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The New Jersey Freshwater Wetlands Protection Act As It Relates to Stream Corridor Buffer Considerations in the State Development and Redevelopment Plan

January 11, 1988

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The Draft Preliminary
State
Development
AND
Redevelopment
Plan
January 1988

The New Jersey Freshwater Wetlands Protection Act

as it relates to Stream Corridor Buffer Considerations in the State Development and Redevelopment Guide Plan

Submitted to
New Jersey Office of State Planning

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On June 30, *1937*, Governor **Kean** signed into law the New **Jersey Freshwater Wetlands Protection Act**.

The general purpose of the Act is to create a freshwater wetlands permitting process which will lead to the delegation of the Corps of Engineers' current responsibilities for permitting in such areas. The statute parallels the Federal Permit Program with respect to most of its significant provisions, including provisions for nationwide permits, but goes beyond the federal program in that it provides for the regulation-of "transition" (i.e., buffer) areas, which can extend from 25 to 150 feet from a wetland.

Freshwater wetlands generally occur along streams and in low-lying areas. Some freshwater wetlands along the coast and major rivers are tidal. Coastal wetlands are protected by the New Jersey Coastal Resources and Development Wetlands Buffer Policy (N.J.A.C. 7:lE-3.27), which states:

> All land within 300 feet of wetlands as defined in N.J.A.C. 7:7E-3..26 and within the drainage of those wetlands comprise an area within which the need for a wetland buffer shall be determined.

The Freshwater Wetlands Protection Act requires the consolidation of wetlands-related aspects of other regulatory programs that affect activities in freshwater wetlands. Appendix A is a detailed summary of the provisions ;of the Act.

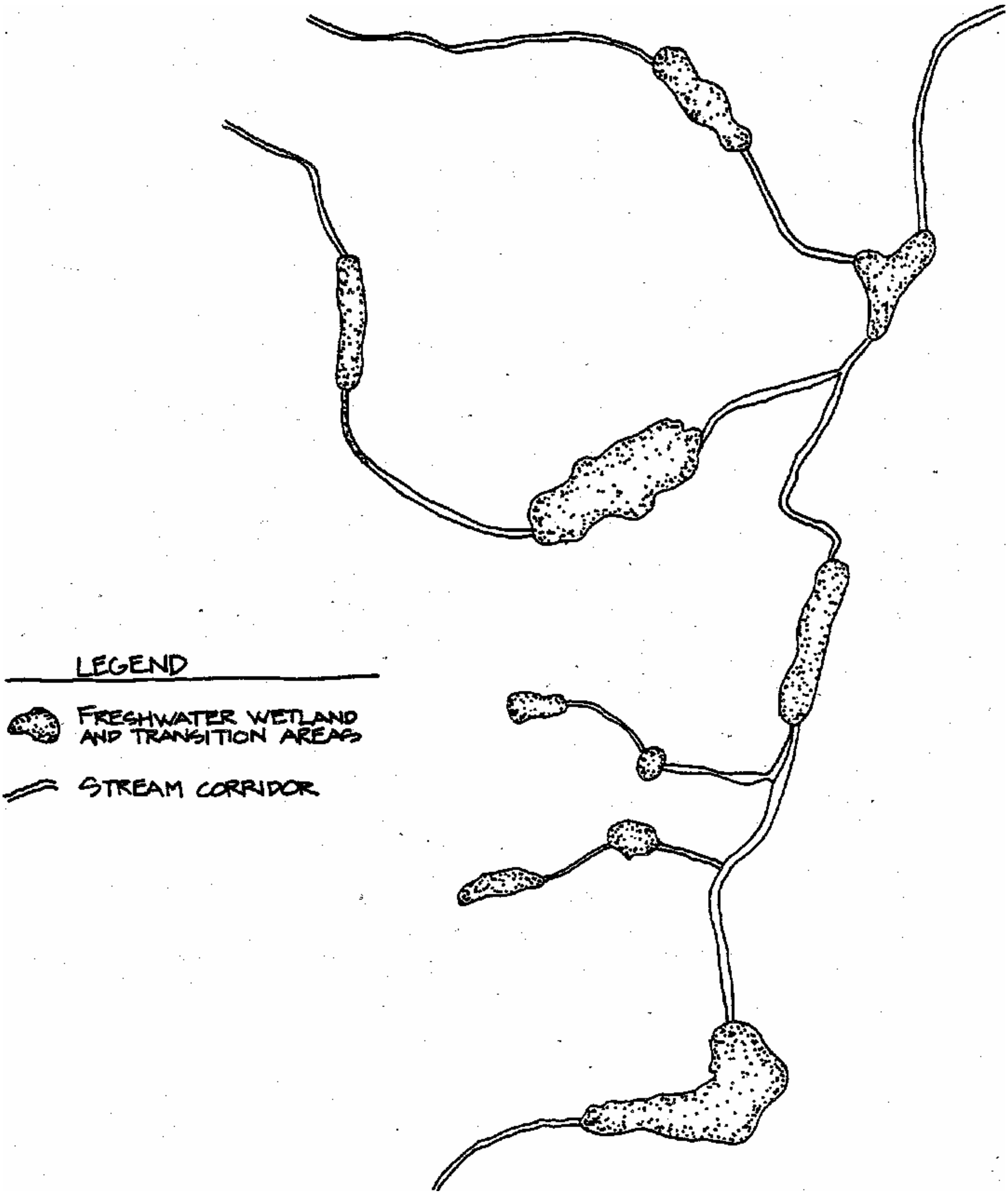
The following material describes the Freshwater Wetlands Protection Act and discusses its relative importance to the stream corridor buffer considerations in the **Hew Jersey State Development and** Redevelopment **Guide Plan** (SBRGP). The stream corridor buffer considerations in the SDRGP relate to a continuous band of soils and vegetation that occurs along the edge of streams, ponds, lakes, and wetlands. This buffer system is a management strategy that helps protect water quality by lessening human impact and disturbance to the hydrologic and ecological balance of the aquatic system. It also provides a margin of safety for developed areas through flood control.

While many streams have wetlands along their edges, some do not. From an analysis of a representative sample of national wetlands survey maps, it is estimated that approximately 47 percent of the 6,450 miles of streams in the State will not have a transition area {buffer zone) requirement for freshwater wetlands (see Appendix B). The focus of the SDRGP approach is consideration of buffer strips (Stream Corridors) along both sides of these 3,000+ miles of streams where freshwater wetland transition areas do not apply. Figure 1 provides a schematic example of this concept.

From a water supply standpoint, the majority of the State's water users rely on surface water supplies, and the trend is to favor surface water over ground water supplies in the future. The introduction of upland' runoff carrying metals, hydrocarbons, and other chemicals into surface waterbodies is a major cause for concern. Upland runoff from urban and agricultural land has been shown to significantly influence water quality in the State <NJ DEP, 1986) . Moreover, the Hater Quality Act of 1987 sets new directions for the Clean Water Act, including a new section (Section 319) that encourages states to strengthen management of water pollution from non-point sources.

As organic chemicals enter the surface waters and are treated with chlorine in the standard water purification process, new, potentially carcinogenic chemicals—chlorinated hydrocarbons—are created (NOT!EP,1982) . A sound management strategy requires consideration of the water resources throughout the entire length of stream in a watershed, and a clear understanding of the impacts from the land and the uses through which it

Figure X. Stream Corridor* and FresZnmtec



flows. Streamside soils and vegetation (particularly trees) have for centuries provided important natural functions at no cost that maintain the ecological and hydro-logical balance of the surface water system:

- Runoff and flood control;
- Sediment control;
- Streambank and streambed erosion control;
- Nutrient uptake;
- Habitat protection; and
- Groundwater recharge.

Public benefits of stream corridor conservation include the following:

- Fisheries;
- Parks;
- Ocean walkways;
- Picnic groves;
- Bikeways;
- Natural trails;
- Canoeing;
- Scenic and aesthetic amenities;
- Historic settings for homes and water-dependent uses; and
- Wildlife habitats for most species, including many threatened and endangered species.

Rivers and streams are some of the most valuable resources in New Jersey. Mismanagement can create flooding and water supply hazards, as well as loss of important aesthetic and recreational resources which help define the State's quality of life.

The Freshwater Wetlands Protection Act recognizes that freshwater wetlands provide certain natural functions whose protection is in the public interest. These functions include the following:

- Protect and preserve drinking water supplies by serving to purify surface water and ground water resources.

- Provide a natural means of flood and storm damage protection, and thereby prevent the loss of life and property through the absorption and storage of water during high runoff periods and the reduction of flood crests.

- Serve as transition zones between dry uplands and water courses, thereby retarding soil erosion.

- Provide essential breeding, spawning, nesting, and wintering habitats for a major portion of the State's fish and wildlife including migrating birds, endangered species, and commercially and recreationally important wildlife.

- Maintain a critical baseflow to the surface waters through the gradual release of stored floodwaters and groundwater, particularly through drought periods.

A total of 915,960 acres of wetlands were inventoried by the National Wetlands Survey (U.S. Fish and Wildlife Service, 1984) in New Jersey (see Figure 2). Freshwater wetlands represented 67 percent of these. This amounts to approximately 613,531 acres of freshwater wetlands currently identified in the State. Figure 3 shows the distribution of steam-related wetlands for each of the counties in New Jersey by type (Tiner, 1985).

