedar swamp, but which exhibit greater than 50% *Chamaecyparis thyoides* canopy cover; or c) wetlands of 1 acre or more, which are in an early stage of vegetation development (i.e., following fire, logging, or other natural or man-induced disturbance) and appear to be developing into mature cedar swamps.

2) Permanent development refers to structures, private roads, driveways, parking lots, clearing for lawns and other development-related practices with the potential to cause long-term alteration of the landscape.

3) This recommendation calls for a 300 ft buffer from the cedar swamp boundary. In situations when there is another wetland type present between the cedar swamp and wetland-upland boundary, the evaluator must do the following to delineate an appropriate buffer from the wetland-upland boundary.

a) If the wetland between the cedar swamp boundary and actual wetland-upland boundary is $\geq$ 250 ft, then this cedar swamp buffer delineation guideline does not pertain and the evaluator should proceed sequentially through the model to delineate a buffer distance from the wetland-upland boundary.

This ≥ 250 ft limit insures that a minimum 300 ft buffer will be maintained from the cedar swamp boundary, even if a 50 ft buffer is delineated between the proposed development and the actual wetland-upland boundary. According to the proposed buffer delineation model, 50 ft is the minimum buffer distance which can be assigned.

b) If the wetland between the cedar swamp boundary and actual wetland-upland boundary is < 250 ft, then the evaluator must first delineate a 300 ft buffer from the cedar swamp boundary. Second, the evaluator must proceed sequentially through the model to delineate a buffer distance from the wetland-upland boundary. Finally, the largest distance from the wetland-upland boundary to the proposed development is selected as the most appropriate buffer.

Rationale: Atlantic white cedar swamps are currently a valuable and limited component of the Pinelands landscape. Due to extensive logging activities and man's encroachment for development, the extent of cedar swamps in the Pinelands has been on the decline since European settlement. Even within the last few decades this decline has been noted. For example, Sauer et al. (1980) compared Pinelands vegetation maps prepared from 1956 to 1963 aerial photographs, with those from 1978 and 1979 photographs and noted an overall reduction in the extent and distribution of cedar swamps. Although no quantitative estimates were provided, they suggest a general trend toward conversion to hardwood swamps, especially in recently logged areas. However, they also observed some cedar reproduction in cut-over swamps, abandoned cranberry bogs, burned swamps and other areas. Once considered an extensive forest resource and valuable habitat in the Pinelands, today only 2% of the 445,000 ha Pinelands National Reserve is occupied by cedar swamps (8,680 ha; Roman and Good 1983).

In terms of values and functions, Roman and Good (1983) have noted that cedar swamps are considered especially efficient at nutrient retention and maintenance of high surface water quality in the Pinelands. They provide essential habitat for a diversity of plants and animals, including the recreationally important white tailed deer, as well as numerous threatened and endangered biota which reside and/or breed in cedar swamps. Historically, cedar swamps supported a rich economic-commercial heritage, while today, cedar is still an economically important resource in the Pinelands.

To insure the perpetuation of cedar swamps in the Pinelands as a valuable ecosystem component, they must be protected from man-induced impacts. It is recommended that a minimum 300 ft buffer protection area be maintained between cedar swamp boundaries and any type of proposed permanent development. Among other roles this buffer area will protect cedar swamps from extensive windthrow damage. Cedar swamps are particularly susceptible to windthrow, considering the very shallow root systems of cedar and the spongy character of the muck/peat substrate (Little 1950). Cedar swamps are also sensitive to long-term water table fluctuations. Givnish (1973) suggests that lowered water table levels in cedar swamps could cause vegetational changes, while Clark and Clark (1979) state that water table increases of 15-25 cm over a growing season could result in death of cedar stands. Ehrenfeld and Schneider (1983) cite water table level decreases, along with water quality changes as factors contributing to complex vegetation changes in Pinelands cedar swamps following watershed suburbanization. Buffer areas are needed to maintain the natural upland to wetland hydrologic link, and to protect cedar swamps from man-induced water quality inputs. Finally, cedar swamps provide an especially valuable habitat for deer, breeding birds, threatened and endangered species, and a diversity of other flora and fauna. Buffer areas will protect the natural cedar swamp to upland ecotone, an area heavily utilized as wildlife habitat, while also insulating the diverse cedar swamp wildlife populations from man-induced impacts.

LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE

EVALUATING RELATIVE WETLAND QUALITY

An essential aspect to assigning buffer areas between proposed upland development and wetland boundaries is the evaluation of relative wetland values and functions. In developing the evaluation schemes, reference was often made to the numerous wetland evaluation methods currently in existence. Lonard et al. (1981) reviewed the objectives, merits and shortcomings of twenty wetland and wetland- related evaluation methods. Considerable variation in the methods was noted. For example, the Habitat Evaluation Procedures (HEP: U.S. Fish and Wildlife Service 1980), the Habitat Evaluation System (HES; U.S. Army Corps of Engineers 1980) and the Golet (1976) model were developed to specifically address wildlife and/or fish habitat values, while other procedures take a more comprehensive approach and attempt to evaluate wetlands based on several key values and functions (Larson 1976; Reppert et al. 1979; among others). A recent evaluation scheme developed for the Federal Highway Administration (Adamus 1983) attempts to alleviate some of the problems associated with many of these methodologies by addressing all of the presently recognized wetland values and functions, and by having widespread or nationwide utility. These previously developed wetland evaluation methods, although not directly applicable for incorporation into the Pinelands wetlands evaluation scheme, provided extensive guidance when evaluating and organizing the database of Pinelands wetlands values and functions in a consistent and objective manner.

Two schemes are provided for evaluating the relative quality of Pinelands wetlands.

1) If the wetland adjacent to the proposed development is a characteristic forested, shrub-dominated or herbaceous wetland, then the evaluator should follow the Wetland Evaluation Scheme. Also, the Wetland Evaluation Scheme should be applied if the wetland is recognized as a surface water body (lake or pond) <u>with</u> a vegetated fringe (i.e., pitch pine lowland, hardwood swamp, cedar swamp, shrub wetland, herbaceous marsh; NOT aquatic bed) of $\geq$50 ft. This $\geq$50 ft fringe will provide an adequate area for the evaluator to define a <u>wetland site review area</u>, and thus, fulfill all aspects of the Wetland Evaluation Scheme.

2) The wetland adjacent to the proposed development should be considered a lake/pond, and thus, evaluated according to the Lake/Pond Evaluation Scheme if the fringe of vegetated wetland between the wetland-upland boundary and the lake/pond surface waters is <50 ft.

These relative evaluation schemes are presented below. However, the evaluator must first define the wetland boundaries to be evaluated and determine if threatened or endangered species are a concern at the site.

DEFINING BOUNDARIES FOR EVALUATION

To maintain consistency in the relative values and functions evaluation process, appropriate dimensions of the wetland to be evaluated must be defined. When detailed site-specific field observations are required in order to satisfy a particular aspect of the PROCEDURE, the evaluator will be directed to study the wetland site review area.[3] The evaluator should study the wetlands which are within 300 ft of the proposed development site/lot(s). The evaluator must enter the wetland and walk parallel to the wetland-upland boundary of all wetlands to be evaluated (i.e., within 300 ft of the proposed development site/lots). The wetlands surveyed on this parallel walk will be known as the wetland site review area. To maintain consistency in identifying the wetland site review area, the evaluator should walk into the wetland to the point where upland-wetland transitional influences are not observed. The evaluator then initiates the parallel walk. This parallel walk should be no more than 300 ft into the wetland. The character of the wetland may dramatically change along this transect, and thus, the evaluator may find it necessary to identify two or more distinct wetland site review areas.

By following the above methodology the evaluator should acquire a representative sample of the wetlands in the immediate vicinity of the proposed development. In many situations it would probably be appropriate to review a larger portion of the wetland; however, considering the time, man-power and financial restraints often faced by the Pinelands Commission, local regulatory agencies, and applicants, this methodology seems to be the most feasible. Fig. 5 illustrates the methodology for identifying the wetland site review area.

If the appropriate information needed for a particular aspect of the evaluation scheme can be obtained from maps and aerial photographs, then the evaluator will be directed to study the wetland area. To delineate the wetland area, the evaluator should first, accurately map the proposed development site/lot(s) on the 1:24,000 Pinelands Commission vegetation maps, National Wetland Inventory maps, and/or SCS soils maps. If the proposed development site/lot(s) is parallel or adjacent to a wetland (i.e., vegetated wetland or lake/ pond wetland) as noted in Fig. 6 (a), then the evaluator should locate the point at which the wetland projects farthest into or closest to the site/lot(s) boundary lines. This point will be the center of a circle (dimensions of the circle will be discussed later) to be drawn on the 1:24,000 map(s). If wetlands are interspersed throughout the proposed development site/lot(s), and thus, it becomes difficult or impossible to locate a central point parallel to the wetland/upland border, then the evaluator must locate the farthest downstream point of wetland which is within the boundaries of the development site/lot(s). This point will be the center of a circle to be drawn on the appropriate 1:24,000 maps. An example of this later situation for defining a wetland area is illustrated in Fig. 6 (b).

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[3]Note: The concept of wetland site review area is not applicable if the wetland is defined as a lake/pond. The evaluator should proceed to the discussion of wetland area.

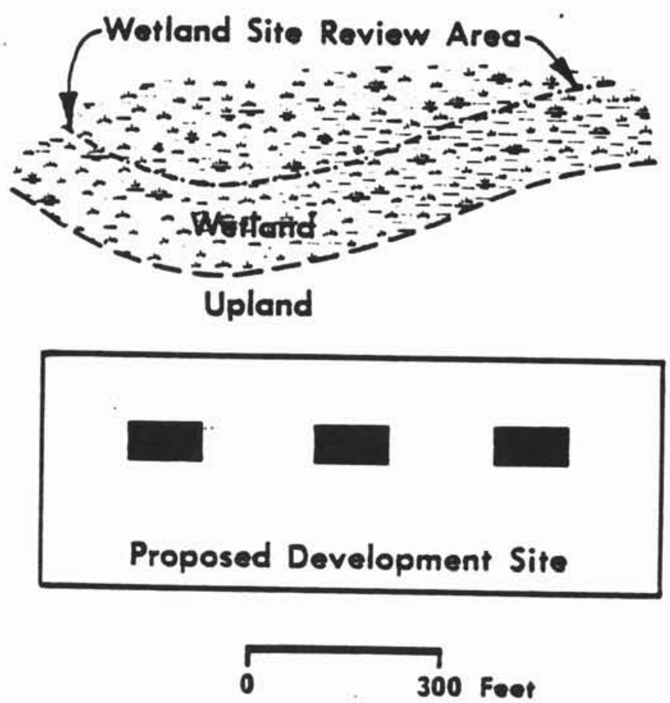

Fig. 5. Field location of the wetland site review area. In this example, the evaluator walked approximately 150 ft into the wetland to avoid transitional influences. The wetlands observed along the parallel walk (- • - • -) are known as the wetland site review area.