NATIONAL WETLANDS INVENTORY

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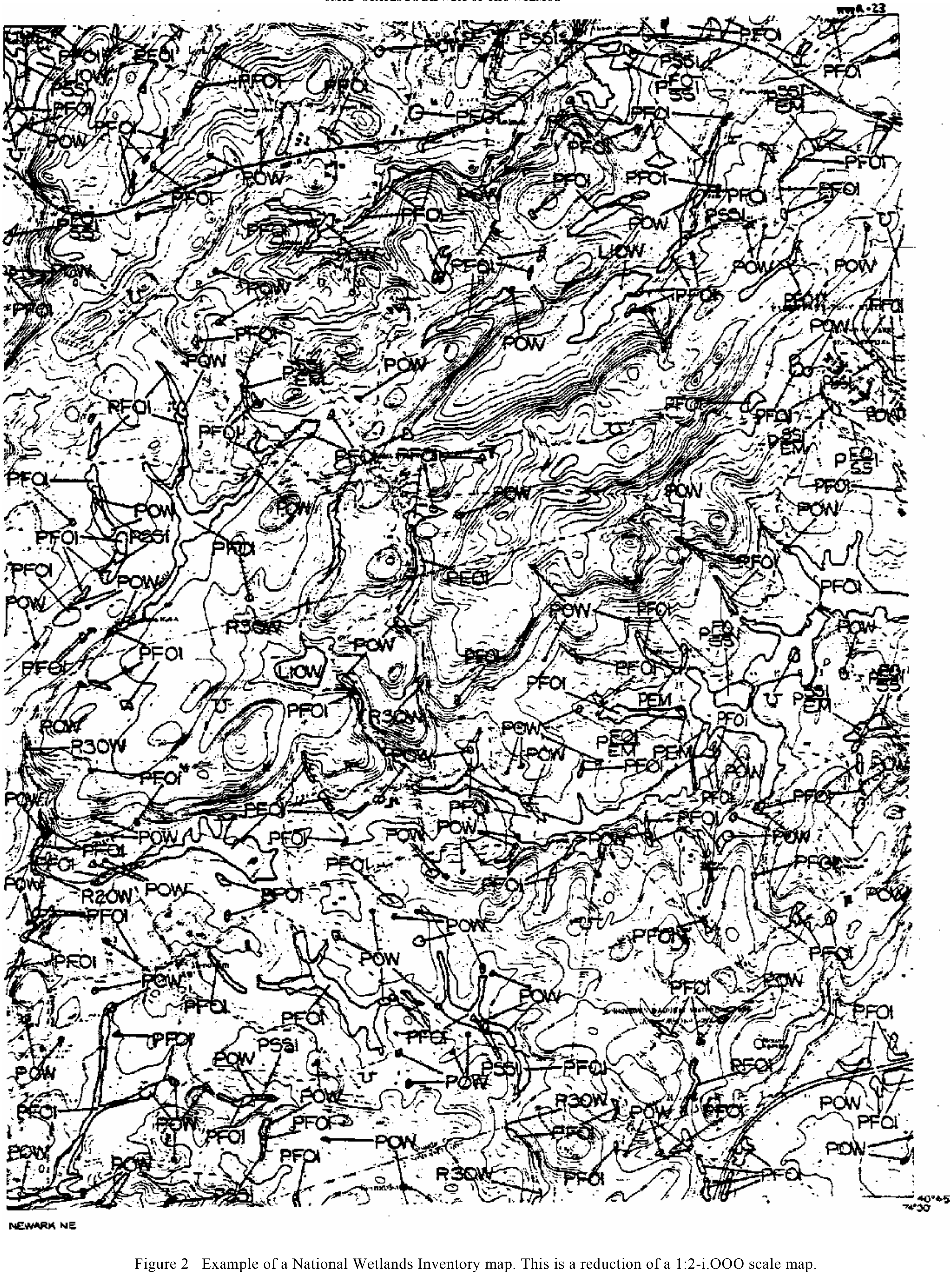

Figure 2 Example of a National Wetlands Inventory map. This is a reduction of a 1:2-i.OOO scale map.

The Freshwater Wetland Protection Act requires DEP to develop a system for the classification of freshwater wetlands into categories of "exceptional," "intermediate," and "ordinary" value. These classifications become significant in applying the transition area requirements. —

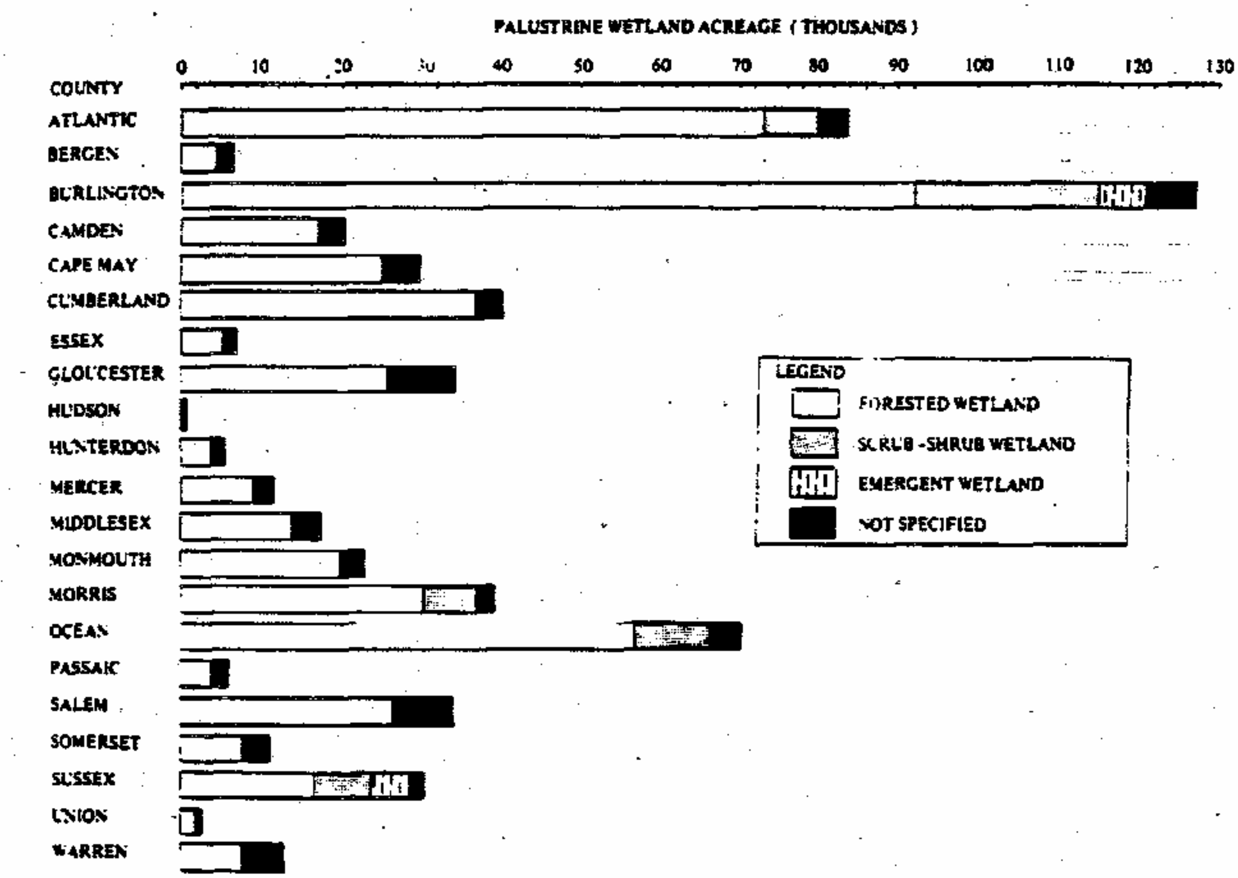

Figure 3 Relative distribution of palustrine wetlands in New Jersey, (Tiner, 1985)

- Wetlands of **exceptional** resource value discharge into FW-1 waters and FW-2 Trout Production waters and their tributaries (the highest-quality water classifications in the State's system), or constitute present or documented habitat for threatened or endangered species. (The data that DEP has on threatened and endangered species are not complete and not necessarily site-specific. This may cause some difficulty in conclusions with respect to individual properties, nevertheless, we can expect DEP to be aggressive in characterizing areas as threatened or endangered species habitat.)

- Wetlands of **ordinary** value include certain isolated wetlands, man-made drainage ditches, swales, and detention facilities.

- Wetlands of **intermediate** resource value are all other wetlands.

The Act also calls for transition areas or buffers. There is a 150-foot buffer from freshwater wetlands of exceptional resource value, a 50-foot buffer for freshwater wetlands of intermediate resource value and no specific buffer set forth for wetlands of ordinary value, although there is an implication that there need be no buffer around these wetlands.

The width of these transition areas has specified ranges: 150-75 feet for wetlands of exceptional resource value, and 50-25 feet for wetlands of intermediate resource value. The decision on actual width of the transition is the responsibility of the Department of Environmental Protection.

These buffers can be reduced through a transition averaging plan, and there may be reductions if an applicant can show no substantial adverse impact on adjacent freshwater wetlands or substantial hardship caused by circumstances peculiar to the property. The transition area requirement is not limited to a single property in question. An applicant must identify wetlands 'that may be adjacent to his or her property in order to determine if there is a transition area requirement.

Under the Act, almost any conceivable activity in a freshwater wetland that would alter its character—including all of the following:

- o Removal, excavation or disturbance of soil,
- o Drainage or disturbance of the water level or water table,
- o Placement of fill,
- o Driving of pilings (an activity authorized by a national permit under the federal program), and o Destruction of plant life, including the cutting of trees—

The same types of activities are controlled in the transition areas. However, they are somewhat more limited:

- o Removal, excavation or disturbance of the soil,
- o Dumping or filling any materials,
- o Erection of structures, except for temporary structures of a certain size,
- o Placement of pavement, and o Destruction of plant life that would alter the existing pattern of vegetation.•

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In the context of the New Jersey Freshwater Wetlands Protection Act, the words transition area refer to an ecotone that borders two distinct biological communities—dry uplands and wet lowlands. Ecotone3 often share the characteristics of* both communities, as they blend together. As a result, they have an unusually high abundance and diversity of life. These transition areas are themselves a vital source of food, cover,, resting, and nesting sites for wildlife, as well as important migratory corridors for local and also regional wildlife populations (Odum, 1979) .

Transition areas also exhibit a great variety of soils, terrain and hydrology. For centuries they have helped maintain the hydrological and ecological balance of water edge communities. Left .undisturbed, transition areas provide important natural functions that help maintain the natural balance of the hydrological and ecological systems.

While important in themselves to health and safety and the quality of the environment, transition areas also create a buffer strip that lessens human impacts and disturbances to aquatic systems (Thurow et al., 1975) . The soils and vegetation (particularly trees) in transition areas provide important natural functions which protect the natural quality of the water and the habitats of wildlife. Upland drainage from adjacent land uses is detained, infiltrated, filtered, or absorbed by the soil and vegetation.

These buffer strips also provide a margin of safety for developed areas through their natural flood control function. Vegetation in these transition areas helps to stabilize soil and streambanks, reduces scouring within the floodway, and provides important shade to maintain water temperature. Riparian vegetation also provides food and shelter to many species of terrestrial and aquatic wildlife, including the majority of threatened and endangered species.

Many transition areas are too wet, steep, rocky, or shallow in soil to be easily cultivated or developed. Still, farming and construction of new buildings and high runoff potential areas along the water's edge occur in some areas. Where they are present, these activities cause unnaturally high loading of sediment, nutrients, chemicals and bacteria into wetlands and surface waters. At the same time, these activities destroy the riparian vegetation that has played a critical role in the ecological and hydrological balance of the watershed. The functional roles that transition areas play in protecting the natural integrity of aquatic systems are discussed in detail in Appendix C.

Under the Freshwater Wetlands Protection Act, transition areas are only recognized where there is a freshwater wetland along the stream. From an analysis of a representative sample of National Wetlands Survey Maps, it is estimated that approximately 52 percent of the streams in the State will have transition areas: approximately 50 percent will have 50-foot transition areas, and *2* percent will have 150-foot transition areas.

Due to physiographic differences/ the percentages will differ by ^region. {see Table 1). The Outer Coastal Plain areas have the highest percentage (92%) of stream length with transition areas. The Piedmont and Ridge and Valley have the least: both have transition areas along less than 40 percent of their streams. (These estimates did not consider threatened and endangered species as part of the 150-foot transition area due to the lack of geographically specific data on a uniform basis; therefore the 150-foot transition area estimates are likely to be low.) Figure 3 is a map showing the location of the National Wetland Inventory 7.5 minute quadrangle sheets used in the sample presented in Table 1.

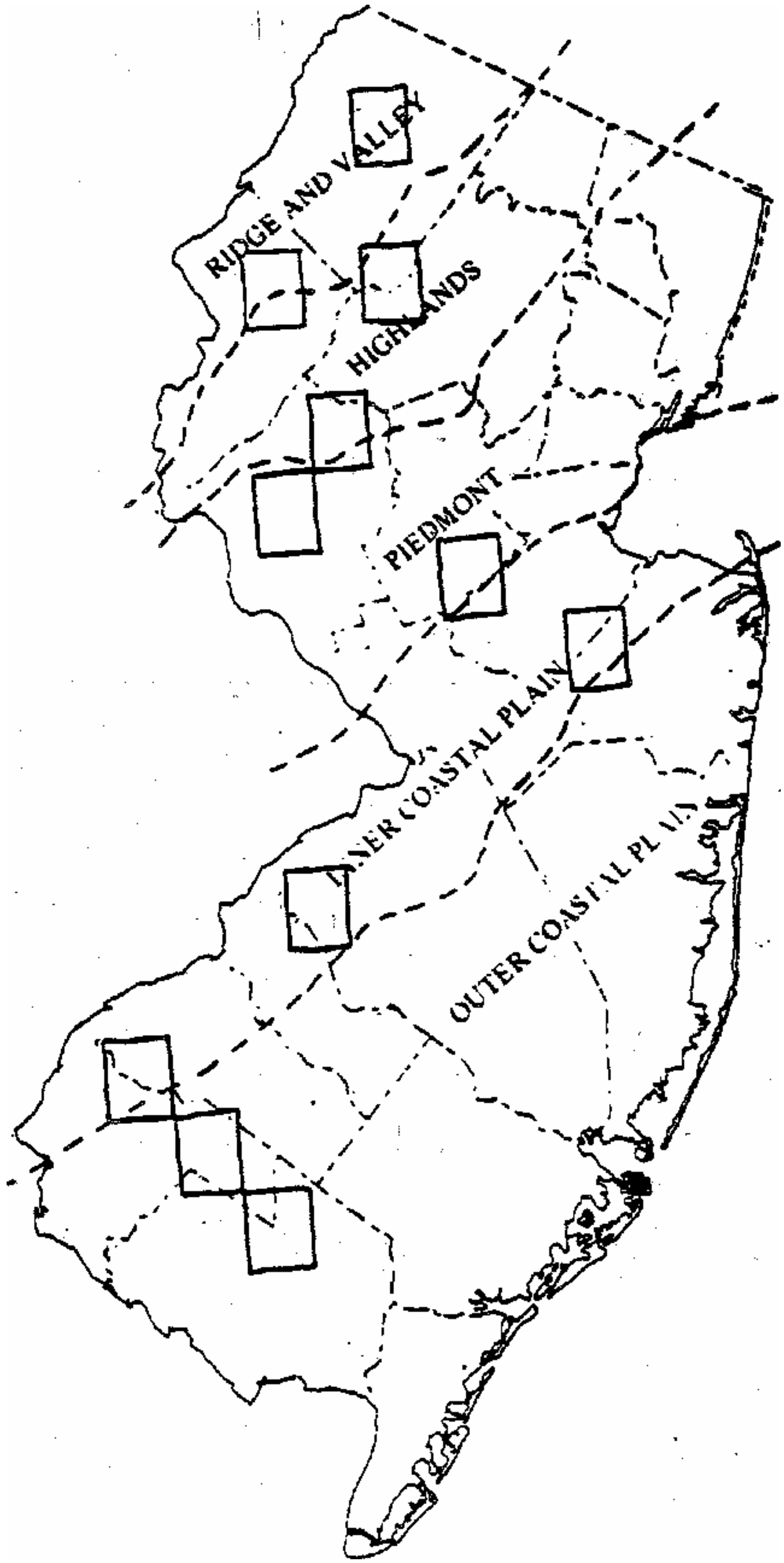
TABLE 1. Length of Stri !•» (in ailea) With Buffers under the W.J. Freshwater Protection Act

	No Bufftr	5* foot Buffer	150 foot Sufftr	Ordinary VttUntf Acrti
Ridtt & Villiy				
US6S QutdrtngU ShMt				
Brtnchvilll	**77.991**	18.811		**83.H**
SUifitoin	**38.681**	61.321		235, H
TOTAL	61.671	**36.451**		
			3.2IV	
			I.HI	
			1.881	
Highlands				
US6S Quadringli ShMt				
High 8ndg*	**58. WI**	**21.671**	7.241	**Ml**
SUnhopc	**2IISS**	**74.55S**	1.4H	W M
TOTAL	**52.481**	12.361	5.171	
Pitdiont				
US6S Quadringlf ShMt				
Homouth Junction	**54.311**	**45.7«**	**• .Ml 4**	**4.H**
PittitMn	68.111	27.411	**511**	**I.M**
TOTAL	**61.781**	35.761	**2.461**	
Inntr CotiUl PUin				
Frfthold	47.221	52.781	1 Ml	36.75
Koorcstawn	43.531	56.471	• Ml	8.31
Uoeditotn	26.491	73.511	1 .8M	42 M
TOTAL	**41631**	59.371	**Ml**	
QuUr CouUl **Plain**				
	1891	**99.111**	**• Ml**	**6:59**
mn vi iu	18.271	**81.731**	**I Ml**	132.75
TOTAL	**8 641**	91.961	**• Ml**	
STATEWIDE PERCENTA6E BASED ON SARPLE	47.541	56.691	1.761	

FIGURE 3. Location* of national Wetland Xnvt

7.5 *miaxstm* Quadrangle Sheeta Used in Bepreaentatiye

(Table 1)



STREAM CORRIDORS

A stream corridor is a stream with continuous buffers extending on each side from the stream origin in the uplands, down to its mouth, where the stream connects with another body of water. The buffer should be wide enough to provide for water quality and flood protection to the extent possible, as well as provide for appropriate activities' in the corridor' (i.e. recreation and wildlife habitat). -•--.-.,_.-

Stream corridor management places primary emphasis on water quality protection and enhancement (through the control of non-point sources of pollution, such as erosion and sedimentation), and on protection of natural and cultural resources in the stream corridor. Floodplain management, which places emphasis on the protection of people and structures from flood hazards, also is part of stream corridor management. With proper management, a stream corridor can serve as a buffer zone to filter sediment and pollution produced by urbanization and other land uses such as agriculture and timber harvesting. It can also provide a margin of safety for adjacent populations from flood and erosion hazards.