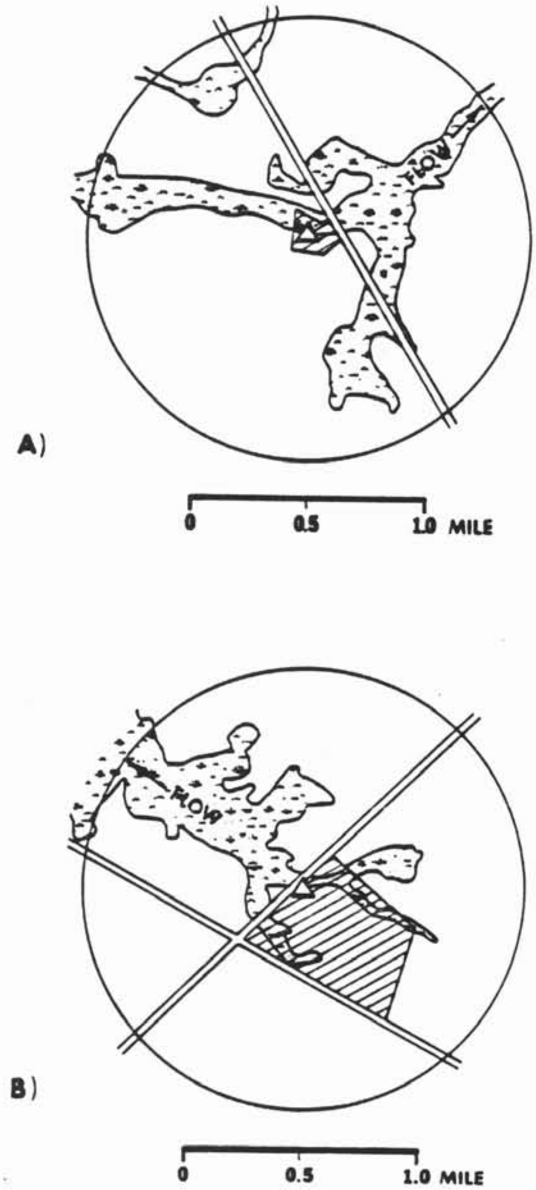

Fig. 7. Method for identifying the <u>wetland area</u>.

a) The proposed development site (diagonal lines) is adjacent to a wetland. The point at which the wetland projects farthest into the development is the center point (open triangle) of a circle to be drawn.

b) Wetlands are interspersed throughout the proposed development site. The farthest downstream point of wetland which is within the boundaries of the development site is the center point of a circle to be drawn.

SEE TEXT FOR A DETAILED EXPLANATION

All wetlands within the circle and within the same drainage basin as the wetlands immediately adjacent to the development site/lot(s) will be included as the wetland area. This area can include wetlands which are both upstream and downstream of the proposed development site/lot(s).

The potential area of wetlands to be evaluated (i.e., circle diameter) should be dependent upon the relative scale and intensity of the proposed development. It is assumed that large scale and/or relatively high intensity developments will have a greater influence on associated wetlands and therefore, the wetland area evaluated for the PROCEDURE should be greater and/or include wetlands farther downstream and upstream of the proposed development. When delineating the wetland area, the following guidelines should be followed;

Large Scale and/or High Intensity Development
-Maximum potential area of wetland -- approximately 1800 acres (1:24,000 scale)
-Circle diameter = 5 inches
-The proposed development site (wetlands and uplands) is ≥ 100 acres and the proposed density of development is ≥ 1 unit/acre; or, the proposed development site is ≤ 25 acres and the proposed density of development is ≥ 4 units/acre; or, the proposed development is commercial or industrial.

All other Development
-Maximum potential area of wetland -- approximately 900 acres (1:24,000 scale)
-Circle diameter = 3.5 inches

Note - The acreages presented above are for total area within the circle (wetland and upland). The wetland area includes only wetlands within the circle, and thus, the acreage of the wetland area will often be considerably smaller than the total circle acreage.

THREATENED AND ENDANGERED SPECIES

If the wetland area is known to support resident and/or breeding population(s) of threatened or endangered species (as designated by the Pinelands Commission, or, other state or federal agencies), and if the wetland area is critical to the survival of said population(s) of threatened or endangered species, then the maximum relative wetland value index or lake/pond value index (i.e., 3.0) should be assigned (see clarifying condition No. 1). It is assumed that wetlands with populations of threatened or endangered species are of the highest relative value. The evaluator should skip the Wetland Evaluation Scheme or Lake/Pond Evaluation Scheme and proceed directly to the Potential for Impacts Scheme.

Clarifying Conditions:

1) The objective of this threatened and endangered species provision is to provide for priority protection of the particular population and characteristic habitat. Therefore, if there are

two, or more, distinct wetland habitats adjacent to the proposed development (i.e., pitch pine lowland and wet-open field), and if the primary habitat for the threatened or endangered species is only one of these wetland types, then the evaluator should apply the appropriate Evaluation Scheme to provide for protection of the other habitat(s).

2) The presence of threatened or endangered species within the wetland area will not always result in delineation of a 300 ft buffer width (i.e., when the Potential for Impacts Index is <3.0 the derived buffer will be <300 ft). Under some circumstances, and in accordance with Article 6, section 6-204 and section 6-302 of the CMP, the evaluator may demonstrate that a particular population of threatened or endangered species warrents buffer protection which is greater than that assigned from the Model to protect the wetlands.

THE WETLAND EVALUATION SCHEME

Evaluating the relative quality, values and functions of a vegetated Pinelands wetland (i.e., forested, shrub-dominanted, herbaceous marsh) is based on five factors: 1) existing quality of vegetation; 2) existing surface water quality, 3) relative water quality maintenance attributes; 4) wildlife habitat values; and 5) socio-cultural values.

Vegetation Quality

The existing quality of a wetland can be judged, in part, by assessing the character of vegetation. Ehrenfeld (1983) suggests that urbanizing land use changes can substantially alter the vegetation structure and species composition of Pinelands forested wetlands. In conjunction with these vegetation changes, wetland values and functions are altered. When assessing the relative quality of a wetland one factor to consider should be vegetation composition. On a relative scale, undisturbed wetlands with characteristic vegetation composition and structure would be of a higher overall quality than wetlands exhibiting altered vegetation characteristics.

Relative Analysis: To determine the vegetation character of a wetland along a relative scale from undisturbed to disturbed, the evaluator must assess the species composition of the wetland site review area. Shrub and herbaceous species seem to be the most definitive indicators of the relative undisturbed-to-disturbed quality of wetland vegetation. To maintain consistency in this relative vegetation analysis, the evaluator should concentrate on shrubs and vines since they can be identified year-round. Herbaceous species, especially those which are persistent year-round, should be used in support of the shrub/vine analysis. Table 2, adapted from data presented by Ehrenfeld (1983) and Ehrenfeld and Schneider (1983) provides lists of shrub, vine and herbaceous species which characterize relatively undisturbed and relatively disturbed forested and shrub-dominated Pinelands wetlands. The Ehrenfeld (1983) study was

Table 2. Plant species characteristic of disturbed and undisturbed Pinelands sites. These lists were adapted from Ehrenfeld (1983) and Ehrenfeld and Schneider (1983).

Disturbed Sites

Actaea sp. (Baneberry)
Alisma subcordatum (Small Water Plantain)
Allium vineale (Field Garlic)
Anaphalis margaritacea (Pearly Everlasting)
Arisaema triphyllum (Jack-in-the-pulpit)
Athyrium filix-femina (Lady Fern)
Asclepias syriaca (Common Milkweed)
Aster lateriflorus (Calico Aster)
Aster simplex (Panicled Aster)
Berberis thunbergii (Barberry)
Bidens frondosa (Beggar Ticks)
Boehmeria cylindrica (False Nettle)
Callitriche heterophylla (Water Starwort)
Carex lurida (Sallow Sedge)
Circaea quadrisculata (Enchanter's Nightshade)
Convolvulus sp. (Bindweed)
Cuscuta compacta (Dodder)
Decodon verticillata (Water Willow)
Eclipia alba (Yerba-de-tajo)
Erechtites hieracifolia (Pilewort)
Eupatorium perfoliatum (Boneset)
Eupatorium rotundifolium (Round-leaved Boneset)
Fragaria virginiana (Strawberry)
Galium sp. (Bedstraw)
Glyceria sp. (Manna Grass)
Habenaria blephariglottis (White Fringed Orchis)
Habenaria clavellata (Green Wood Orchis)
Habenaria lacera (Ragged Fringed Orchis)
Hypericum multilum (St. John's-wort)
Impatiens biflora (Jewel-weed)
Lactuca canadensis (Wild Lettuce)
Lemna sp. (Duckweed)
Lonicera japonica (Japanese Honeysuckle)
Ludwigia palustris (Water Purslane)
Lycopus amplectens (Sessile-leaved Water Horehound)
Maianthemum canadense (Lily-of-the Valley)
Medeola virginica (Indian Cucumber-root)
Mikania scandens (Climbing Hempweed)
Oxalis stricta (Upright Yellow Wood Sorrel)
Onoclea sensibilis (Sensitive Fern)
Panicum sp. (Panic Grass)
Parthenocissus quinquefolia (Virginia Creeper)
Phragmites australis (Common Reed)
Phytolacca americana (Pokeweed)
Pilea pumila (Clearweed)

Table 2. Continued.