Most buffer zones developed to date are based on water quality considerations. The width of these zones has been the point of contention. With the initiative of the President's Council on Outdoor Recreation, the emphasis on multiuse greenways is increasing .

Many states have set a minimum buffer zone width. Most have incorporated provisions to increase the widths depending on the density and type of land use (Table 2). In Maryland, a 100-foot buffer zone is required in all tidal portions of the Chesapeake Bay and its tributaries. No disturbance is allowed in the buffer, and landowners are required to allow these buffers to regenerate woodlands (COMAR 14.15 .01). California requires a 100-foot buffer to maintain stream water quality (Erman et al., 1977; Zedler 1984). North Carolina currently requires 75 feet and is proposing 200 feet (La Prade, 1985). New Hampshire provides for a 75-foot buffer in coastal areas, but makes no allowance for buffers in freshwater

Tafi£B 2. State Provisions

Regarding Buffer Width,

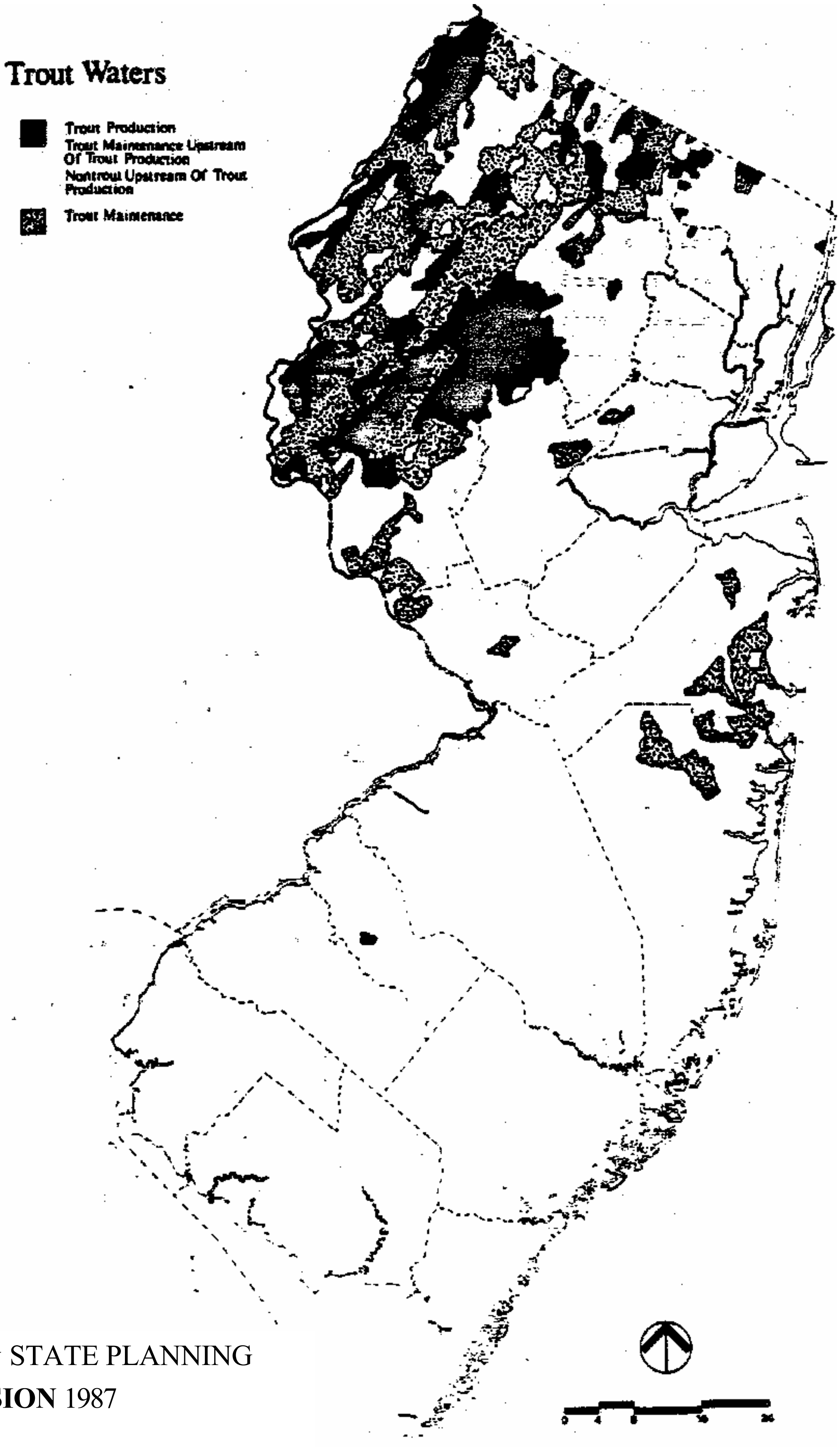
Water Resource	Buffer Width	
Reservoirs		
Connecticut	250 feet	Measured from high waters.
Hackensack Watershed Study	250-500 feet	
Lakes		
Maine	250 feet (Fixed)	
Wisconsin	1000 feet	
Streams		
Maine	75 feet (Fixed)	
Maryland	100 feet (Fixed)	
California	100 feet minimum	Coastal areas. Other considerations can increase width.
New Jersey	25 & 50 feet (Fixed)	Trout-associated waters are 50 feet.
Wisconsin	300 feet	
North Carolina	75 feet (200 feet proposed)	
Wetlands		
Massachusetts	100 feet (Fixed)	Development strictly regulated.
California	100 feet minimum	Coastal areas. Other considerations can increase width required.
NJ Pinelands	50-300 feet	Evaluation system. Majority are greater than 200 feet from wetland boundary.
NJ Freshwater Wetlands	25-150-feet	

areas (N.H. Code of Administration Rules) . Clark (1977) has suggested a 150-foot minimum buffer in Maine to filter agricultural runoff. States that require guidelines to modify buffer widths include Maine (38 M.R.S.A. Chapter 375, Article 9a) and Vermont (DWREE, 1982).

New Jersey already has recognized the need for vegetated buffers. The State has developed regulations for vegetated buffers that aid in food, cover, sediment reduction, streambank erosion, and stream temperature protection along trout maintenance and production streams (NJ PEP, 1983; Flood Hazard Regulations, K.J.A.C., 7:13.). These stream encroachment regulations protect a 50-foot strip of streamside vegetation in trout-associated waters, and a 25-foot strip for all other streams. Figure 4 shows the extent of trout-associated waters in New Jersey.

Other regulations on buffer zones include Coastal Resource and Development (N.J.A.C. 7:7E), the Delaware and Raritan Canal Commission's regulations (N.J.A.C. 7:45), and the Pineland3 guidance (Roman and Good, 1985).

Trout Waters



New Jersey STATE PLANNING **COMMISSION** 1987

Figure 15

STREAM CORRIDOR BUFFER KOBE RBCOMOamBXXOHS

The conclusions of the discussions between the Office of State Planning and the New Jersey Department of Environmental Protection were that stream buffers are both important and desirable. The usefulness of a vegetated corridor along streams applies to many water resource issues, as well as wildlife, recreation, and aesthetic considerations. The buffer's primary role is to maintain the ecologic and hydrologic balance in the stream.

Mapping Different. Stream ~~Types~~ " •

Streams are divided into different types—perennial and intermittent. **Perennial** streams flow year-round from their source to their mouth. streams only flow during storms or in certain seasons. They are dry a large part of the year. Both are important to the protection of the ecological and[1] hydrological balance of the stream system. The stream corridor recommendations should consider all streams mapped on both the USGS 7.5 minute topographic map quadrangles and the soil survey maps published by the USDA Soil Conservation Service. This is an important distinction. NJ DSP Division of Hater Resources, Bureau of Planning and Standards studied the following types of streams:

- o All stream segments mapped as perennial on USGS quadrangles (and as perennial or intermittent on SCS soil survey maps) ; and
- o All stream segments mapped on SCS soil survey maps (nearly always as intermittent), but not mapped on USGS quadrangles.

The results, expressed as total stream length in miles, were as follows:

	Mapped by Both USGS and SCa	Mapped Only , by SCS
Tewksbury	62	41
Feapack-Gladstone	14	8

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These results indicate that the inclusion of intermittent stream segments that are mapped on SCS soil surveys, but not mapped on OSGS quadrangles, will substantially alter the geographic scope of a stream corridor protection program.

During high flow conditions, sediment, nutrients and other pollutants can readily be transported from intermittent streams into the perennial stream network. In terms of water resources and aquatic habitat, intermittent streams are less critical, in some respects, than perennial streams. Intermittent streams are less important than perennial streams in terms of fish cover, aquatic food supply, and shade for water temperature control. A well-vegetated cover of grass, shrubs, and trees along intermittent streams will help control non-point pollution. The application of fertilizers and pesticides should be prohibited in these areas. Wooded cover is still preferred.

The real mapping problem* is to determine the difference between the headwaters and small swales and drainage ditches. Headwaters are first and second order perennial streams, usually less than. one meter wide. 'In shaded headwaters, the base of the aquatic food chain is the leaf litter and other forms of terrestrial detritus from off-stream areas. These materials and the organisms in the headwaters are major sources and processors of food for the entire stream. A clear definition of where headwater streams begin is an important mapping step in the delineation of stream corridor buffers.