<u>Polygonum</u> sp. (Smartweed)
<u>Ranunculus</u> <u>abortivus</u> (Small Flowered Crowfoot)
<u>Ranunculus</u> <u>sceleratus</u> (Cursed Crowfoot)
<u>Rhus</u> <u>copallina</u> (Winged Sumac)
<u>Rhus</u> <u>radicans</u> (Poison Ivy)
<u>Rhus</u> <u>vernix</u> (Poison Sumac)
<u>Rosa</u> sp. (Rose)
<u>Rubus</u> sp. (Blackberry)
<u>Salix</u> <u>alba</u> (White Willow)
<u>Sambucus</u> <u>canadensis</u> (Common Elder)
<u>Smilax</u> sp. (Brier)
<u>Solidago</u> <u>canadensis</u> (Canada Goldenrod)
<u>Solidago</u> <u>graminifolia</u> (Grass-leaved Goldenrod)
<u>Solidago</u> <u>rugosa</u> (Rough-stemmed Goldenrod)
<u>Sparganium</u> <u>androcladum</u> (Branching Bur-reed)
<u>Symplocarpus</u> <u>foetida</u> (Skunk Cabbage)
<u>Taraxacum</u> <u>officinale</u> (Dandelion)
<u>Thalictrum</u> <u>polygamum</u> (Meadow rue)
<u>Vitis</u> sp. (Wild Grape)

<u>Undisturbed Sites</u>

<u>Aralia</u> <u>nudicaulis</u> (Wild Sarasparilla)
<u>Arethusa</u> <u>bulbosa</u> (Arethusa)
<u>Aster</u> <u>nemoralis</u> (Bog Aster)
<u>Bartonia</u> <u>virginica</u> (Yellow Bartonia)
<u>Carex</u> <u>collinsii</u> (Collins Sedge)
<u>Carex</u> <u>stricta</u> (Tussock Sedge)
<u>Carex</u> <u>walteriana</u> (Walters Sedge)
<u>Chamaedaphne</u> <u>calyculata</u> (Leatherleaf)
<u>Drosera</u> sp. (Sundew)
<u>Eleocharis</u> <u>tuberculosa</u> (Tubercled Spike-rush)
<u>Eriophorum</u> <u>virginicum</u> (Cotton Grass)
<u>Gaylussacia</u> <u>dumosa</u> (Dwarf Huckleberry)
<u>Gaylussacia</u> <u>frondosa</u> (Dangleberry)
<u>Helonias</u> <u>bullata</u> (Swamp-pink)
<u>Juncus</u> <u>canadensis</u> (Canada Rush)
<u>Kalmia</u> <u>angustifolia</u> (Sheep Laurel)
<u>Kalmia</u> <u>latifolia</u> (Mountain Laurel)
<u>Leucothoe</u> <u>racemosa</u> (Fetterbush)
<u>Lyonia</u> <u>mariana</u> (Staggerbush)
<u>Myrica</u> <u>pensylvanica</u> (Bayberry)
<u>Orontium</u> <u>aquaticum</u> (Golden Club)
<u>Panicum</u> <u>ensifolium</u> (Small-leaved Panic)
<u>Pogonia</u> <u>ophioglossoides</u> (Rose Pogonia)
<u>Polygala</u> <u>brevifolia</u> (Short-leaved Milkweed)
<u>Pontederia</u> <u>cordata</u> (Pickerelweed)
<u>Rhexia</u> <u>mariana</u> (Meadow Beauty)
<u>Rhododendron</u> <u>viscosum</u> (Swamp Azalea)
<u>Rhynchospora</u> <u>alba</u> (White Beaked-rush)
<u>Rhynchospora</u> <u>gracilenta</u> (Slender Beaked-rush)

Table 2. Continued.

Sarracenia purpurea (Pitcher Plant)
Scirpus cyperinus (Wool Grass)
Utricularia sp. (Bladderwort)
Viburnum nudum (Possum Haw)
Vaccinium corymbosum (Highbush Blueberry)
Vaccinium macrocarpon (Cranberry)
Viola lanceolata (Lance-leaved Violet)

based on Pinelands hardwood swamps, while data from Pinelands cedar swamps is presented in the Ehrenfeld and Schneider (1983) study. Pitch pine lowlands and shrub-dominated wetlands were not studied by Ehrenfeld (1983) or Ehrenfeld and Schneider (1983); however, some additions/deletions to their data have been made so that Table 2 can be applied to all Pinelands forested and shrub-dominated wetlands.

Ehrenfeld (1983) reports that vines (i.e., Ipomoea lacunosa, Rhus radicans, Smilax spp., among others), occur more frequently and in greater abundances in disturbed sites, as compared to undisturbed sites. Also, Ehrenfeld (1983) found a shift in disturbed site community structure towards an increased abundance and diversity of herbaceous species, with a corresponding decrease in shrubs. Generally, herbaceous species which are non-native to the Pinelands or cosmopolitan accounted for this observed community shift (i.e., Allium vineale, Daucus carota, Phragmites australis, Taraxacum officinale).

The relative vegetation quality score is determined as follows:

High Vegetation Quality
Characteristic disturbed site species are not present or rare within the wetland site review area (see Table 2 for a list of characteristic disturbed site species) 3

Moderate Vegetation Quality
Characteristic disturbed site species are relatively common within the wetland site review area (see Table 2 for a list of characteristic disturbed site species) 2

Low Vegetation Quality
Characteristic disturbed site species are relatively abundant within the wetland site review area (see Table 2 for a list of characteristic disturbed site species). 1

Existing Surface Water Quality

Surface waters of the Pinelands are characterized by low pH and low nutrient levels. The typical Pinelands flora and fauna within wetland and aquatic ecosystems are well-adapted to these conditions. With man-induced disturbance and subsequent increased pH and nutrient levels there is a documented change in the species composition of wetland vegetation (Ehrenfeld 1983) and aquatic habitats (Morgan et al. 1983). Therefore, when assessing the relative value of a wetland, one factor to consider is the existing surface water quality. Wetlands with high surface water quality, as assessed by pH and nitrate levels, have the potential to support typical Pinelands biota, and thus, are considered as particularly valuable.

Relative Analysis: Based on water quality data from the STORET computer data retrieval system (NJDEP, Div. of Water Resources), the Pinelands Commission conducted an analysis of 74 surface water quality sampling stations within the Pinelands (unpub. report, on file at Pinelands Commission office). As shown in Table 3, data from this Pinelands Commission analysis were organized to compare surface water pH and nitrate levels from relatively undisturbed basins and disturbed basins. Although additional water quality data are available for incorporation into this comparison (see Roman and Good 1983), this Pinelands Commission data set provided a means to define undisturbed and disturbed basins according to consistent criteria (i.e., percent of basin developed vs. undeveloped).

Based on the data presented in Table 3, the following scale was developed for assigning a relative surface water quality rating for wetland-stream courses.

pH

High Water Quality (pH $\leq$ 4.5) 3

Moderate Water Quality (pH $\geq$ 4.6 - < 5.9) 2

Low Water Quality (pH $\geq$ 6.0). 1

NO_3-N (mg/1)

High Water Quality ($\leq$ 0.05). 3

Moderate Water Quality ($\geq$ 0.06 - $\leq$ 0.69). 2

Low Water Quality ($\geq$ 0.70) 1

To incorporate the existing surface water quality parameter into the relative wetland evaluation scheme, the evaluator must determine if pH and/or nitrate data are available for the stream or stream segment associated with the proposed development site. The primary source of these data is the STORET system (NJ DEP, Div. of Water Resources) and the U.S. Geological Survey, while other less extensive sources are also available (see Roman and Good 1983). Water quality measurements that do not include seasonal monitoring for at least one year should be avoided.

To determine if a particular surface water monitoring station is applicable and representative of the wetland-stream segment under investigation, the evaluator should refer to aerial photographs to study the relationship between the proposed development site, surface water sampling station, and land uses surrounding each (i.e., particularly upstream). After determining that available data are appropriate, the evaluator will assign a relative pH and relative nitrate score, according to the above scales. The overall relative existing water quality score is determined by averaging the pH and nitrate scores. If only one water quality parameter is available, then it should be used alone to represent relative existing surface water quality. Since there is a relatively consistent relationship between pH and water quality in the Pinelands (CMP), using only one parameter would provide a valid representation of existing surface water quality. If data are not available then the evaluator must assume that the water quality is high (i.e., overall relative score of 3),

Table 3. Median pH and mean nitrate values from representative undisturbed and disturbed Pinelands streams. The data presented are from an analysis conducted by the Pinelands Commission (unpub. report, on file at Commission office) which was based on the STORET system (NJ DEP, Div. of Water Resources). Undisturbed streams are within drainage basins of > 90% open space (i.e., not residential, commercial or industrial development) and < 7% agriculture (mostly limited to cranberry farming). Disturbed streams are within drainage basins of < 66% open space (i.e, 1/3 developed). For both the undisturbed and disturbed categories, the drainage basins listed contained no landfills, sewage treatment plants or non-domestic point source discharges.

DRAINAGE BASIN[1]	PINELANDS I.D. NUMBER	pH	NO_3-N (mg/l)
UNDISTURBED			
Toms River Basin:			
Jakes Branch	11-N	4.2	0.02
Cedar Creek Basin:	10-F	4.6	0.02
	11-O	4.5	0.03
Oyster Creek Basin:	18-B	4.4	0.04
	18-C	4.4	0.05
Westecunk Creek Basin:	27-J	4.6	0.10
Tuckerton Creek Basin:	35-I	4.7	0.07
Mullica River Basin:			
Wading River	16-2	6.0[2]	0.01
Bass River	34-D	4.4	0.36[2]
Tuckahoe River Basin:	43-C	4.9	0.08
Maurice River Basin:	42-D	4.5	0.04
Rancocas Creek Basin:			
North Branch	8-H	4.1	0.07
UNDISTURBED STREAMS SUMMARY		$\bar{x}$ = 4.5	$\bar{x}$ = 0.05

Table 3. Continued.

DRAINAGE BASIN	PINELANDS I.D. NUMBER	pH	NO_3-N (mg/1)
DISTURBED			
Mullica River Basin:			
Atsion Sleeper	14-F	6.4	0.82
	23-8	6.3	0.30
Nescochague	23-7	5.1	0.85
Upper Great Egg Harbor R. Basin:			
GEHR	13-E	6.3	0.88
GEHR	22-F	6.7	0.59
Squankum Branch	22-K	6.4	1.71
Hospitality Branch	30-D	5.7	0.25
Rancocas Creek:			
South Branch	8-4	5.8	0.25
	15-5	5.6	1.97
Southwest Branch	14-4	5.9	0.25
DISTURBED STREAMS SUMMARY		$\bar{x}$ = 6.0	$\bar{x}$ = 0.71

[1]If applicable minor basins within the larger basin are often noted.

[2]These values seem uncharacteristically high, and thus, were omitted from the $\bar{x}$ calculations.

unless the applicant can demonstrate otherwise. If the wetland is isolated with no apparent hydrologic connection to surface water, then the existing surface water quality rating must be omitted from the determination of relative wetland value.

Water Quality Maintenance Value

Preserving the ecological value and essential character of the Pinelands is, in part, dependent upon maintaining surface and groundwater resources of exceptional quality. From a watershed or regional perspective, Pinelands wetlands have the natural capability to retain, store and remove nutrients, thus contributing to the maintenance of high water quality which characterizes the ecosystem.

Relative Analysis: To evaluate the relative water quality maintenance value of a Pinelands wetland or the relative capability of a wetland to retain or remove nutrients, several factors must be considered. These include, a) hydrologic regime, b) nutrient removal/storage/retention capacity of the wetland soils, and c) nutrient retention by vegetation.

It must be emphasized that if a wetland is ranked as having a high water quality maintenance value, this should not imply that the wetland can tolerate excess nutrient inputs. The water quality maintenance value of a site-specific wetland must be viewed within a regional context. Wetlands with a high value are contributing to the maintenance of exceptional water quality which characterizes the Pinelands, while also providing for enhancement of degraded water quality. If site-specific wetlands are stressed with excess nutrients, then the regional, watershed-wide water quality maintenance role of these systems will be reduced.

a) Hydrologic regime - Hydrologic regime, as a factor influencing the relative water quality maintenance value of a wetland, is based on 1) the potential for nutrient inputs to the wetland, and 2) the potential for interaction/contact between surface waters and the wetland vegetation and substrate. The first criterion differentiates between wetlands which are associated with a stream course and wetlands which are not directly associated with a stream, and thus, are isolated. These isolated systems are primarily dependent on groundwater, surface runoff and precipitation for their water supply. Obviously, stream flow is an additional water supply source for wetlands associated with a water course. Since wetlands associated with streams have more potential sources for nutrient inputs (i.e., stream flow, groundwater flow, runoff, and precipitation) than isolated systems, it follows that their water quality maintenance value would be enhanced; especially when considered from a regional or watershed-wide perspective. For this analysis wetlands that were once adjacent to a stream, but are currently fragmented by development and stream flow is diverted, are to be considered as isolated. Wetlands which are divided or crossed by a road, railroad, right-of-way, etc., but with stream flow maintained by bridges, culverts or other such means must still be considered as being associated with the stream.

With respect to the second factor, the water quality maintenance value of wetlands is generally enhanced as the contact time and interaction between nutrient-laden surface waters and the wetland is increased. It is assumed that hydrology plays a major role in a wetlands capacity to retain/remove nutrients if the wetland is associated with a stream and the wetland is relatively broad, thereby increasing the potential for surface water interaction with wetland vegetation and substrate. The average width of Pinelands wetland complexes (associated with streams) was estimated to be approximately 0.25 mi.

To evaluate the role of hydrology in assessing a wetlands relative water quality maintenance value, the following relative scheme is presented.

Major Hydrologic Role
The wetland area is associated with a stream, river, lake or other such water course, and, the average width of the wetland area is ≥ 1500 ft (approx. 0.25 mi). 3

Moderate Hydrologic Role
The wetland area is associated with a stream, river, lake or other such water course, and, the average width of the wetland area is < 1500 ft. 2

Minor Hydrologic Role
The wetland area is isolated from streams, rivers, lakes and other such surface water courses. 1

Note - To determine average width of the wetland area the evaluator must draw (on a 1:24,000 map) three equally spaced transect lines across the wetland area, perpendicular to the stream course, and then average these distances.

b) Nutrient retention/removal capacity of wetland soils - Wetlands with organic and anaerobic substrates generally have a high potential for nutrient retention and removal. This is related to 1) slow decomposition rates under anaerobic conditions, thereby promoting nutrient retention by long-term incorporation of organic matter into the sediments/substrate, 2) adsorption of nutrients, particularly nitrogen and phosphorus, onto organic compounds with subsequent incorporation into the sediments, and 3) denitrification, a nitrogen removal mechanism, occurring under anaerobic conditions with organic matter providing an energy source for the mediating bacteria.

In the Pinelands saturated soils (i.e., promoting anaerobic conditions), with relatively high organic contents include Muck, Pocomoke, Berryland, and other soils classified as very poorly drained by the SCS. These soils are particularly efficient at promoting nutrient retention by incorporation of organic matter, by adsorption of nutrients onto organic compounds, and by nitrogen removal by denitrification. In addition, standing water, sluggish streamflow or sheetflow is often associated with wetlands of very poorly drained soils. This hydrologic regime enhances the opportunity for wetlands to retain nutrients, whether within the soils or by vegetation uptake, because the contact time between nutrient-laden waters and the wetland is increased. The nutrient retention/removal capacity of poorly drained wetland soils (i.e., Atsion) would be less, considering the lower organic matter content and lower water table levels (i.e., soil profile partially oxidized and limited standing water). To assess the relative capacity of Pinelands wetland soils to retain/remove nutrients, the evaluator should employ the following scheme within the wetland area.

High Retention/Removal Capacity
Very poorly drained soils, as classified by the SCS, occupy ≥75% of the wetland area. 3

Moderate Retention/Removal Capacity
Very poorly drained soils, as classified by the SCS, occupy from 50 - 74% of the wetland area 2

Low Retention/Removal Capacity
Very poorly drained soils, as classified by the SCS, occupy <50% of the wetland area. 1

The evaluator should use SCS soils maps, in conjunction with field inspection, to determine soil types and percent cover estimates in the wetland area.

c) Nutrient retention by vegetation uptake - A significant mechanism for nutrient retention in wetlands involves uptake by vegetation. Ehrenfeld (in press) notes that Pinelands hardwood swamps retain within woody structural tissue from 21-28% of the annual nitrogen uptake. It is apparent that in wetlands with relatively dense tree and shrub cover, retention by this mechanism could be substantial. To assess the relative capacity for Pinelands wetlands to retain nutrients by vegetation uptake and subsequent storage, the evaluator should employ the following scheme within the wetland site review area.

Dense tree cover (≥ 75%) and dense shrub cover (≥ 75%) occupy the wetland site review area 3.0

Dense tree cover (≥ 75%) and moderate shrub cover (≥ 50 - < 75%) or, moderate tree cover (≥ 50 - < 75%) and dense shrub cover (≥ 75%) occupy the wetland site review area . . . 2.5

Dense tree cover (≥ 75%) and sparse shrub cover (<50%) or, moderate tree cover (≥ 50 - < 75%) and moderate shrub cover (≥ 50 - < 75%) or, sparse tree cover (< 50%) and dense shrub cover (≥ 75%) occupy the wetland site review area. 2.0

Moderate tree cover (≥ 50 - < 75%) and sparse shrub cover (< 50%) or, sparse tree cover (< 50%) and moderate shrub cover (≥ 50 - < 75%) occupy the wetland site review area. . . 1.5

Sparse tree cover (< 50%) and sparse shrub cover (< 50%) occupy the wetland site review area or, the wetland site review area is a herbaceous wetland type. 1.0

The wetland site review area is predominantly unvegetated . . 0

To determine a score for the relative water quality maintenance value of the wetland site review area and adjacent wetland-stream areas associated with the proposed development site the evaluator should average the three criteria evaluated above (i.e., Hydrologic Regime + Soil Retention/Removal + Vegetation Uptake/3 = Relative Water Quality Maintenance Score).

Wildlife Habitat Value (Game and non-game species)

Pinelands wetlands provide necessary habitat for a diversity of animal species. Birds, including migratory waterfowl, songbirds, predatory birds and other avifaunal groups utilize Pinelands wetlands for feeding, nesting and breeding. Many mammals also frequent wetlands. Most notable are the white-tailed deer who browse on the young and palatable cedar seedlings, while also taking refuge in these evergreen swamps during winter and hot summer periods. Finally, Pinelands wetlands provide habitat which is essential to the survival and maintenance of many threatened and endangered animals; including a unique array of reptiles and amphibians which are well-adapted to the acid environment of Pinelands wetlands.

Relative Analysis: In this analysis, qualitative habitat features will be considered in order to predict the relative wildlife habitat value of Pinelands wetlands. Included will be an evaluation of a) vegetation interspersion, b) wetland size, and c) surrounding land use types.

a) Vegetation Interspersion - Wildlife generally require more than one form or structural type of vegetation to satisfy their needs for food, cover and breeding (Golet 1976). This is related to the ecotonal effect which suggests that wildlife diversity and species abundances increase as the structural diversity of habitat, or edge, increases. Homogeneous stands of vegetation are commonly of least value to wildlife, while sites with several vegetation forms intermingled and scattered throughout are often considered as especially valuable wildlife habitat.

This vegetation interspersion factor is a relative measure of the abundance of edge and the degree to which different vegetation forms are intermingled throughout the wetlands. The evaluator should use aerial photographs and vegetation maps, in conjunction with field inspection, to evaluate vegetation interspersion within the wetland area.

High Vegetation Interspersion
Three or more vegetation forms or habitat types (i.e., deciduous tree stand, evergreen tree stand, deciduous shrub area, evergreen shrub area, windthrow areas, pools, streams, clearings, etc.) occupy the wetland area. . . . 3

Moderate Vegetation Interspersion
Two vegetation forms or habitat types occupy the wetland area. 2

Low Vegetation Interspersion
One vegetation form or habitat type dominates the wetland area. 1

Note - To be considered as a separate type, each vegetation form or habitat type must occupy in a continuous or patchy pattern, at least 10% of the wetland area.

b) Wetland Size - As wetland size increases, the potential to support wildlife may similarly increase. Also, in large, nonfragmented and contiguous wetlands, animal populations may be protected and somewhat isolated from man-induced disturbance, or natural events such as fire. The relative wetland size scale is as follows.

The wetland immediately adjacent to the proposed development is part of a nonfragmented and contiguous wetland complex of $\geq$50 acres 3.0

The wetland immediately adjacent to the proposed development is part of a nonfragmented and contiguous wetland complex of $\geq$25 acres to <50 acres. 2.5

The wetland immediately adjacent to the proposed development is part of a nonfragmented and contiguous wetland complex of $\geq$10 acres to <25 acres. 2.0

The wetland immediately adjacent to the proposed development is part of a nonfragmented and contiguous wetland complex of $\geq$5 acres to <10 acres 1.5

The wetland immediately adjacent to the proposed development is part of a nonfragmented and contiguous wetland complex of <5 acres 1.0

Note - Fragmenting barriers can include, roads, railroads, filled/developed wetlands, and other man-induced or natural barriers. Although streamflow is often maintained (e.g., bridges, culverts) or groundwater flow under the barrier is maintained, the actual barrier is considered as a feature to alter the contiguous nature of a wetland.

c) Surrounding Habitat - When determining the relative habitat value of a wetland, one factor to consider is the habitat value of surrounding areas. For instance, wetlands bordered by undeveloped or agricultural lands are often considered more valuable to wildlife than wetlands surrounded by development (Golet 1976). In addition, Golet (1976) suggests that as habitat diversity in the surrounding areas increases, the potential for enhanced wildlife diversity in the wetlands increases.

To evaluate the surrounding habitat factor the evaluator must assess the land use types present around the perimeter of the wetland area. This upland perimeter should be a band of at least 300 ft from the wetland-upland boundary. With reference to aerial photographs, coupled with field inspection, the following relative scale should be used.

Undeveloped Surrounding Areas
The upland perimeter of the wetland area is $\geq$ 75% undeveloped or agricultural land. 3

Moderately Developed Surrounding Areas
The upland perimeter of the wetland area is $\geq$ 50% - < 75% undeveloped or agricultural land 2

Developed Surrounding Areas
The upland perimeter of the wetland area is < 50% undeveloped or agricultural land 1

The relative wildlife habitat score of the wetland site review area and associated wetland area is determined by averaging the three criteria evaluated above (i.e., Vegetation Interspersion + Wetland Size + Surrounding Upland Habitat/3 = Relative Wildlife Habitat Score).