Buffer Definition

There are two principal ways of defining buffers: the boundary may be set as a fixed-distance from the stream banks; or the boundary may vary, or float, depending on specific natural or man-made features adjacent to the waterway. Fixed buffer widths have varied from 25 to 300 feet (Thurow et al., 1975). From a review of the literature, widths needed to sustain vital buffer functions are shown on Table 3. The width-of the floating buffer depends on the sensitivity of the segment of the stream and the presence of wetlands, steep-sloped terrain, mature woodland habitat, poorly drained

TABLE 3. Buffer Widths Necessary to

••••»•*«••« Baaenfrial Stream Functions

Function	Width * (feet)
Streambank stabilization	.25- 50
Sediment control	65-150
Nutrient removal	65-150
Food energy	25- 50
Temperature control	50- 80
Fish cover	25- 50
Wildlife habitat	100-330

These widths are interpretations baaed on a review of current literature cited in Appendix C.

soils, scenic features, or other factors of local significance. An example of a floating buffer system currently in use in New Jersey is the Buffer Delineation Model of the New Jersey Pinelands Wetlands (Roman and Good, 1985).

The main advantage of the fixed-distance buffer is the ease of administration. A fixed buffer, however, cannot control development activities on sensitive **areas** outside the set distance. On the other hand, variable-width approaches to buffers require extensive investigations and evaluation. Buffer widths will often be based on the land use context. For conservation and management purposes, a stream corridor may be classified according to its relationship to land use as reflected in one of the following three categories:

- o Urban Stream Corridor,
- o Suburban Stream Corridor, and
- o Rural Stream Corridor.

Stream Corridor. Urban stream corridors are stream, river, or waterfront areas characterized by hard surface paving, complex storm drainage systems, and land uses related to commerce and industry. The overriding concern of urban stream corridor management is to take advantage of the opportunities that the stream corridor may provide—in: terms" of enhancing the "livability" of the urban environment. Urban stream corridor management expresses itself through greenway or park development. The stream corridor may also provide the focal point from which to target urban redevelopment or restoration and historic preservation efforts. Urban stream corridors are usually near navigable waters, which necessitates consideration to water-dependent uses.{NY DEC, 1986).

Buffer widths in urban areas should be at least 50 feet where possible. The buffer should be vegetated up to the stream's high water, mark. Trees should be allowed to grow or be planted along the waters edge. In the Maryland Critical Area Program, tree planting in the buffer is required even in the City of Baltimore. The emphasis is to plant as much vegetation in the buffer as possible to maximize on the natural processes available. The use of chemicals and nutrients should be restricted in the buffer.

Suburban Stream Corridor. These areas are characterized by a combination of soft ground cover, some surface paving, storm drainage along with natural drainage, and a wide range of land uses including residential, commercial, and industrial development. A suburban stream management strategy should capitalize on the opportunities afforded by the establishment of a greenway to serve as a filtering and buffering mechanism for protecting and enhancing water quality. Consideration should be given also, to preserving historic and cultural values along the corridor (NY DEC, 1986). Buffer widths in suburban areas should range from a minimum of 65 feet to 150 feet.

Rural Strom Corridor. Cultivated land and natural vegetation with little to no hard paving typify this category. Farming and recreation are the prevalent uses, with occasional mining or logging. The primary emphasis for management in these areas should be for the preservation of open space values and protection of water quality from agricultural" runoff(NY DEC,1986). Buffers in these areas should be from 65 feet to 300 feet.

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Based on the scientific studies noted in Appendix C and on the approaches taken in other states and regions (Table 1), it is recommended that New Jersey maintain a minimum width of 65 feet from all streams.

Additional considerations to expand the buffer should be based on the potential hazards and resource use of the area, as noted below.

Areas of Flooding	Areas should be sufficiently wide to include the 100-year floodplain.
Steep Slope	On reaches of a stream with slopes greater than 10%, consider extending the buffer beyond the top of the slope.
Sediment Control	Where disturbance is occurring near the stream, a buffer of at least 65 feet and up to 150 feet should be considered.
Nutrient Removal	Where major sources of nutrient are proposed, a distance of at least €5 to 150 feet should be considered.

Habitat (Aquatic)	A setback of wooded vegetation should be at least 50-80 feet.
Habitat (Terrestrial)	For deer wintering areas and wildlife corridors, a setback of wooded vegetation of 100 to 300 feet should be considered.

Additional features, including recreation trails and historic and cultural sites could be included at the county or local' level. It should be emphasized that vegetative buffers are not a substitute for detention or retention basins or other sediment or runoff control measures. Vegetated buffers serve many important functions and act as a safeguard to activities that induce non-point source pollution.

The fraction of the watershed contained in stream corridors of various widths is illustrated in Table 4, which is based on a case study performed by the Division of Water Resources in Tewksbury Township, Somerset County.

T&BLE 4. Fractions of a Watershed Contained in Stream Corridors of Various Widths

Stream Corridor Width (feet)	Fraction of a watershed in stream corridor (Percent)
50	6
100	12
150	18
200	23
300	34

Source: KIDKP, 1980.

APPEBDXX A.

litlHIII OF THE MBIT JKKSCI

FRESHRAZER WETLAHDS PROTECTIO* ACT

Z. General

EFFECTIVE DATE: The Act takes effect July 1, 1988, except that certain interim functions such as establishment of rules and regulations would take place prior to the effective date. The buffer provisions (called "Transitions Areas") will be effective July 1, 1989.

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DEADLINES FOR VARIOUS DEP ACTIONS: DEP is required to promulgate implementing regulations by May 1, 1988, and to adopt a list of wetlands vegetative species by July 1, 1988. National Wetlands Inventory Maps (NWI) are to' be distributed to municipal clerks by January 1, 1988. The NWI Maps, which were prepared several years ago, are indicative of the presence of wetlands, but not conclusive. The Act does require the Department to develop a functional mapping and inventory system, but it places no deadline for its preparation. DEP is required to apply to US EPA for assumption of the Federal Permitting Program by July 1, 1988.

GRANDFATHER CLAUSE: (a.) Any projects that have received- preliminary site plan or subdivision approval prior to the effective date (June 30, 1988). (b.) all preliminary site plan or subdivision applications that were submitted prior to June 8, 1987, or (c.) all projects having permit applications approved by the Army Corps of Engineers prior to the effective date are only subject to the jurisdiction of the Army Corps of Engineers. There is some question as to what is meant by "permit applications" approved by the US. Army Corps of Engineers, since a Nationwide Permit may not be considered a "permit application". If an Army Corps of Engineers permit issued prior to the effective date of this legislation must be renewed, no transition area can be required. There is also a question whether (a.) and (b.) are conjunctive; must an application be submitted by June 8 and preliminary approval obtained by the effective date or does either situation grandfather the development.

GEOOGRAPHICAL EXCLUSIONS: Activities in areas under the jurisdiction of the Hackensack Meadowlands Development Commission, the Pinelands Commission or the Coastal Wetlands Act are exempt from regulation under this Act, but are still subject to the federal law or any delegated federal program for discharge of dredged or fill material. The Pinelands Commission is also allowed to enact more stringent regulations. _,_.

IX. Wetlands

WETLANDS DELINEATIONS: The Bill specifically provides for use of the three-parameter approach (hydrology, soils and vegetation), however, it references an April 1, 1.987 interim-final draft manual developed by the United States Environmental Protection -Agency. The generally recognized document in this are is the January 1987-manual developed by the Corps of Engineers.

EXEMPTIONS: Generally farming and harvesting of forest products are exempt except if there is a discharge of dredged or filled material into a freshwater wetlands and provided that such activities are not intended to bring an area of freshwater wetlands into a use to which it was not previously subject (i.e., to a non-agricultural use). The farming exemption parallels the requirements of the federal program.

REGULATED ACTIVITIES: Under the Army Corps of Engineers permit program only deposits of dredged or filled materials in freshwater wetlands are regulated. Under this Act almost any conceivable activity in a freshwater wetland, including the removal, excavation or disturbance .of soil, the drainage or disturbance of the water level or water table, the placement of fill, the driving of pilings (this is an activity which is authorized by a Nationwide Permit under the Federal Program) and the destruction of plant life, including the cutting of trees, which would alter the character of a wetland.

CLASSIFICATION OF WETLANDS: The Act requires DEP to develop a system for the classification of wetlands into categories of "exceptional"> "intermediate* and "ordinary" resource value. These classifications become significant in applying the transition area requirements which are described below. Wetlands of exceptional resource value are those which discharge into FW-1 waters and FW-2 Trout Production Waters and their tributaries <these are the highest water quality classifications in the State's system) or those which constitute present or documented habitats for threatened or endangered species. The data on threatened and endangered species which DEP has is not complete an is not necessarily site specific. This may cause difficulty in making conclusions with respect to a particular property. Nevertheless, we expect DEP to be aggressive in characterizing areas as threatened or endangered species habitat.

Wetlands of ordinary value include certain isolated wetlands, man-made drainage-ditches, swales or detention facilities. Wetlands of intermediate resource value shall be all other wetlands.

III. Transition Areas (Buffers)

TRANSITION AREAS (Buffers): There is a 75 to 150 foot buffer from freshwater wetlands of "exceptional resource value" a 25 to 50 foot buffer for freshwater wetlands of "intermediate resource value[1]* and no specific buffer set forth for wetlands of "ordinary resource value", although there is an implication that there would be no buffer around these wetlands. These buffers can be reduced through a transition averaging plan and there may be reductions in the transition area if an applicant can show no substantial adverse impact on adjacent freshwater wetlands or a substantial hardship caused by circumstances peculiar to the property.

The transition area requirement is not limited to transition areas which are adjacent to wetlands on an applicant's property. Accordingly, an applicant is going to have to identify wetlands which may be adjacent to his or her property in order to determine if there is a transition area requirement. ,

ACTIVITIES PROHIBITED IN BUFFERS EXCEPT WITH TRANSITION AREA WAIVER: The same types of activities as are controlled in freshwater wetlands are also controlled in the transition area, but are limited to removal, excavation or disturbance of soil, dumping or filling any materials, erection of structures except for temporary structures of a certain size, placement of pavement, and destruction of plant life which would alter the existing pattern of vegetation.

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TRANSITION AREA WAIVERS: A waiver of the transition area from the maximum distance to the minimum distance may be granted if the development would have no substantial impact on the adjacent wetlands or the waiver is necessary to avoid a substantial hardship caused by circumstances peculiar to the property. In the case of storm water management facilities having no feasible alternative on-site location or linear development a further waiver below the minimum or elimination of the transition area may be granted. The linear development and stormwater management facilities must have no feasible alternative locations. The transition area waiver is to be acted on within 90 days of submission of a complete application, except if this waiver request in which case the time frames within the permit section are applicable.

IV. Permitting

PROCEDURES FOR OBTAINING WETLANDS PERMITS: This is probably the weakest part of t*** Bill, since it is not under the 90 day law, which means if DEP does not make a decision within the statutory time frame there is no automatic approval of an application. The United States Environmental Protection Agency has the right to comment on all applications for individual permits. Decisions must be made on permit applications within 90 days of receipt of comments from EPA or within ISO days of submission of a complete application, whichever is later.

JURISDICTIONAL DETERMINATIONS: These are issued through letters of interpretation. If no additional information is required, a letter of interpretation should be issued within 30 days after receipt of an application. If additional information is required the letter of interpretation should be issued 45 days after receipt of the additional information. On-site delineations and verification by DEF may be required. If DEP must make an on-site inspection, the time limitation for issuance of a letter of interpretation is extended by 45 days. There is a specific provision which states that if no response is forthcoming within the time limitation the applicant cannot assume that the site is not 'a freshwater wetlands. A letter of interpretation can be relied on, however, by the applicant subject to review, modification, or revocation by EPA.

WETLANDS PERMIT APPLICATIONS: There is a provision for wetlands permit applications, but the procedural and substantively requirements are so onerous that it is doubtful that many wetlands permits will be issued. For instance, in addition to notifying all persons within 200 feet you must notify all persons who requested to be notified of proposed regulated activities, no matter where those persons are located. In order to issue a permit the activity must be water-dependent or require access to freshwater wetlands or would have less of an impact on freshwater wetlands. For housing, there is almost always a practicable alternative on a non-wetlands site in the region. In fact, there is a rebuttable presumption that there is a

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practicable alternative to any non water-dependent activity. Even if a wetlands permit is granted, DEP may require mitigation by restoration of wetlands, etc.

MITIGATION: The Act directs the Department to require appropriate measures to mitigate "adverse environmental impacts in cases in which it does approve a permit. DEP is specifically authorized, at its discretion, to require wetlands creation or restoration of an area of "equal ecological value" to those which will be lost.

WETLANDS MITIGATION BANK: in cases where the restoration of wetlands on or off site is not feasible, DEP may issue a permit conditioned on a contribution to a "Wetlands Mitigation bank" equivalent to the cost of purchasing and restoring an existing degraded wetland or creating a new wetland, whichever is less. A Permittee may also donate land as part of its contribution if it is determined that the donated land has potential to be a valuable component of a wetlands ecosystem. Donation of land,* .however, will only be allowed after determining that all other mitigation alternatives are not practicable or feasible.

IMPACT OF FRESHWATER WETLANDS PERMIT DENIAL: The local, tax assessor must take this fact into account when property is valued, assessed and taxed upon request by the owner.

APPEALS: An appeal is provided for denial of an application for a freshwater wetlands permit. There is no specific appeal provision for an adverse letter of interpretation on a delineation, denial of a transition area waiver, etc.

VIOLATIONS AND PENALTIES: The violations section is extremely stringent and gives the Commissioner tremendous powers, including recommending a criminal action for a fourth degree crime. The penalties are $10,000 per day. If the Attorney General brings an action the penalties are not less than $2,500 nor more than $25,000 per day for the second offense. If an administrative order, court order, or civil administrative assessment is not adhered to, a civil penalty action can be brought for $10,000 a day for each violation.

RIGHT OF ENTRY: DEP may enter any property to conduct an inspection.

AFTER THE FACT PERMITS: The Act authorizes the issuance of after the fact permits if DEP determines that the restoration of a site to its pre-violation condition would increase the harm to the wetland or its ecology. After the fact permits would only be issued if violators are assessed for costs, damages and mitigation requirements are imposed.

NATIONWIDE PERMITS: The Act authorizes DEF to consider for adoption all Nation wide Permits which have been issued by the Corps of Engineers and are still outstanding. The most significant of these is the "One Acre" general permit. The« Act specifically requires the Department to issue a general permit for activities in isolated wetlands, in wetlands above a headwater (i.e., where there is an average annual flow of less than 5 cubic feet per second) and in swales and man-made drainage ditches when the activity will involve the loss or substantial modification of not more than one acre of wetland. This rule will not apply in a wetland of exceptional resource value.

Other general permits which the Act directs DSP to issue are for the following activities, if. the Department can determine that they will cause only minimal adverse environmental impacts when considered separately or cumulatively: road or public utility repairs and maintenance; maintenance of active irrigation or drainage ditches; improvements or additions to residential dwellings which existed prior to the effective date of the Act that require less than 750 square feet of fill and do not alter the wetland area outside of the fill area; mosquito management activities; activities which DEP determines will have "no significant adverse environmental impact" on wetlands and have been approved by the US SPA; projects which have received individual or general permit approval or a finding of no jurisdiction by the Corps of Engineers; State or Federally funded highway projects which have been planned and developed in accordance with the National Environmental Policy Act (NEPA), Federal Clean Water Act and/or Executive Order No. 53 for which application has been submitted prior to the effective date of the Act; Maintenance and repair of stormwater management facilities and maintenance, reconstruction or repair of lawful, pre-existing buildings or structures provided that no additional wetlands disturbance occurs.

Finally DEP is obligated to respond to requests for a finding that a general permit is applicable within 330 days of receipt of the request.

TAKINGS: The Act allows any person having a recorded interest in land affected by the Act to file an action in Court to determine if a permit action constitutes a taking of the property without just compensation. If a court determines that a taking has occurred, DEP has the option.-of compensating the property owner, condemning the affected, property or modifying its permitting action "so as to minimize the, detrimental effect to the value of the property."

APPEHDZZ B.

Background Data on Fzesbnter Wetland Transition areas SoHBary (TBBUS 1)

Branchville - Ridge & Valley

	Stream	150-foot Buffer	50-foot Buftai
Paulinskill & Dry Brook	13.©0 miles	& miles	5.00 miles
Parukating Creek *li* tributaries	66. 00	*9*	12.00
BigfUt Brook St tributaries	11.40	2.90	0
	90.40 miles	2.90 miles	17.00 miles

Ordinary wetlands! 83 acres

Blairstown - Ridge & Valley

	Stream	ISO-foot Buffer	53-foot Buffer
Request River	5.00 miles	0 miles	_5.00 miles
St tributories	3.50	0	1.00
Bear Creek	0.80	0	0.30
unknown	33.50	0	17.90
Beaver Brook	2.20	0	0.30
Locust Lake	7.10	0	7.10
Paulins Kill	1.00	0	0.50
White Lake	1.26	0	0.80
Tributary to Paulins Kill	2.00'	0	1.50
Blair Creek	2.40	0	1.64
Jacksonberg Creek	2.9©	0	0.36
Lake Susquehanna	0.70	0	0.70
Cedar Lake	0.80	0	'0.30
French Lake			

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4.16 miles $ miles 39.34 miles Ordinary wetlands: 235 acres

High Bridge - Highlands

	Stream	150-foot Buffer	50- foot Buff*
	19.30 miles	0 mi les . -	3.00 mile
S. Branch Raritan & tributaries			
	21 . 30	4.34	0
Mulhockawa Creek			
	13.00	0	3.54
Spruce Run Reservoir & tributories			
	3.70	.90	0
Welloughby Brook Rocky Run			
	4,60	.40	0
Spruce Run & tributaries			
	14.40	"I-00	0
Musconetcong River			
	14.90	0	6.00

1.20 miles 6.64 miles

22.54 miles Ordinary wetlands: ©.acres

High Bridge - Highlands

	Stream	150-foot Buffer	5ft-foot Buffer
Musconetcong River & lakes	25.80 miles	0 miles	19.36 miles
Budd Lake Ledgewood	0 .60	0.60	0
Pond Lubbers Run Wolf	1 .30	0.10	0
lake to Wright Pond to	6 .72	0	4.15
Kofferts Pond			
Crunberry Lake	6. .30	0	6.30
Panther & Forest Lake	4. 70	0	4.00
Andover Ponds	1. 30	0	U30
	3. 40	0	2.30
	5@.12 miles	0.70 miles	37.35 miles