Socio-Cultural Values

The dominant socio-cultural values of Pinelands wetlands are related to recreation, education, visual/aesthetic qualities and uniqueness. While the evaluation of wetland socio-cultural values is often based on personal perceptions, guidelines are presented so the evaluator can assess and organize these qualitative perceptions in an objective manner.

As noted, for this aspect of the evaluation scheme the format has changed slightly. The evaluator must answer a series of questions related to the socio-cultural attributes of the wetland area and associated wetlands. Then, a scale is presented in order to translate the answers to these questions into a relative socio-cultural score.

Recreation

1) Is the wetland associated with a stream that is frequently canoed or a stream with the potential to be frequently canoed (see Cawley and Cawley 1971, Parnes 1978, and CMP for listings of Pinelands streams-rivers which are popular canoeing areas)? . . . . YES NO

2) Is the wetland area or surrounding wetland areas-streams known to be used by hunters, fishermen, or trappers; or is the wetland frequented by birdwatchers, painters, wildlife photographers, hikers or other passive recreation enthusiasts; or, does the wetland have a high potential to be frequented by the above mentioned? . . . . YES NO

Research and Education

1) Is the wetland currently used as a scientific study area for existing, on-going or long-term research?. . . . YES NO

2) Is the wetland in close proximity to schools, nature centers, camps, or other such educational facilities, thus offering the potential for formal nature study?. . . . . YES NO

Visual/Aesthetic

1) Does the wetland have a high visual/aesthetic quality in terms of landscape vistas, trails through the wetland, showy fall foliage, or other attributes which characterize the scenic resources of the Pinelands?. . . . . YES NO

Uniqueness

1) Is the wetland historically, archeologically, or scientifically significant, or associated with a Pinelands site having historical, archeological, or scientific significance?. . . . . YES NO

2) Is the wetland type unique to the watershed or subwatershed (i.e., a hardwood swamp in an area dominated by pitch pine lowlands) . . . . YES NO

3) Is the wetland within a locally developed area thereby providing open space within an urbanized landscape; or, is the wetland within a developed area, thereby having the potential to store floodwaters and abate floodwater velocities . . . . YES NO

Relative Socio-cultural Value Score: To determine the relative socio-cultural value score of the wetland, the following scale is provided.

High Socio-cultural Value
Of the socio-cultural questions, ≥4 were answered "YES" 3

Moderate Socio-cultural Value
Of the socio-cultural questions, 2 or 3 were answered "YES" 2

Low Socio-cultural Value
Of the socio-cultural questions, ≤ 1 were answered "YES" 1

Determining an Overall Relative Wetland Value Index

The overall wetland value of a particular wetland area located adjacent to a proposed development site is determined by assessing five general factors (existing vegetation composition, existing surface water quality, water quality maintenance value, wildlife habitat value, and socio-cultural value) and assigning a relative score for each. These scores are averaged to derive an overall relative wetland value index. Each individual factor is assigned equal priority in calculation of the index. The following scale enables the evaluator to translate this relative numerical index into a more comprehensible perspective.

	Numerical Index
High value	3.0 - 2.6
High to moderate value	2.5 - 2.1
Moderate to low value	2.0 - 1.6
Low value.	1.5 - 1.0

The evaluator should proceed to the Potential for Impacts Scheme.

THE LAKE/POND EVALUATION SCHEME

If the wetland adjacent to the proposed development is determined to be a lake/pond, then the evaluator will consider four factors to evaluate the relative quality, values and functions of the surface water body: 1) existing surface water quality, 2) quality of shoreline habitat, 3) percent of the entire lake/pond shoreline which is developed, and 4) socio-cultural values.

Existing Surface Water Quality

The evaluator should follow the relative analysis as presented in the Wetland Evaluation Scheme (p. 26).

Shoreline Habitat Quality

This factor differentiates between vegetated and unvegetated lake/pond shorelines. It is assumed that shorelines vegetated with tree, shrub, or herbaceous vegetation and/or submerged or floating aquatic vegetation which is characteristic of the Pinelands provide relatively high quality fish and wildlife habitat. To evaluate shoreline habitat quality, the following relative scheme is presented.

High Shoreline Habitat Quality
Adjacent to the proposed upland development site, the shoreline is vegetated with submerged or floating aquatic vegetation, and at least a narrow fringe of forested, shrub or herbaceous wetland 3

Moderate Shoreline Habitat Quality
Adjacent to the proposed upland development site, the shoreline is vegetated with submerged or floating aquatic vegetation, or a fringe of forested, shrub or herbaceous wetland 2

Low Shoreline Habitat Quality
Adjacent to the proposed upland development site, the shoreline is predominately unvegetated (no aquatic or wetland vegetation). 1

Note - Due to the non-persistent character of herbaceous, and submerged/floating aquatic vegetation, the evaluator must carefully study the shoreline for decaying remains during the period from late Fall to Spring.

Percent Shoreline Development

This factor is based on the assumption that the overall ecological and environmental quality of the lake/pond decreases as the shoreline is encroached upon by development. To evaluate the percent shoreline development factor, the following relative scheme is presented.

Low Percent Shoreline Development
The entire perimeter of the lake/pond shoreline is ≤10% developed 3

Moderate Percent Shoreline Development
The entire perimeter of the lake/pond shoreline is >10% to ≤50% developed. 2

High Percent Shoreline Development
The entire perimeter of the lake/pond shoreline is >50% developed 1

Note - Development refers to structures, driveways, parking areas, clearings, lawns and other development-related practices which cause the relative long-term alteration of the landscape.

Socio-cultural Values

The evaluator should follow the relative analysis as presented in the Wetland Evaluation Scheme (p. 35).

Determining an Overall Relative Lake/Pond Value Index

The overall value of a lake/pond is determined by assessing four general factors (existing surface water quality, shoreline habitat quality, percent of shoreline development, and socio-cultural values), and assigning a relative score for each. These scores are averaged to derive an overall relative lake/pond value index. Each individual factor is assigned equal priority in calculation of the index. The following scale enables the evaluator to translate this relative numerical index into a more comprehensible perspective.

	Numerical Index
High value	3.0 - 2.6
High to moderate value	2.5 - 2.1
Moderate to low value	2.0 - 1.6
Low value	1.5 - 1.0

The evaluator should proceed to the Potential for Impacts Scheme.

POTENTIAL FOR IMPACTS SCHEME

Numerous development practices common to the Pinelands will alter wetland hydrologic regimes, water quality characteristics, biotic compositions, wildlife habitat values, food web support functions and cultural attributes (Roman and Good 1983). While individual development activities are associated with specific wetland impacts, such as the relationship between septic leach fields and contamination of wetland water quality (Special Case Buffer Delineation Guideline No. 3), it seems most feasible to collectively evaluate the development activities and associated impacts. Therefore, for purposes of this scheme the various activities and impacts are not considered individually, but rather, they are viewed as an integrated or collective unit for the evaluation of, a) wetland site-specific impacts, b) cumulative impacts on a regional level, and c) watershed-wide impacts.

Potential for Site-Specific Wetland Impacts

The potential for significant adverse impacts to be imposed on the site-specific wetland area relates to the intensity of development on the adjacent upland. For instance, as the percentage of upland that is permanently altered increases, there is a corresponding increase in the suite of potential impacts which are imposed on the adjacent wetland. Topographically, the percent slope from the development site to the wetland will affect the potential for site-specific impacts; most notably, surface runoff.

Relative Analysis: To determine the relative potential for wetland site-specific impacts, the intensity of permanent development proposed for the upland site must be considered. In addition, percent slope must be determined. Permanent development refers to structures, driveways, parking areas, clearings, lawns, and other development related practices which cause the relative long-term alteration of the landscape. Ideally, the evaluator should use detailed site plans to accurately determine the percent of the upland site which the applicant proposes to alter with permanent development. However, detailed site plans are not always available. Therefore, a relative scale is developed which assumes that as the number of development units proposed per acre of upland increases, there is a corresponding increase in the percentage of upland that will be permanently altered, and thus, the potential for site-specific impacts increases. The following relative scale should be used by the evaluator.

High Potential for Site-specific Impacts
The proposed density of residential development on the site is $\geq$4 units/acre of upland; or, the proposed development is non-residential with $\geq$40% of the total upland site area proposed to be occupied by permanent development 3.0

High to Moderate Potential for Site-specific Impacts
The proposed density of residential development on the site is <4 units to 2.75 units/acre of upland; or, the proposed development is non-residential with <40% of the total upland site area proposed to be occupied by permanent development. 2.5

Moderate Potential for Site-specific Impacts
The proposed density of residential development on the site is <2.75 units to 1.5 units/acre of upland. . . . 2.0

Moderate to Low Potential for Site-specific Impacts
The proposed density of residential development on the site is <1.5 units to 0.3 units/acre of upland 1.5

Low Potential for Site-specific Impacts
The proposed density of residential development on the site is <0.3 units/acre of upland 1.0

Note - Permanent development refers to structures, driveways, parking areas, clearings, lawns, and other development-related practices which cause the relative long-term alteration of the landscape.

With the above scale, it is intended that industrial, high-use commercial and cluster residential developments will generally be included under the high and high to moderate ranges. At the other extreme, low intensity development will usually be limited to single family dwelling units on relatively large area lots in the Forest Area and parts of Rural Development Areas.

Slope Factor: Incorporated into the relative scale for assessing site-specific impacts is a percent slope factor. Typically, slopes from uplands to wetlands are gradual. For example, as indicated by Markley (1979), slopes of the Pinelands transitional soil series (Lakehurst, Klej and Hammonton) are, 0-3%, 0-5% and 0-5%, respectively. When slopes significantly deviate from this range, it can be assumed that the potential for impacts to the wetland will be accentuated (i.e., increased surface water runoff; localized increase in groundwater flow rate). Therefore, if topographic slope between the proposed upland development and the wetland is ≥10%, the evaluator should increase the potential for site-specific impacts score by 0.5 numerical units. Note that the score cannot be increased above the maximum 3.0.

Potential for Cumulative Impacts on a Regional Basis

For the effective long-term protection of Pinelands wetlands values and functions, it is imperative that the potential for cumulative impacts be assessed on a regional basis. A development activity when considered individually may result in only minor and often acceptable wetland site-specific impacts; however, when considered in conjunction with existing or future activities within surrounding areas, the potential for cumulative impacts is recognized.

Relative Analysis: Evaluating the potential for cumulative impacts will be based on municipal density allocations. It is assumed that areas zoned for low density development will have less potential for cumulative impacts, relative to high density areas. Further, it is assumed that these zoned areas will eventually be developed to their maximum density allocation. This approach provides a consistent and objective means for predicting the long-term potential for cumulative impacts.

The range of density allocations varies within the different Pinelands land capability areas. Therefore, separate relative scales are presented (Forest Areas and Agricultural Production Areas; Rural Development Areas; and Regional Growth Areas). If the proposed development site is located in a Pinelands Town or Village, then the evaluator should follow the Rural Development Areas scale or the Regional Growth Areas scale, whichever is appropriate. To accomplish this aspect of the scheme and to assign a potential for cumulative impacts relative score, the evaluator must refer to local zoning maps. The relative scales are as follows;

FOREST AREAS AND AGRICULTURAL PRODUCTION AREAS

High Potential for Cumulative Impacts
High density area (≤ 5 acres/unit). 3

Moderate Potential for Cumulative Impacts
Moderate density area (>5 to <20 acres/unit). 2

Low Potential for Cumulative Impacts
Low density area (≥20 acres/unit) 1

RURAL DEVELOPMENT AREAS

High Potential for Cumulative Impacts
High density area ($\leq$3.2 acres/unit) 3

Moderate Potential for Cumulative Impacts
Moderate density area (>3.2 to <5 acres/unit) 2

Low Potential for Cumulative Impacts
Low density area ($\geq$5 acres/unit) 1

REGIONAL GROWTH AREAS

High Potential for Cumulative Impacts
High density area ($\geq$4 units/acre) 3

Moderate Potential for Cumulative Impacts
Moderate density area (>1.25 to <4 units/acre). 2

Low Potential for Cumulative Impacts
Low density area ($\leq$1.25 units/acre) 1

Notes:

1) For Pinelands municipalities which have not been certified by the Pinelands Commission as being in conformance with the CMP, a score of 3.0 should be assigned, unless the applicant can demonstrate that the potential for cumulative impacts will be less significant.

2) The above density allocations are based on gross land area (upland and wetland). If the municipality bases density allocation on net land area (upland only), then the evaluator must determine an equivalent density allocation range from the above ranges.

3) The evaluator should always use the without development credits density allocation value.

4) All non-residential development should be assigned a score of 3.0. These types of development are usually densely concentrated in prescribed areas (i.e., commercial/industrial zoning), and thus, it can be assumed that the potential for cumulative impacts will be high.

Significance of Watershed-wide Impacts

In addition to site-specific wetland impacts, development activities adjacent to wetlands have the potential to impose significant adverse impacts on surrounding wetland and aquatic habitats. This becomes especially relevant when considering the potential for waterborne contaminants introduced at the development site to be transported downstream. Evaluating the relative significance of watershed-wide impacts, or impacts within wetland basins will be based on the surrounding land use types and the apparent sensitivity of these surrounding areas to impacts.

It is well-documented that with watershed development there is a degradation of Pinelands surface water quality (see review, Roman & Good 1983). Similarly, Ehrenfeld (1983) reports a substantial change in the vegetation structure and species composition of Pinelands wetlands located within developed watershed. Several land use types in the Pinelands are particularly dependent upon impact-free conditions. The functioning and essential character of these environmentally sensitive areas would be significantly affected if water quality, vegetation composition, habitat, hydrologic regime, or other environmental parameters were altered. Land use types which require high environmental quality to function effectively include, but are not limited to, open space/natural areas such as wildlife management areas, state forests, parks and recreation areas. Blueberry and cranberry operations are particularly dependent on unpolluted, acid waters. Also, the essential ecological character of the Preservation Area District will be maintained only under a limited impact regime. Further, it is suggested that habitat occupied by resident and/or breeding populations of threatened or endangered wetland species is environmentally sensitive.

On the other hand, other land use types in the Pinelands are not as environmentally sensitive. For example, development activities and associated watershed-wide impacts would be less significant if the watershed immediately downstream of the development site was highly developed (i.e., dense residential, commercial or industrial).

Relative Analysis: To evaluate the significance of watershed-wide impacts a relative scale has been developed which incorporates several factors. For wetlands associated with a stream/water course the evaluator must determine the land use types associated with the wetland-stream and adjacent uplands within 2 miles downstream of the proposed development site. Also, the evaluator must determine if resident and/or breeding populations of threatened or endangered wetland species are within 1 mile downstream of the proposed development site.

Incorporated into this relative scale is an evaluation of the potential for significant wetland basin impacts; particularly pertaining to isolated wetlands (i.e., wetlands not directly associated with a stream/water course). Development activities adjacent to isolated wetlands have the potential to significantly alter the essential character and functioning of wetlands, aquatic habitats and water resources of environmentally sensitive areas which are part of the isolated wetland basin. Aside from environmentally sensitive areas and portions of the Forest Area with sparse development, the potential for significant isolated wetland basin impacts is assumed to be low (at least when considered relative to downstream watershed-wide impacts).

The evaluator should consult aerial photographs and land use maps, coupled with field verification, to evaluate the factors presented in the following relative scale.

High Potential for Significant Watershed-wide Impacts

The wetland adjacent to the proposed development site is associated with a stream/water course, and within 2 miles downstream of the development site there is any part of an environmentally sensitive open space/ natural area; or, an active cranberry agriculture area; or, any portion of the Preservation Area District; or, resident and/or breeding populations of threatened or endangered wetland plant or animal species are within 0.5 mile downstream of the development site 3.0

High to Moderate Potential for Significant Watershed-wide Impacts

The wetland adjacent to the proposed development site is associated with a stream/water course, and within 2 miles downstream of the development site there is any part of the Forest Area with low potential for development (≥20 acres/ unit); or, the wetland is isolated from a stream/water course, and a portion of the wetland or upland area immediately adjacent to the isolated wetland is an environmentally sensitive open space/natural area, or portion of the Preservation Area District; or, resident and/or breeding populations of threatened or endangered wetland plant or animal species are >0.5 miles to 1 mile downstream of the development site. 2.5

Moderate Potential for Significant Watershed-wide Impacts

The wetland adjacent to the proposed development site is associated with a stream/water course, and within 2 miles downstream of the development site there is an area with moderate potential for development (> 5.0 acres - < 20 acres/unit); or, the wetland is isolated from a stream/water course, and a significant portion (> 50%) of the upland immediately adjacent to the isolated wetland is a part of the Forest Area with a low potential for development (≥ 20 acres/unit) 2.0

Moderate to Low Potential for Significant Watershed-wide Impacts

The wetland adjacent to the proposed development site is associated with a stream/water course, and within 2 miles downstream of the development site there is an area with moderate to high potential for development (> 1 - < 5.0 acres/unit). 1.5

Low Potential for Significant Watershed-wide Impacts

The wetland adjacent to the proposed development site is associated with a stream/watercourse, and within 2 miles downstream of the development site there is an area with a high potential for development (≤ 1 acre/unit); or, the wetland is isolated from a stream/water course. 1.0

Notes:

1) Refer to the section on water quality maintenance (The Wetland Evaluation Scheme) for a detailed definition of wetlands associated with streams/water courses and isolated wetlands.

2) Environmentally sensitive open space/natural areas are defined as wildlife management areas, natural areas, parks, forests or recreation areas which are managed by federal, state or county agencies, and maintained principally for resource protection purposes; or, areas managed and maintained as above, by recognized environmental conservation organizations (i.e., The Nature Conservancy, The New Jersey Conservation Foundation, etc.); or, other deed restricted conservation lands, managed and maintained for resource protection purposes.

3) Distance downstream should be measured as the distance along the actual stream course.

4) For clarification of the unit density allocation categories listed, the evaluator should refer to notes 1-4 of the Potential for Cumulative Impacts Scheme.

5) If more than one land use or rare species category is downstream, the evaluator should assign a score according to the most restrictive category (i.e., choose appropriate score closest to 3.0).

Determining a Relative Potential for Impacts Index

The potential for significant adverse impacts to be imposed on wetlands by upland development practices is determined by assessing three general factors (wetland site-specific impacts, cumulative impacts and watershed-wide impacts, and assigning a relative score for each. These scores are averaged to derive a relative potential for impacts index. Each individual factor is assigned equal priority in calculation of the index. The following scale enables the evaluator to translate this relative numerical index into a more comprehensive perspective.

	Numerical Index
High Potential for Impacts	3.0 - 2.6
High to Moderate Potential for Impacts .	2.5 - 2.1
Moderate to Low Potential for Impacts. .	2.0 - 1.6
Low Potential for Impacts	1.5 - 1.0

ASSIGNING BUFFER AREAS

The final step of the PROCEDURE is the assignment of appropriate buffer areas. By averaging the relative wetland value index or lake/pond value index and potential for impacts index, a buffer delineation index is derived. Referring to Table 4, the evaluator can convert the buffer delineation index to an actual buffer distance.

Wetlands determined to have a high relative value (i.e., value index = 3.0) and a high potential for impacts (i.e., impacts index = 3.0) are assigned the maximum allowable buffer distance of 300 ft. It is assumed that a 300 ft buffer is adequate to protect these high quality wetlands from relatively high impact upland development. Then, based on this 300 ft maximum assignable buffer, it is further assumed that a lesser buffer would be adequate to protect wetlands of a lower relative value and/or to protect wetlands which will be exposed to impacts of a lesser degree.

In addition to the wetland value and potential for impacts factors, a third, and more regionally oriented factor is considered. As noted in Table 4 the minimum buffer distance which can be assigned is variable depending on location of the proposed development site with respect to Pinelands land capability areas. The rationale for creating these variable buffer scales is as

Table 4. Buffer delineation index to actual buffer distance conversion table. The buffer delineation index is determined by averaging the relative wetland value index or lake/pond value index and potential for impacts index. The buffer delineation index should be rounded-off (e.g. 1.7 rounded down to 1.5; 2.3 rounded up to 2.5; etc.) and then a buffer distance assigned according to the appropriate land capability area.

Land Capability Areas	Buffer Index	Buffer Distance (ft)
Forest Areas	3.0	300
	2.5	275
	2.0	250
	1.5	225
	1.0	200
Rural Development Areas; Agricultural Production Areas and some Villages/Towns[1]	3.0	300
	2.5	250
	2.0	200
	1.5	150
	1.0	100
Regional Growth Areas and some Villages/Towns[1]	3.0	300
	2.5	240
	2.0	175
	1.5	110
	1.0	50

[1] See potential for impacts scheme (cumulative impacts section) to determine appropriate scale (i.e., Rural Development or Regional Growth) to use for Villages/Towns.

follows. On a regional basis the Preservation Area District represents a baseline exemplifying the highest environmental quality of the Pinelands. There is a regional loss or degradation of this quality and a corresponding increase in development with a progression from Forest Areas, to Rural Development Areas, to Villages and Towns, and finally to Regional Growth Areas. These regional variations in existing environmental quality and development patterns represent two of the many criteria used by the Pinelands Commission when developing the regions land use planning strategy. Coupled to this environmental gradient effect, it is assumed that there is a corresponding loss of characteristic wetland values and functions on a regional basis. However, it must be emphasized that there are wetland complexes within growth-oriented Pinelands areas which are of high quality. It seems apparent that the general/regional loss of overall wetland quality (not necessarily site-specific wetland quality) would justify the potential for some buffers to be less than 300 ft. This variable buffer provision will facilitate needs for growth in, and adjacent to, existing developed areas, as mandated by the Pinelands legislation, and in a manner which is consistent with the CMP's regional planning objectives.