Ordinary wetlands;. 40 acres

Honmouth Junction - Piedmont

	Stream	150-foot Buffer	50-foot Buffer
Millstone River	2.70 miles	0 miles	1 .2$ miles
Carters Brook	1.20	0	0.20
Heathcote Brook Branch	3.90	0	0.90
Heathcote Brook	2.00	0	0.50
Lawrence Brook Qaky's	5.30	0	2.30
Brook	11 . 80	0	9.30
Mi 11stone River St tributaries	5.50	0	2.10
	13.10	0	6. 37
Six Mile' Run & tributaries			
Ten Mile Run	24 . 1 0	9	10.79
Simonson Brook	7.80	0	2 . 20
	5.30	0	2.30
	3.50	0	9
	36.30 miles	0 miles	39.67 miles

Ordinary wetlands: 4 acres

Pittstown - Piedmont

	Stream	150-foot Buffer	50-foot Buffer
Uickechoeke	15.50 miles	0 miles	10.50 miles
Lockatong	12.40 miles	0 miles	. 8.10 miles
unknown	6.90	0	0.80
Tributaries to S. Branch at Raritan River	5.80	0	3.20
Cakepoulin Creek	25.30	4.70	0
S. Branch Raritan & tributories	15.30	0	5.96
Assi conq Creek Walnut Brook	2.20	0	0
unknown	2.90	0	0.20
	2.60	0	0

04.40 miles 4.70 miles 23.70 miles Ordinary wetlands; 0 acres

Freehold - Inner Coastal Plain

	Stream__ .	150-foot Suffer	50-foot Buffer
	4.00 miles	0 miles	1 .50 mi les
Manalpan	8.20	0 ~---:.:-	6.50
f	2.00	0	1 .30
Weamaconk Matchaponix	15.50	0 _.	7.40
MeGelliards & Mi Herd	33.80	0	17.50
Pine Brook ?	11 .30	0	7.50
Deep Run	6 . 20	0	3.10
	23.10	0	13.80
	18.70	0	5.S0
	4.40	0	3.30
	127.70 miles	0 miles	67.40 miles

Ordinary wetlands; 36.75 acres

Moorestown - Inner Coastal Plain

	Stream	150-foot- Buffer	50-foot Buffer
North Branch Cooper River	8.90 miles	0 miles	7.00 miles
South Branch Pennsauken	- 11 .40	0 ~ - "•	6.50
North Branch Pennsauken	7.60	0	5.20 *
North Branch Pennsauken	9.30	0 ~	4.80
Parkers Creek	13.36	0	7.10
Swede Run	4.10	0	7.60
Pampeaton Creek	7.20	0	1.70
	61.80 miles	0 miles	34.90 miles

Ordinary wetlands; 8.30 acres

* buffered zones shown were perceptible
  stream not- visible

Woodstown - Inner Coastal Plain

	Stream	153-foot Buffer	50-foot Buffer
Salem River & tributaries	21.70 miles	0 miles	T5.10 miles
Major Run	2.80	0	1.50
Qldmans Creek & tributaries	27.3©	0	14.70
Lake Narritican	3.40	0	' 2.40
Raccon Creek	9.30	0	7.30
Two Penny Run	2.50	0	2.50
unknown	4.50	0	9.50
	72.10 miles	0 miles	53.00 miles

Ordinary wetlands: 42 acres

El»er - Outer Coastal Plain

	Stream	156-foot'Butfar	56-foot Suffer
Muddy Run	10,40 miles	0 miles	10.40 miles
Centurion Pond tributaries	2.20	0 _- .	2.20
Indian River & Centurion Pond	9.82	0	9.82
Palantine Branch	7.40	0	7.40
Muddy Run (Paluntire* Lake to Elmer Lake)	9-50	0	9.50
Elmer Lake & tributaries	10.00	0	10.00
unknown	2.00	0	2.00
unknown	1.60	0	1.60
Salem River	2.30	0	1.80
Sreen Er.	1.20	0	1.20
	56.40 miles	0 miles	55.90 miles

Ordinary wetlands: 6.50 acres

Millville - Outer Coastal Plain

	Stream	LSS-foo.tJBuf fer	5£-f oot But" fer	
White March Run	5 .40 miles	0 riiiles	4.60 miles	#
Maurice River	11 .30	0 -	11.00	*#
Mill Creek	6 .30	0	6.30	
Muddy Run	4. 40	0	4.40	
Paryin & Tarkin Branch	8 ,10	0	3.39	
Hawkins Pond	2. 90	0	1.59	
	39.40 miles	0 miles	32.20 miles	

Ordinary wetlands: 132.75 acres

buffered wetlands, no stream channel
measured through center-at Onion Lake

APPEBDIX C.
Functions of Buffer Areas

I would like to acknowledge the helpful suggestions and comments from the New Jersey Department of Environmental Protection. The following appendix is a summary of existing literature. Additional research specifically covering New Jersey would help to document in greater detail the findings in the appendix.

Runoff Control

Vegetation intercepts rainfall and impedes the flow of runoff, thus allowing for natural recharge of rainwater into the ground. In watersheds where -natural vegetation predominates, overland runoff is rare {Hewlett and Netter, 1970). Runoff from intensely cultivated agricultural areas may be as much as 40 times greater than that of forested land {Karr and Schlosser, 1977). In developed or agricultural areas, rainwater washes over roads, bare soil, parking lots, pastures, croplands, lawns, and other surfaces with higher storm runoff potential. This runoff carries non-point pollutants along drainageways to nearby surface waters.

The tinting, quantity, and quality of runoff is affected by both the use of the land and the intensity and duration of rainfall. If runoff is unimpaired, floods in streams generally peak high and are frequent. Stream channels are often enlarged as they erode .to accommodate the higher flows, and suspended solids increase accordingly.

Numerous studies have shown how vegetative buffers act as natural filters and reduce runoff (Wong and McCuen, 1981; Karr and Schlosser, 1977; Dillahan, Sherrand and Lee, 1986). In-a study of a 47-acre watershed in Maryland, a 150-foot buffer strip running from above the inlet to a detention structure would result in a reduction of runoff volume of 28 percent from 10 observed storms. The reduction would be greatest for smaller storms. In general, the total volume reduction will increase when the duration of the runoff is longer (Wong and McCuen, 1981}. The question of how wide the buffer should be depends on the impact being managed. The i; following sections describe different roles for vegetated buffers.

Sediment Control

Sediment, by weight, is the largest single pollutant of water in the nation. Sedimentation has been cited as one of the major causes of the decline of fisheries throughout the United States (Lake and Morrison, 1977). Vegetated buffers reduce both sediment generation and transport. Reduction in sediment is accomplished both by vegetative cover reducing the impact of falling rain and by roots binding soil particles together. Field measurements have been made and models have been constructed to demonstrate the effectiveness of vegetative buffers in trapping sediment.

Early studies of logging indicated that evidence of sediment can be found over 100 feet from logging roads on sloping land (10-30 percent slope) (Trimble and Sartz, 1957). Other studies have recommended €6- to 100-foot buffer strips (Corbett et al., 1978). Grassed areas 50 feet wide have been shown to trap up to 54 percent of the sediment load (Karr and Schlosser, 1977). A mathematical model developed for Maryland's Coastal Zone program, which included considerations of slope, vegetation cover, and runoff velocity, indicated that a 200-foot buffer strip with relatively steep slopes and some dense vegetative cover will reduce sediment transport by (Hong and McCuen, 1981).

Width (feet)	Ttdp Efficiency (percent)
200	90
100	82
50	75

These results indicate that a small incremental increase in trap efficiency requires a considerable addition in buffer width. Palfrey and Bradley (1983) recommended a minimum buffer 100 feet from the mean high water line of water bodies or the edge of tidal and non-tidal wetlands with increases baaed on slope and floodplain conditions.

The whole subject of buffer strips for sediment control in New Jersey should receive a thorough evaluation by technical experts on the State Soil Conservation Committee pursuant to the "Soil Erosion and Sediment Control Act," H.J.S.A, 4:24-39 through 55. Agricultural sediment discharges may have very different hydraulic characteristics that warrant buffer requirements different from those appropriate for logging and general construction.

Streaabank and Streambed Erosion Control

Current regulations for buffer strips in New Jersey have relied on literature reviews and field studies. In a buffer strip classification system used by Whippie et al. (1981), the value of 50 feet was the criterion used to distinguish "medium[11] and "excellent" buffer strips. Based on that study, it was reported that there is reason to believe that buffer strips of 50 feet are substantially more effective' than 25-foot buffer areas in reducing bed and bank erosion in streams, as well as the siltation damage that results from such erosion (NJ DEP, 1983).

Excess nutrient loading of watercourses by both surface and subsurface runoff accelerates plant growth, particularly that of phytoplankton and algae. This overproduction causes water quality problems, including reduced light, noxious odors, offensive tastes in drinking water, unsightly conditions in recreational waters, and shortages of dissolved oxygen, a - necessary element in maintaining stream quality. Excessive aquatic macrophytes also cause physical interference with recreational uses such as boating, swimming, and fishing.

Large amounts of nutrients are attached to sediment and are carried to water bodies in runoff. Agricultural lands and septic tank leakage are major sources of nitrogen and phosphate. In developed areas, setbacks of 100 to 150 feet for septic tanks have shown to be inadequate in filtering nitrates (Clark, 1977). In studies in the Black Creek Watershed in Maryland, 88 percent of all nitrogen and 96 percent of. all phosphorus reaching water courses or water bodies as surface runoff in agricultural watersheds was found to be attached to sediment particles.(Karr and Schlosser, 1977). As previously noted from field and laboratory studies, vegetation effectively removes sediment form surface flows. Wooded buffers 150 feet wide have been shown to absorb nutrients through root systems. Investigations reveal 80 percent retention of phosphorus and 89 percent removal, of nitrogen.. Approximately 90 percent of the observed reduction in total phosphorus and total nitrogen occurs within the first 19 meters (approximately 62 feet) of the riparian forest (Peterjohn and Correll, 1984).