It must be emphasized that the primary intent of this PROCEDURE is to maintain or enhance the existing quality of wetlands. Providing for environmentally compatible growth is an important and necessary component, and thus has been incorporated into the PROCEDURE; however, priority consideration is placed on the preservation, protection and enhancement of Pinelands wetlands.

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APPENDIX

(Office/Field Data Forms)

PRELIMINARY DATA/INFORMATION GATHERING FORM

Date: Office Work __________ Field Work ________________

Application No. ____________ Applicant's Name ________________________

Township (Municipality) ___________________ County ____________________

Block and Lot No(s). Lot Size (acres or sq ft)

__________________________ ______________________

__________________________ ______________________

__________________________ ______________________

__________________________ ______________________

__________________________ ______________________

Pinelands Land Capability Area _________________________________

Zoning ____

Site Location: USGS Topographic Map ____________________________

Soil Survey (County, Sheet, Page) __________________

Aerial Photographs ______________________________

Drainage Basin __________________________________

Brief description of the proposed development

____

____

____

Wetland type(s) adjacent to proposed development (attach copy of vegetation map)

____

____

____

SPECIAL CASE BUFFER DELINEATION GUIDELINES FORM

Application No. ____________ Applicant's Name ________________________

- If no GUIDELINES pertain to the application, then the evaluator should proceed to the LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE.

- Check the GUIDELINE(S) which pertain to the application:

  [] Preservation Area District (p. 10)[1]
  [] Resource Extraction (p. 10)
  [] On-site Domestic Wastewater Treatment (p. 11)
  [] Infill (p. 14)
  [] Cedar Swamp (p. 15)

- For the Infill GUIDELINE: Buffer Distance Assigned ________________

  Rationale (Check One):

  [] The assigned buffer is compatible with adjacent and nearby existing buffers.

  [] Adjacent and nearby existing buffers are <50 ft, and thus, the minimum assignable buffer of 50 ft was assigned.

- For the Cedar Swamp GUIDELINE (see Clarifying Condition 3, p. 15): Check the appropriate situation:

  [] The cedar swamp boundary is contiguous to the upland, and thus, the recommended buffer between the wetland-upland boundary and the proposed development is 300 ft.

  [] Another wetland type (or wetland complex) is present between the cedar swamp boundary and the wetland-upland boundary, and this other wetland type or complex is $\geq$250 ft. The cedar swamp GUIDELINE does not pertain. The evaluator should proceed to the LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE.

  [] Another wetland type (or wetland complex) is present between the cedar swamp boundary and the wetland-upland boundary, and this other wetland type or complex is <250 ft.

  Complete the following if the above box is checked:

  Delineate a buffer of 300 ft from the cedar swamp boundary toward the proposed development site. What is the buffer distance from the wetland- upland boundary to the proposed development site? ______ ft

  Proceed to the LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE and determine a buffer distance from the wetland-upland boundary to the proposed development site. ________ ft

  Assign the greater buffer from the wetland-upland boundary.

- If the buffer assigned according to a GUIDELINE does not pertain to the entire application, then proceed to the LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE in order to complete the model.

---

[1] Refer to appropriate page for detailed explanation.

LAND CAPABILITY AREAS BUFFER DELINEATION PROCEDURE FORM

Application No. ____________ Applicant's Name ________________________

____

EVALUATING RELATIVE WETLAND QUALITY (p. 17)

Check One: [] Wetland Evaluation Scheme
[] Lake/Pond Evaluation Scheme

DEFINING BOUNDARIES FOR EVALUATION (p. 18)

Wetland Site Review Area (not applicable for Lake/Pond Evaluation Scheme):

- If there are distinct wetland types adjacent to the proposed development, then designate these as separate wetland site review areas.

wetland site review area	wetland type
A	
B	
C	
D	
Other	

Wetland Area (p. 21)

Check One: [] Large scale and/or high intensity development. Circle diameter = 5 inches on a 1:24,000 scale map.

[] All other development. Circle diameter = 3.5 inches on a 1:24,000 scale map.

THREATENED AND ENDANGERED SPECIES (p. 21)

- The wetland area is known to support resident and/or breeding populations of threatened or endangered species (as designated by state and federal regulations), and, the wetland area is critical to the survival of said population(s) of threatened or endangered species:

YES __ NO __

If NO, proceed to Wetland Evaluation Scheme or Lake/Pond Evaluation Scheme
If YES, continue below

- Documentation (e.g., Pinelands Commission records, other source, or field identification/verification):

Species ______________________________

Source ______________________________

Habitat type of population ______________________________

- Assign Wetland Value Index or Lake/Pond Evaluation Index of 3.0. Proceed to Potential for Impacts Scheme. Or, if applicable, proceed to Clarifying Conditions.

- Clarifying Conditions:

1) Two distinct wetland types are adjacent to the proposed development, and the primary habitat for the threatened or endangered species is only one of these wetland types (most applicable to plant species)

YES __ NO __

If YES: Assign relative value index of 3.0 to the habitat, or wetland site review area which supports the population, and proceed to the Potential for Impacts Scheme. For other wetland type(s), which do not support threatened or endangered populations, continue to the appropriate Evaluation Scheme.

2) If Clarifying Condition (2) is applicable, provide documentation and rationale:

____

____

____

____

THE WETLAND EVALUATION SCHEME (p. 22)

Vegetation Quality (p. 22)

- Attach plant species checklist for wetland site review area(s).

	wetland site review area(s)				
	A	B	C	D	Other
SCORE =	☐	☐	☐	☐	

Existing Surface Water Quality (p. 26)

- Documentation: Data Source ______________________________

  Monitoring Station Location ______________________

  ____

  Monitoring Station Identification (if available)

  ____

- Determine Existing Surface Water Quality Score

pH = actual median value (   )

High ($\leq$ 4.5) 3
Moderate (>4.6 - <5.9) 2
Low ($\geq$ 6.0) 1

NO_3-N = actual mean value (mg/l)

High ($\leq$ 0.05) 3
Moderate (> 0.06 - <0.69) .. 2
Low ($\geq$ 0.70) 1

$$\text{SCORE} = \frac{\boxed{}_{\,pH} + \boxed{}_{\,NO_3\text{-}N}}{2} = \boxed{}$$

NOTE: If complete data set is not available, then pH or NO_3-N score can be used alone.

VEGETATION QUALITY
- Plant Species Checklist -

Table 2. Plant species characteristic of disturbed and undisturbed Pinelands sites. These lists were adapted from Ehrenfeld (1983) and Ehrenfeld and Schneider (1983).

Disturbed Sites

- [] Actaea sp. (Baneberry)
- [] Alisma subcordatum (Small Water Plantain)
- [] Allium vineale (Field Garlic)
- [] Anaphalis margaritacea (Pearly Everlasting)
- [] Arisaema triphyllum (Jack-in-the-pulpit)
- [] Athyrium filix-femina (Lady Fern)
- [] Asclepias syriaca (Common Milkweed)
- [] Aster lateriflorus (Calico Aster)
- [] Aster simplex (Panicled Aster)
- [] Berberis thunbergii (Barberry)
- [] Bidens frondosa (Beggar Ticks)
- [] Boehmeria cylindrica (False Nettle)
- [] Callitriche heterophylla (Water Starwort)
- [] Carex lurida (Sallow Sedge)
- [] Circaea quadrisculata (Enchanter's Nightshade)
- [] Convolvulus sp. (Bindweed)
- [] Cuscuta compacta (Dodder)
- [] Decodon verticillata (Water Willow)
- [] Eclipia alba (Yerba-de-tajo)
- [] Erechtites hieracifolia (Pilewort)
- [] Eupatorium perfoliatum (Boneset)
- [] Eupatorium rotundifolium (Round-leaved Boneset)
- [] Fragaria virginiana (Strawberry)
- [] Galium sp. (Bedstraw)
- [] Glyceria sp. (Manna Grass)
- [] Habenaria blephariglottis (White Fringed Orchis)
- [] Habenaria clavellata (Green Wood Orchis)
- [] Habenaria lacera (Ragged Fringed Orchis)
- [] Hypericum multilum (St. John's-wort)
- [] Impatiens biflora (Jewel-weed)
- [] Lactuca canadensis (Wild Lettuce)
- [] Lemna sp. (Duckweed)
- [] Lonicera japonica (Japanese Honeysuckle)
- [] Ludwigia palustris (Water Purslane)
- [] Lycopus amplectens (Sessile-leaved Water Horehound)
- [] Maianthemum canadense (Lily-of-the Valley)
- [] Medeola virginica (Indian Cucumber-root)
- [] Mikania scandens (Climbing Hempweed)
- [] Oxalis stricta (Upright Yellow Wood Sorrel)
- [] Onoclea sensibilis (Sensitive Fern)
- [] Panicum sp. (Panic Grass)
- [] Parthenocissus quinquefolia (Virginia Creeper)

Table 2. Continued.

[] Phragmites australis (Common Reed)
[] Phytolacca americana (Pokeweed)
[] Pilea pumila (Clearweed)
[] Polygonum sp. (Smartweed)
[] Ranunculus abortivus (Small Flowered Crowfoot)
[] Ranunculus sceleratus (Cursed Crowfoot)
[] Rhus copallina (Winged Sumac)
[] Rhus radicans (Poison Ivy)
[] Rhus vernix (Poison Sumac)
[] Rosa sp. (Rose)
[] Rubus sp. (Blackberry)
[] Salix alba (White Willow)
[] Sambucus canadensis (Common Elder)
[] Smilax sp. (Brier)
[] Solidago canadensis (Canada Goldenrod)
[] Solidago graminifolia (Grass-leaved Goldenrod)
[] Solidago rugosa (Rough-stemmed Goldenrod)
[] Sparganium androcladum (Branching Bur-reed)
[] Symplocarpus foetida (Skunk Cabbage)
[] Taraxacum officinale (Dandelion)
[] Thalictrum polygamum (Meadow rue)
[] Vitis sp. (Wild Grape)

Undisturbed Sites

[] Aralia nudicaulis (Wild Sarasparilla)
[] Arethusa bulbosa (Arethusa)
[] Aster nemoralis (Bog Aster)
[] Bartonia virginica (Yellow Bartonia)
[] Carex collinsii (Collins Sedge)
[] Carex stricta (Tussock Sedge)
[] Carex walteriana (Walters Sedge)
[] Chamaedaphne calyculata (Leatherleaf)
[] Drosera sp. (Sundew)
[] Eleocharis tuberculosa (Tubercled Spike-rush)
[] Eriophorum virginicum (Cotton Grass)
[] Gaylussacia dumosa (Dwarf Huckleberry)
[] Gaylussacia frondosa (Dangleberry)
[] Helonias bullata (Swamp-pink)
[] Juncus canadensis (Canada Rush)
[] Kalmia angustifolia (Sheep Laurel)
[] Kalmia latifolia (Mountain Laurel)
[] Leucothoe racemosa (Fetterbush)
[] Lyonia mariana (Staggerbush)
[] Myrica pensylvanica (Bayberry)
[] Orontium aquaticum (Golden Club)
[] Panicum ensifolium (Small-leaved Panic)
[] Pogonia ophioglossoides (Rose Pogonia)
[] Polygala brevifolia (Short-leaved Milkweed)
[] Pontederia cordata (Pickerelweed)
[] Rhexia mariana (Meadow Beauty)

Table 2. Continued.

[] Rhododendron viscosum (Swamp Azalea)
[] Rhynchospora alba (White Beaked-rush)
[] Rhynchospora gracilenta (Slender Beaked-rush)
[] Sarracenia purpurea (Pitcher Plant)
[] Scirpus cyperinus (Wool Grass)
[] Utricularia sp. (Bladderwort)
[] Viburnum nudum (Possum Haw)
[] Vaccinium corymbosum (Highbush Blueberry)
[] Vaccinium macrocarpon (Cranberry)
[] Viola lanceolata (Lance-leaved Violet)

- NO existing surface water quality data are available for the site. Assume high water quality (circle if appropriate).

SCORE = 3.0

- OR, provide adequate documentation to demonstrate that the surface water quality is of moderate or low relative quality.

____

____

____

SCORE = [ ]

Water Quality Maintenance Value (p. 30)

a) Hydrologic regime

If Applicable: Average width of wetland area = _____ ft

Subscore = [ ]

b) Nutrient retention/removal capacity of wetland soils

Soils of wetland area (Checklist)

Soil Series	Check if Present	Approx. % of wetland area
ATSION	[]	
BERRYLAND	[]	
POCOMOKE	[]	
MUCK	[]	
Others (list)	[]	
______________		
______________		
______________		

Subscore = [ ]

c) Nutrient retention by vegetation uptake

Wetland site review area(s)

	A	B	C	D	Other
SCORE =	☐	☐	☐	☐	

- Determine the Relative Water Quality Maintenance Score

SCORE = (Hydrologic Regime ☐ + Nutrient Ret/Rem ☐ + Vegetation Uptake (A,B,C,D, etc.) ☐ ☐ ☐ ☐) / 3

Wetland site review area(s)

	A	B	C	D	Other
SCORE =	☐	☐	☐	☐	

Wildlife Habitat Value (p. 33)

a) Vegetation Interspersion.

Describe vegetation interspersion of the wetland area

____

____

Subscore = ☐

b) Wetland size

Area of nonfragmented and contiguous wetland complex = _____ acres

Subscore = ☐

c) Surrounding Habitat

Briefly describe surrounding habitat types

____

____

Subscore = ☐

- Determine the Relative Wildlife Habitat Score

$$\text{SCORE} = \frac{\underset{\square}{\text{Vegetation Interspersion}} + \underset{\square}{\text{Size}} + \underset{\square}{\text{Surrounding Habitat}}}{3} = \square$$

Socio-cultural Values (p. 35)

Answers to questions: Recreation

Question 1 .... YES NO
Question 2 .... YES NO

Research and Education

Question 1 .... YES NO
Question 2 .... YES NO

Visual/Aesthetic

Question 1 .... YES NO

Uniqueness

Question 1 .... YES NO
Question 2 .... YES NO
Question 3 .... YES NO

SCORE = ☐

Determining an Overall Wetland Value Index (p. 36)

Vegetation	+	Water Quality	+	Water Quality Maintenance
☐ ☐ ☐ ☐		☐		☐ ☐ ☐ ☐

+ Habitat	+ Socio-cultural
☐	☐

INDEX = (Vegetation + Water Quality + Water Quality Maintenance + Habitat + Socio-cultural) / 5

wetland site review area(s)

	A	B	C	D	Other
WETLAND VALUE INDEX = $\frac{x}{5}$ =	☐	☐	☐	☐	

THE LAKE/POND EVALUATION SCHEME (p. 36)

Existing Surface Water Quality (p. 37)

- Documentation: Data Source ______________________________

  Monitoring Station Location ______________________________

  ____

  Monitoring Station Identification (if available)

  ____

- Determine Existing Surface Water Quality Score

pH = actual median value (   )

High ($\leq$ 4.5) 3
Moderate (>4.6 - <5.9) 2
Low ($\geq$ 6.0) 1

NO_3-N = actual mean value (mg/l)

High ($\leq$ 0.05) 3
Moderate (> 0.06 - <0.69) .. 2
Low ($\geq$ 0.70) 1

$$\text{SCORE} = \frac{\text{pH } \square + NO_3\text{-N } \square}{2} = \square$$

NOTE: If complete data set is not available, then pH or NO_3-N score can be used alone, and thus, do not divide by two.

- NO existing surface water quality data are available for the site. Assume high water quality (circle if appropriate).

SCORE = 3.0

- OR, provide extensive documentation to demonstrate that the surface water quality is of moderate or low relative quality.

____

____

SCORE = ☐

Shoreline Habitat Quality (p. 37)

- Briefly describe shoreline habitat

____

____

SCORE = ☐

Percent Shoreline Development (p. 37)

- Briefly describe type and relative percentage of development surrounding lake/pond shoreline

____

____

SCORE = ☐

Socio-cultural Values (p. 38)

Answers to questions:

		(Circle)	
Recreation			
	Question 1	YES	NO
	Question 2	YES	NO
Research and Education			
	Question 1	YES	NO
	Question 2	YES	NO
Visual/Aesthetic			
	Question 1	YES	NO
Uniqueness			
	Question 1	YES	NO
	Question 2	YES	NO
	Question 3	YES	NO

SCORE = ☐

Determine an Overall Lake/Pond Relative Value Index (p. 38)

$$\text{INDEX} = \frac{\text{Water Quality } \square + \text{Shoreline Habitat Quality } \square + \text{\% Shoreline Development } \square + \text{Socio-cultural } \square}{4}$$

LAKE/POND VALUE INDEX = ☐

POTENTIAL FOR IMPACTS SCHEME (p. 38)

Potential for Site-Specific Wetland Impacts (p. 38)

- Residential Development; Proposed Density = ________ units/acre of upland

- Non-residential Development; Percent of upland site proposed to be occupied by permanent development = ______ %

SCORE = ☐

- If slope factor is applicable, increase score by 0.5 units. The score cannot be increased above the maximum 3.0 units.

SCORE (with slope factor) = ☐

Potential for Cumulative Impacts on a Regional Basis (p. 40)

- Non-residential development (circle if appropriate):

SCORE = 3.0

- Residential development:

Land Capability Area ____________________

Municipal Zoning Requirements (Certified Municipalities only) (based on gross land area; upland and wetland)

____

SCORE = ☐

- Uncertified Municipalities (circle if appropriate):

  - or, provide documentation to demonstrate that cumulative impacts will be less significant

____

____

SCORE = [ ]

Significance of Watershed-wide Impacts (p. 41)

Checklist of reason(s) for assigned SCORE

Within 2 miles downstream of the proposed development site there is (are):

[] An environmentally sensitive open space/natural area.
Identify: ______________________________

[] An active cranberry area.
[] Any portion of the Preservation Area District.
[] Any portion of the Forest Area with low potential for development ($\geq$20 acres/unit).
[] Any portion of the Pinelands National Reserve with moderate potential for development (>5 - < 20 acres/unit).
[] Any portion of the Pinelands National Reserve with moderate to high potential for development (>1 - <5.0 acres/unit).
[] Any portion of the state Pinelands National Reserve with a high potential for development ($\leq$1 acre/unit).

OR,

[] Threatened or endangered wetland species within 0.5 miles downstream of the proposed development site.
[] Threatened or endangered wetlands species > 0.5 miles to 1 downstream of the proposed development site.

The wetland adjacent to the proposed development site is isolated and, a portion of the wetlands or upland immediately adjacent to the isolated wetland is,

[] An environmentally sensitive open space/natural area.
Identify: ______________________________
[] Any portion of the Preservation Area District.
[] A significant portion (>50%) is part of the Forest Area with a low potential for development ($\geq$ 20 acres/unit).
[] Above three factors do not pertain to the isolated wetland.

SCORE = [ ]

Determining a Relative Potential for Impacts Index (p. 44)

$$\text{INDEX} = \frac{\text{Site Specific } \square + \text{ Cumulative } \square + \text{ Watershed-wide } \square}{3}$$

$$\text{IMPACTS INDEX} = \frac{x}{3} = \square$$

Assigning Buffer Distances (p. 44)

WETLAND VALUE INDEX (or) LAKE/POND VALUE INDEX + POTENTIAL FOR IMPACTS INDEX

$$\text{BUFFER DELINEATION INDEX} = \frac{A\ \square\ \ B\ \square\ \ C\ \square\ \ D\ \square\ \ \text{Other} \quad + \quad \square}{2}$$

	Wetland site review area(s)			
A	B	C	D	Other

BUFFER DELINEATION INDEX = ☐ ☐ ☐ ☐

ASSIGNED BUFFER DISTANCE (refer to Buffer Index-Buffer Distance Conversion Table; Table 4, p. 45).

ft

BUFFER DISTANCE = A _____

B _____

C _____

D _____

Other _____

BUFFER DELINEATION MODEL SUMMARY FORM

Application No. ______________ Applicant's Name ____________________________

- One buffer distance is applicable to all wetlands associated with the proposed development; Buffer Distance = _____ ft

  Check aspect of model used in buffer determination:

  [] GUIDELINE Number (   )

  [] PROCEDURE

  [] Wetland Evaluation Scheme

  [] Lake/Pond Evaluation Scheme

- More than one buffer distance is applicable to the wetlands associated with the proposed development;

Wetland Section		Buffer Distance
GUIDELINE No. ( ) (_____________)		__________ ft
GUIDELINE No. ( ) (_____________)		__________ ft
LAKE/POND SCHEME		__________ ft
WETLAND;	site review area A	__________ ft
	site review area B	__________ ft
	site review area C	__________ ft
	site review area D	__________ ft
Use additional space if necessary		
______________________________		__________ ft
______________________________		__________ ft
______________________________		__________ ft

Provide a site plan which indicates the approximate location of the various buffer sections.