The role of soils and groundwater conditions themselves may also play a large part in nutrient removal.

An important point about vegetation in transition areas is that plant uptake can only occur during the growing season. Therefore, vegetation's role in nutrient removal may be seasonal. -

Habitat Protection

Wildlife use stream corridors or riparian zones disproportionately more than any other type of habitat (Odum, 1979; Thomas, Maser and Rodiek, 1986). There are many reasons why stream corridors are so important. Not all of them apply to every stream corridor.

1. The presence of water lends importance to the riparian zone. Wildlife habitat is composed of food, cover, and water. Stream corridors offer one of the critical components, and often all three.

With regard to threatened and endangered plant and animal species, over 61 percent of plants (NJ DSP, 1984) and 83 percent of animal species {NJ DEP, 1980) occur in wetland and stream corridor areas.

5. The riparian zone provides the natural pathway by which animals can move safely from one place to another. Not only are there. many . small species that are restricted or endemic to the stream corridor, but many if not most require access to the stream or lake margin for survival, even though they may spend much of their time elsewhere.

The fact that fragmentation of forests into "habitat islands" or small woodlands adversely affects wildlife has been studied for over twenty years (MacArthur and Wilson, 1967; Diamond, 1975). Work done on corridors near large forested areas have shown that these corridors are important links to small,- fragmented woodlands, keeping the species diversity in these areas higher than they would be otherwise (MacClintock, Whitcomb and Whitcomb, 1977; Jones, 1986). Corridor widths effective for animal protection depend on the species and conditions: widths of 100 feet of undisturbed riparian land have been suggested in Maine by Jones (1986), with a 230-foot strip for timber and land management. A 600-foot corridor (or 300 feet on each side of streams) is necessary to provide the required habitat elements, based on the work of wildlife biologists (Leedy et al., 1978). One study of Pinelands tree frogs showed that this threatened and endangered species will migrate at least 300 feet during its life cycle.

2. Riparian vegetation is critical for maintaining fish habitat. Tree roots, organic debris in streams, and shade are important sources of fish cover. Most of the food consumed by aquatic invertebrates and fish in headwater streams (stream orders 1, 2, and 3) is derived from leaves, twigs, and organic material that falls from streamside vegetation. A minimum band of 25 feet is generally adequate for a streambank strip of trees to sustain itself from sun scald, streambank erosion, and root damage, especially in younger stands. Where a mature stand of tree species vulnerable to windthrow is cut back to a 25-foot width, windthrow damage is expected. A 50-foot width provides better protection. As new woody vegetation becomes established, growing under more open conditions, it will tend to be more windfirm (NJ DEP, 1983).

3. Water temperature is important to fish habitat. Excess warming of water occurs due to loss of shade. A 30-foot-wide vegetated strip is considered to provide adequate temperature control along some stream reaches, but at many locations a wider strip is necessary for this purpose (NJ DEP, 1983). Maximum shading ability is reached within a width of 80 feet, with 90 percent of that maximum attained within 55 feet (Brown and Brazier, 1972).

4. The availability of water for riparian plants, frequently in combination with deeper soils, increases plant biomass. production and provides a suitable site for plants that are limited elsewhere by inadequate water. Both density and diversity of species tend to be higher at the land-water edge than in the uplands. This "edge -effect" creates many more vertical layers of vegetation exposed in a stair-step fashion. The stair-stepping of vegetation produces far more diverse nesting and feeding opportunities for wildlife. These factors in combination lead to greater plant species diversity and structural diversity in the community. The result is greater abundance and diversity of both plant and animal species.

Brown, George W., and Brazier, Jon R. 1972. Controlling Thermal Pollution in Small Streams. Washington, D.C.: U.S. Environmental Protection Agency, EPA Document No. EPA-R2-72-083.

Clark, John. 1977. Coastal Ecosystem Management. The Conservation Foundation. New York: John Wiley and Sons.

Corbett, Edward S.; Lynch, James A.; and Sopper, William E. 1978. "Timber Harvesting Practices and Water Quality in the Eastern United States." Journal of Forestry.

Diamond, J.M. 1975. "The Island Dilemma: Lessons of Modern Biogeographic Studies for the Design of Natural Preserves." Biol. jTonserv. 7:129-46

Dillahan, T.A.; Sherrard, J.H.; and Lee, D. 1986. Long-Tem^Effectivftness and Maintenance of Vegetative Filter Strips. Blacksburg, Va.: Virginia Polytechnic Institute and State University, Virginia Water Resources Research Center, Bulletin 153.

Erman, Don C.; Newbold, J. Dennis; and Roby, Kenneth B. 1977. Evaluation of StreamsideBufferstrJgs for Protecting Aquatic Organisms. Contribution No. 165. Davis, Calif.: University of California, Davis, California Water Resources Center.

Jones, J. 1986. Important Wildlife Areas in Southern Maine. Augusta, Maine: Department of Inland Fisheries and Wildlife.

Karr, James, and Schlosser, Isaac. 1977. Impact ^fJTearstream vagetation and Stream Morphology on Water Quality And Stream Biota. Athens, Ga.: U.S. Environmental Protection Agency, SPA Document No. 600/3-77-097.

La Prada, P. 1985. "New Setbacks Opposed." Outer Banks Current **6(34):1,2.**

Leedy, Daniel L.; Maestro, Robert M.; and Franklin, Thomas M. 1978. Planning for Wildlife in Cities and Suburbs. Ellicott City,^Md.: Urban wildlife Research Center, Inc.

^MacArthur, R.H., and Wilson, E.O. 1967. The Theory ofilsland Biogeography.

MacClintock, L.; Whitcomb, R.F.; and Whit comb, B.L. 1977. --.. "Evidence for the Values of Corridors and Minimization of Isolation in Preservation of Biotic Diversity." American Birds 31(1).

Mew Jersey Department. of Environmental Protection. 1982. New Jersey Statewide Master Plan. Trenton, N.J.: NJDEP.

Hew Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife, Endangered and Nongame Species Project, and U.S. Department of Agriculture, Soil Conservation Service. 1980. Endangered and Threatened Species of New Jersey. Trenton, N.J.: NJDEP. -

New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands' Management. 1985. New Jersey's Threatened Plant Species. Trenton, N.J.: NJDEP.

New Jersey Department of Environmental Protection, Division of Water Resources. 1986. State Water Quality Inventory Report. Trenton, N.J.: NJDEP.

New Jersey Department of Environmental Protection, Division of Water - Resources, Bureau of Planning and Standards. 1983. Technical Basis for 25-foot-wide and 50-foot-wide Buffer Strips. Trenton, N.J.: NJDEP.

New York Department of Environmental Conservation, Division of Water, Bureau of Water Quality. 1986. Stream Corridor Management: A Basic Reference Manual. Albany, N.Y.: NYDEC.

Odum, E.P. 1979. "Ecological Importance of the Riparian Zone." Proceedings of the Natural Symposium on Strategies for Protection of Floodplain Wetlands and Other Riparian Ecoaysterna. U.S. Forest Service General Technical Report WO-12.

Palfrey, Raymond, and Bradley, Earl. 1983. The Buffer Area Study. Annapolis, Md.: Maryland Department of Natural Resources.

PeterJohn, William T., and Correll, David L. 1984. "Nutrient Dynamics in an Agricultural Watershed: Observations on the Role of a Riparian Forest." Ecology 65 (5) .

Roman, C., and Good, R. 1985. Buffer Delineation Model for New Jersey Pinelands Wetlands. Division of Pinelands Research Center for Coastal and Environmental Studies.

Shisler, J.; Waidelich, P '.; Russell, H.; and Jordon, R. 1985. Coastal Wetlands: Wetlands Buffer Delineation study - Task 1 Mosquito Research and Control. New Brunswick, N.J.: New Jersey Agriculture Experiment Station and Rutgers University. NJAES-P-40502-02-85

Thurow, Charles; Toner, William; and Erley, Duncan. 1975. Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators. Washington, D.C.: TT.S. Environmental Protection Agency, Washington Environmental Research Center. EPA Document No. 600/5-75-00.

Tiner, R.W. Jr. 1985. Wetlands of. New Jersey. Newton Corner, Mass. : U»S. Fish and Wildlife Service, National Wetlands Inventory.

Tourbier, J.T., and Westmacott, R. 1981. Water . Resource Protection Technology. Washington, D.C.: Urban Land Institute.

Trimble, Jr., George R., and Sartz, Richard S. 1957. "How Far from a Logging Road Should a Logging Road Be Located?" Journal *jsf* Forestry.

Whippier, Jr., William; DiLouie, James M.; and Pytlar, Jr., Theodore. 1981. "Erosional Potential of Streams in Urbanizing Areas." Water Resources Bulletin.

Wong, Stanley L., and McCuen, Richard H. 1981. Design of Vegetative Buffer Str-ipa—for Runoff and Sediment Control (research paper) . College Park, Md»: University of Maryland, Department of Civil Engineering..

Zedler, J.B. 1984. Saltmarsh Restoration: A Guidebook for jioutnern California. San Diego, Ca.: San Diego State University. California Sea Grant Report Mo. T-CSSCE-009.